



Understanding the role of competition beliefs and learning orientations in Duolingo learners' engagement: the mediating effects of autonomy and motivation

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Abstract

This study examines how learners' beliefs about competition (positive vs. negative) and learning orientations (cooperative vs. competitive) shape engagement in language learning on Duolingo, with autonomy and motivation serving as mediators. Although competition is often viewed as either motivating or debilitating, little is known about how differing competition beliefs and orientations jointly influence engagement in digital learning contexts. Accordingly, a sample of 191 multilingual Duolingo users, recruited via convenience sampling, completed self-report scales assessing competition beliefs, learning orientations, autonomy, motivation, and engagement. Structural equation modeling indicated that positive beliefs about competition significantly and positively predicted both autonomy and motivation, whereas negative competition beliefs negatively predicted motivation. Moreover, competitive orientation significantly predicted autonomy, motivation, and engagement, whereas cooperative orientation showed only a direct positive path to engagement. Mediation analysis also revealed that both positive and negative beliefs about competition, along with competitive orientation, were indirectly associated with engagement, whereas cooperative orientation had no indirect effects. These findings suggest that cooperative and competitive dynamics promote engagement through different mechanisms, highlighting the value of supporting both orientations in digital learning environments. This study contributes to understanding how individual differences in learners' beliefs and orientations interact with motivational processes to shape engagement, offering practical implications for designing adaptive, inclusive, and motivating language learning platforms that cater to diverse learner profiles.

Keywords Competition beliefs · Competitive orientation · Cooperative orientation · Engagement · Autonomy · Motivation

Introduction

Technological innovations such as artificial intelligence (AI), large language model-based chatbots, and interactive digital learning platforms are rapidly transforming how students learn and engage in higher-education contexts (Castro-Lopez et al., 2025, 2026; Evangelista, 2025; Stan et al., 2025; Yigci et al., 2025). The integration of digital platforms into higher education has enabled personalized and adaptive learning approaches that respond to individual student needs, thereby shaping learners' motivation and behavior (Bashir & Lapshun, 2025). Within this expanding technological ecosystem, gamified (or game-informed) language learning platforms like Duolingo have revolutionized how learners learn multiple languages. Engagement arises not only from external gamification elements but also from internal psychological processes. Self-determination theory (Ryan & Deci, 2017), for instance, highlights autonomy and motivation as key mediators between environmental stimuli and learner behavior (Derakhshan & Noughabi, 2024). Autonomy—the sense of volition and control—is crucial in digital learning, where self-paced progression is a central feature (Handayani, 2024). Meanwhile, motivation—whether intrinsic (driven by interest) or extrinsic (driven by rewards)—determines the quality and persistence of engagement (Fredricks et al., 2019). Given that engagement is a cornerstone of successful language learning (Fredricks et al., 2004; Mercer, 2019), understanding how these psychological factors interact within gamified environments is critical for optimizing digital language learning experiences.

By integrating game mechanics such as points, leaderboards, and reward systems, Duolingo fosters a dynamic learning environment that blends competition and cooperation (Hanus & Fox, 2015; Li & O'Rourke, 2022). While prior research has examined the general effects of gamified language learning on motivation and achievement (Dindar et al., 2021; Zhang, 2024), less attention has been paid to the intrapersonal factors—particularly cooperation and competition—that can affect learners' engagement in these contexts. Competition is a double-edged sword in educational settings (Murayama & Elliot, 2012). It can enhance motivation, creativity, and performance (Burguillo, 2010; Suwaeda & Altrapolsi, 2017); it may also trigger anxiety, reduce self-efficacy, and undermine engagement (Cheng et al., 2009; Zhao & Lian, 2024). These divergent outcomes stem partly from learners' beliefs about competition; that is, whether they perceive it as a positive, energizing force or a negative, stressful experience (Kesebir et al., 2019). For instance, learners with positive beliefs about competition may thrive in competitive gamified learning environments, whereas those with negative beliefs may disengage due to fear of failure or social comparison (Hanus & Fox, 2015; Li et al., 2022). Despite growing interest in studying competition within digitally gamified learning contexts, no research to date has examined how L2 users' positive and negative beliefs about competition influence their engagement with Duolingo.

Beyond beliefs about competition, learners' orientations, i.e., whether they prefer cooperative or competitive learning, also play a pivotal role in determining levels of engagement (Johnson & Johnson, 2013). Cooperative orientations are linked to higher self-efficacy, peer support, and sustained motivation (Gocłowska et al., 2017; Roseth et al., 2008), whereas competitive orientations may boost short-term performance but often at the cost of heightened anxiety and reduced intrinsic motivation (Elliot, 2020; Oxford, 1997). Recent studies in gamified language learning suggest that cooperative mechanics (e.g., team challenges) enhance engagement and enjoyment more effectively than competitive mechanics (Zhang, 2024). However, it remains unclear how these learning orientations interact with beliefs about competition to influence language learners' autonomy, motivation, and,

ultimately, engagement in self-directed learning environments, such as Duolingo, where learners navigate both solo and social features.

Despite the growing body of research on gamification and language learning, prior studies have typically examined competition and cooperation in isolation rather than as interacting orientations that may jointly shape learner engagement. Moreover, little is known about how learners' beliefs about competition—whether positive or negative—interact with cooperative and competitive orientations to influence engagement in self-directed, informal digital learning contexts. This gap is particularly salient in Duolingo, where competition and cooperation coexist through features such as leaderboards, leagues, and friend challenges. Unlike instructor-led platforms, Duolingo's gamified structure relies on voluntary participation and self-regulation, making it an ideal environment to examine how learners' beliefs and orientations translate into engagement. While prior studies have explored the direct effects of gamified elements on motivation and achievement (Dindar et al., 2021; Zhang, 2024), few have tested the mediating pathways, specifically through autonomy and motivation, that link interpersonal factors to engagement in such environments. Importantly, the present study is part of a broader research project investigating motivational and psychological factors underlying engagement in Duolingo. In a previous study, Jabbari et al. (2026) drew on the same participant sample to explore the relationships between grit, psychological flow, and academic buoyancy, with perceived competence and competitiveness as mediators. The results showed that perseverance of effort and consistency of interest, as elements of L2 grit, directly and indirectly predicted flow and buoyancy among L2 users in gamified language learning environments. Extending earlier work, the current study shifts its focus to interpersonal factors—specifically, learners' positive and negative beliefs about competition and their cooperative versus competitive orientations—and examines how these beliefs and orientations predict engagement among Duolingo learners, with autonomy and motivation as mediating factors. By examining the interplay among these variables, this study offers actionable insights into optimizing engagement in digitally gamified language learning environments, particularly for platforms like Duolingo. Educators and platform designers can leverage these findings to foster greater inclusivity and sustained motivation. By thoughtfully integrating both competitive and cooperative elements, they can cater to diverse learner profiles and cultural contexts, ultimately contributing to the design of more effective, engaging, and supportive digital learning experiences.

Literature review

Engagement in language learning

The emphasis on fostering engagement in second-language (L2) education is supported not only by the rapidly growing field of positive psychology but also by ongoing efforts to integrate its principles into L2 teaching (Bonner et al., 2023; Wang et al., 2023). As the cornerstone of successful language learning, engagement denotes the dynamic state in which learners actively think about, focus on, and enjoy the learning process (Mercer, 2019). Furthermore, engagement reflects the extent to which this involvement with language is purposeful and goal-oriented (Hiver et al., 2021). Engagement is broadly conceptualized as a multifaceted construct, most commonly defined by three distinct yet interconnected dimensions (Fredricks et al., 2004, 2019). Behavioral engagement involves voluntary, effortful,

and sustained participation in learning tasks (Zhou et al., 2023). Cognitive engagement encompasses self-regulated learning, the application of deep learning strategies, and the effort required to understand complex ideas (Fredricks et al., 2016; Li et al., 2024). Emotional engagement is defined by learners' reactions and emotional connections to peers and learning activities (Sang & Hiver, 2021).

Recently, integrating digital technology into English language learning has transformed how learners engage with educational resources and develop their language skills (Handayani, 2024). Mobile learning tools, in particular, have been shown to enhance behavioral, cognitive, and emotional engagement and improve English language learning outcomes (Yu et al., 2022). For instance, the gamified design of mobile language-learning platforms like Duolingo incorporates features such as points, levels, rewards, dynamic feedback, progress tracking, competitive elements, and leaderboards, which collectively create an engaging environment that supports sustained learner practice (Farisatma et al., 2024; Tajik, 2025). Duolingo's variety of educational activities—including speaking and listening exercises, multiple-choice tests, and flashcards—cater to diverse cognitive abilities and learning styles, fostering a dynamic environment that promotes engagement (Kazu & Kuvvetli, 2024).

Considerable progress has been made in understanding the predictors of L2 engagement; however, research has primarily focused on interpersonal factors, such as perceived social support, teachers' affective scaffolding, teacher-student rapport, and parental goals (Derakhshan et al., 2022a; Luan et al., 2023; Pan et al., 2023; Wang et al., 2023), and on environmental factors like classroom social climate, perceived classroom goal structures, and flipped learning approaches (Derakhshan et al., 2022b; Wang et al., 2023). Consequently, the role of intrapersonal variables, including personal beliefs, thoughts, and emotions, has been neglected in the current literature (Kirkpatrick et al., 2025; Liu et al., 2023). This neglect is particularly evident in digital gamified language learning, where research on how intrapersonal factors, such as enthusiasm (Ardi & Rianita, 2022), individual learning styles, motivation (Guo et al., 2024; Shen et al., 2024), and enjoyment (Zhou, 2024), influence L2 engagement remains limited. To bridge this gap and given the critical role of engagement in successful learning, especially in higher education contexts (Altstaedter & Johnson, 2025; Galve-González et al., 2024, 2026; Sun et al., 2025), this study aims to identify the role of beliefs about competition, competitive versus cooperative orientations, autonomy, and motivation as potential factors influencing language learners' engagement on Duolingo.

Beliefs about competition

Competition is such a ubiquitous phenomenon that it has become integral to a wide range of disciplines, including economics (Niederle, 2017), psychology (Kesebir et al., 2019), and education (Amini et al., 2025; Zarrinabadi, 2025). The psychological definition of competition is deeply rooted in social comparison theory, which holds that individuals seek to outperform others or attain higher status through comparison (Festinger, 1954). Extending this theoretical perspective to education, competition pits students against one another as they strive for academic goals attainable by only a select few (Johnson & Johnson, 2013). This competitive environment can affect various educational outcomes, including goal setting, performance (Elliot, 2020), classroom climate, and social relationships (Butera et al., 2024).

Research on the role of competition in educational settings, including L2 learning, has yielded mixed results (Zarrinabadi, 2025). Some studies view it as constructive and beneficial (e.g., Bailey et al., 2024), while others consider it debilitating and harmful (e.g., Cheng et al., 2009). For instance, research shows that competitive behavior can boost personal growth (Ross et al., 2003), creativity and self-esteem (Suwaeda & Altrapolsi, 2017), and intrinsic motivation and performance (Burguillo, 2010), but it can also negatively influence perceived language learning outcomes (Bailey et al., 2024). In contrast, some studies suggest that competition inhibits students' attention, elaboration, and metacognition (Van Eck & Dempsey, 2002), undermines self-efficacy (Chan & Lam, 2008), nurtures anxiety (Cheng et al., 2009; Zhao & Lian, 2024), and fosters cheating, exploitation, and aggression (Butera et al., 2024). Murayama and Elliot (2012) argued that competition appears to be double-edged. It can either enhance performance by fostering performance-approach goals (i.e., trying to outperform others) or negatively affect it by triggering performance-avoidance goals (i.e., seeking to avoid performing worse than others).

In light of evidence highlighting the ambivalent nature of competition, individuals may hold varying beliefs about its effects (i.e., lay beliefs about competition), viewing it as either a positive and beneficial force that can promote performance, personal growth, and innovation, or a harmful and destructive factor that may lead to self-harm, relational conflict, and unethical conduct (Kesebir et al., 2019). Accordingly, examining both positive and negative beliefs about competition can offer insights into how individuals define competition, their inclination to compete, and their performance and engagement in competitive contexts (Kesebir et al., 2019). In the context of L2 learning, Zarrinabadi et al. (2024) found that competition beliefs were associated with language learning mindsets (fixed versus growth) and with emotions such as anxiety and enjoyment. Further research indicated that competition beliefs could predict different forms of learner engagement, including behavioral, emotional, cognitive, and agentic dimensions (Amini et al., 2025). Notwithstanding these contributions, the literature has yet to explore whether learners' competition beliefs predict their engagement with digitally gamified platforms, particularly Duolingo, leaving a gap in current research. As such, we hypothesized that Duolingo users' positive and negative competition beliefs can predict their engagement:

H1: L2 learners' positive and negative beliefs about competition predict their engagement.

Competitive and cooperative orientations

Beyond beliefs about competition, learners' orientations, i.e., whether they prefer cooperative or competitive learning environments, also play a pivotal role in shaping their engagement (Johnson & Johnson, 2013). Deutsch (1949) developed social interdependence theory, which outlines two primary types of interdependence: positive interdependence (i.e., cooperativeness), in which individuals perceive their success as a product of collective efforts to attain shared goals, and negative interdependence (i.e., competitiveness), in which one's success is contingent upon others failing to achieve their objectives (Johnson & Johnson, 1989). These orientations play a substantial role in education by affecting students' goal attainment, motivation, engagement, and overall academic achievement (Johnson et al., 2014).

As prior research indicates, cooperatively oriented students tend to exhibit stronger peer relationships (Roseth et al., 2008), higher self-efficacy (Gocłowska et al., 2017), and better

psychological well-being (Johnson & Johnson, 2009) than those with competitive preferences. Subsequent studies have supported a positive association between cooperativeness and various educational factors such as cognitive involvement (Peterson & Miller, 2004), achievement and productivity (Johnson & Johnson, 2009), persistence, motivation, and positive attitudes toward tasks (Johnson et al., 2014), as well as classroom engagement (Amini et al., 2025; Herrmann, 2013). Furthermore, higher education research underscores the importance and impact of collaborative learning, particularly in technology-mediated environments such as those involving AI (Kovari, 2025; Msambwa et al., 2025). As indispensable elements of gameplay, competition and cooperation also play crucial roles in digitally gamified language learning (e.g., Li & O'Rourke, 2022; Zhang, 2024). For instance, Jabbari et al. (2026) reported that Duolingo users' perceived competitiveness was positively associated with their persistence and psychological flow. Furthermore, Zhang (2024) studied the effects of cooperative and competitive gamification mechanics in language learning and found that cooperative gamification significantly improved L2 learners' engagement, enjoyment, and classroom social climate compared to competitive gamification. However, a meta-analysis by Ho et al. (2022) revealed that competition can enhance the effectiveness of gamification on learning performance and engagement in educational settings. Given these discrepancies, a lingering question remains: do cooperative and competitive orientations enhance or diminish engagement in gamified learning environments? To address this gap, we hypothesized that L2 learners' cooperative and competitive orientations can predict their engagement with Duolingo:

H2: L2 learners' cooperative and competitive orientations predict their engagement.

Motivation and autonomy

Motivation is one of the most important individual differences that affect L2 learning and achievement (Dörnyei & Ryan, 2015; Dörnyei & Ushioda, 2021). Motivation is widely understood as a key determinant of success in language learning, affecting both the rate and depth of learning and the development of language skills (Dörnyei & Ushioda, 2021). Motivation sustains students' efforts and shapes the quality of their engagement with input and practice opportunities, ultimately influencing long-term achievement (Dörnyei & Ryan, 2015). As Dörnyei and Ushioda (2021) asserted, without motivation, even learners with exceptional aptitude are unlikely to reach their potential in mastering an L2. Past research indicates that motivation is strongly associated with learner engagement and investment in learning tasks (Dörnyei & Ryan, 2015). Research also shows that motivated learners tend to engage more actively, sustain attention, and persist in the face of challenges (Al-Hoorie, 2017). Recent research also indicates that task motivation influences engagement across affective, social, and cognitive dimensions (Hiver & Dao, 2025). Additionally, cooperativeness and competitiveness within gamified digital learning platforms have been shown to influence EFL learners' task effort and motivation (Zhang, 2024). Li and O'Rourke (2022) found that the leaderboard feature in Duolingo effectively stimulated a sense of competitiveness, which, in turn, enhanced users' motivation and persistence. Conversely, Hanus and Fox (2015) found that inducing comparison and competition via a digital leaderboard, in which players' scores are displayed to everyone, can adversely affect users' motivation, satisfaction, and empowerment. Despite these well-established findings, the precise pathways through which these factors operate remain unclear. Specifically, while motivation is a significant driver of engagement and is influenced by both cooperative and competitive

orientations, the existing literature presents conflicting views on how these variables interact, particularly within digital gamified learning contexts. Therefore, a gap exists in understanding how motivation mediates the interplay among learners' beliefs about competition, their cooperative and competitive orientations, and their ultimate engagement. Thus, we hypothesized that:

H3: Motivation mediates the relationships between L2 learners' competition beliefs and learning orientations and their engagement.

Autonomy is another psychological factor examined as a mediator between competitive and cooperative orientations and engagement. Learner autonomy refers to the experience of volition and psychological freedom, and the feeling that one's actions are self-endorsed, chosen, and aligned with one's personal values and interests (Ryan & Deci, 2017). Autonomy is a critical factor for L2 learning and achievement (Chong & Reinders, 2022). According to Chong and Reinders (2022), autonomy encompasses the ability and willingness to make decisions about learning objectives, strategies, and evaluation. The significance of autonomy lies in fostering self-directed behaviors that enable students to manage their progress beyond the classroom, thereby increasing opportunities for learning and skill development (Chong & Reinders, 2022). In the context of L2 engagement, autonomy plays a pivotal role by empowering learners to initiate and sustain participation, adapt strategies to meet task demands, and pursue meaningful communicative opportunities (Chong & Reinders, 2022). Research also shows that when learners perceive greater control over their learning, they are more likely to exhibit behavioral, cognitive, and emotional engagement (Dörnyei & Ushioda, 2021). In the present study, we propose that autonomy mediates the relationship between language learners' beliefs about competition and their cooperative and competitive orientations, on the one hand, and their engagement, on the other, by shaping how these beliefs and orientations are expressed in the learning context. We hypothesize that learners with a cooperative orientation and a high degree of autonomy are more likely to actively seek collaborative opportunities, thereby transforming cooperative tendencies into meaningful engagement. We also hypothesize that competitively oriented learners with strong autonomy can internalize competition as a drive for self-improvement, maintaining engagement even in the absence of external competitive stimuli.

H4: Autonomy functions as a mediator between L2 learners' competition beliefs and learning orientations and their subsequent engagement.

Methodology

Participants

Participants were recruited through convenience sampling and multiple channels, including posting an invitation letter on one of the authors' Facebook pages, using the British Association for Applied Linguistics' mailing list, and contacting friends and students who were Duolingo users or connected to other Duolingo users. A total of 191 Duolingo users participated in the study: 57 males (29.8%), 130 females (68.1%), and 4 participants (2.1%) who did not disclose their gender. Participants' ages ranged from 18 to 75 years, with a mean age of 26.55 years ($SD=9.69$). This wide age range reflects the diverse user base typical

of the Duolingo language-learning application. Regarding their experience with Duolingo, 95 participants (49.7%) had less than one year of experience, 76 participants (39.8%) had between one and three years, 9 participants (4.7%) had between three and five years, and 11 participants (5.8%) had more than five years of experience. This distribution indicates a sample that includes both novice and experienced Duolingo learners. Among the participants, 103 (53.9%) were learning only one language on Duolingo, while 88 (46.1%) were learning multiple languages. Thus, the sample captured a diverse range of Duolingo users across gender, age, and experience with the application, thereby enhancing its representativeness. The participants received an information sheet and a consent form at the start of the survey. They had to confirm their informed consent by clicking “Next” on the survey’s first page.

Instruments

In this study, self-report scales were used to assess beliefs about competition, cooperative and competitive orientations, autonomy, motivation, and engagement.

Lay beliefs about competition scale

Participants’ beliefs about competition were assessed using the Lay Beliefs about Competition Scale (Kesebir et al., 2019), which measures perceptions of competition as either beneficial or detrimental rather than assuming it is inherently positive or negative. The scale comprises two dimensions: positive and negative beliefs about competition. The positive dimension includes three subscales—*performance increase* (e.g., “Competition makes people work harder”), *personal growth* (e.g., “Competition makes people stronger”), and *innovation* (e.g., “Competition prompts people to seek new solutions”)—each with three items. The negative dimension also includes three subscales—*unethical behavior* (e.g., “Competition leads to cheating”), *self-damage* (e.g., “Competition damages self-confidence”), and *relational damage* (e.g., “Competition divides people”)—each with three items. Participants responded on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Higher scores within each subscale indicate stronger endorsement of the corresponding belief. Confirmatory factor analyses (CFA) results for the scale in this study were as follows for positive beliefs about competition ($\chi^2=44.176$, $df=23.000$, $\chi^2/df=1.921$, CFI=0.978, PClose=0.140, RMSEA=0.060) and negative beliefs about competition ($\chi^2=29.587$, $df=18.000$, $\chi^2/df=1.644$, CFI=0.990, PClose=0.327, RMSEA=0.058).

Cooperative and competitive orientation

The Cooperative and Competitive Orientation Scale, developed by Chen et al. (2011), was adapted in this study to assess participants’ orientation toward cooperation or competition on the Duolingo platform. The scale treats cooperative and competitive orientations as distinct constructs rather than opposite ends of a continuum. The cooperative orientation subscale comprises seven items (e.g., “One must work with others to succeed”) that measure individuals’ inclination to collaborate and view others as interdependent partners. The competitive orientation subscale includes six items (e.g., “I feel somewhat disappointed when others perform better than me”) that assess individuals’ tendency to pursue personal achievement and use others as benchmarks for self-comparison. The adaptation process involved modifying item wording to reflect the digital language-learning

context while preserving the scale's original conceptual integrity. Participants responded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In addition, the CFA results for the scale in this study were as follows for cooperative orientation ($\chi^2=2.896$, $df=2.000$, $\chi^2/df=1.448$, $CFI=0.998$, $PClose=0.386$, $RMSEA=0.049$) and competitive orientation ($\chi^2=5.166$, $df=4.000$, $\chi^2/df=1.292$, $CFI=0.995$, $PClose=0.490$, $RMSEA=0.039$).

Autonomy

The participants' autonomy was assessed using the Autonomy Scale developed by Fu et al. (2009), which measures learners' sense of autonomy and self-control in online learning and educational games from a self-determination theory perspective. A sample item is "I feel a sense of control and impact over the game." Participants rated the items on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating a greater perceived sense of autonomy. The CFA results for the scale in this study were $\chi^2=2.971$, $df=2.000$, $\chi^2/df=1.486$, $CFI=0.993$, $PClose=0.376$, and $RMSEA=0.051$.

Motivation

Participants' intrinsic motivation was measured using the Intrinsic Reward subscale of the Psychological Flow Scale (Norsworthy et al., 2023). This subscale comprises three items (e.g., "I found the experience rewarding") and assesses the extent to which individuals perceive an activity as inherently motivating and rewarding, independent of external incentives. Responses were collected on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater motivation to learn a language on Duolingo. The CFA results for the motivation scale in the present study were $\chi^2=2.364$, $df=2.000$, $\chi^2/df=1.182$, $CFI=0.999$, $PClose=0.462$, and $RMSEA=0.010$.

Engagement

Learner engagement was assessed across three dimensions—behavioral, emotional, and cognitive—using the engagement scale developed by Jang et al. (2016). Behavioral engagement, measured with five items (e.g., "I try hard to do well on this application"), captured learners' effort, attention, and persistence. Emotional engagement, measured with five items (e.g., "I enjoy learning new things with this application"), assessed enthusiasm, interest, and enjoyment. Cognitive engagement, measured with four items (e.g., "When using this application, I try to explain the key concepts in my own words"), reflected deep learning strategies such as critical thinking and elaboration. Participants provided their responses on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The CFA results for the engagement scale in this study were ($\chi^2=137.510$, $df=58.000$, $\chi^2/df=2.370$, $CFI=0.990$, $PClose=0.130$, $RMSEA=0.055$).

Data collection and analysis

The survey was administered online via Google Forms. Data were collected over a five-month period from March to August 2024. To ensure data quality, attention-check items were embedded in the questionnaire. Although no time limits were imposed, participants took an average of 30 to 45 min to complete the survey. Accordingly, participants who

completed the survey in an unrealistically short time were excluded from the analyses. Before proceeding to the main survey items, participants viewed the information sheet and consent form, which briefly described the study's aims and emphasized that participation was voluntary. Respondents were assured that their responses would remain anonymous and confidential in accordance with ethical research standards.

Data were analyzed in SPSS version 24 for descriptive statistics (means and standard deviations [SDs]), reliability analyses, and preliminary assumption checks (skewness, kurtosis, and the Shapiro–Wilk test). Structural equation modeling (SEM) was conducted in AMOS version 24 using maximum-likelihood estimation. Model fit was evaluated using conventional cutoff criteria: $\chi^2/df \leq 3.0$, comparative fit index (CFI) $\geq .90$, Tucker–Lewis index (TLI) $\geq .90$, and root mean square error of approximation (RMSEA) $\leq .08$, with PClose $> .05$ indicating a close fit. Indirect effects were tested using bias-corrected bootstrapping with 5,000 resamples and 95% confidence intervals.

Results

The data were primarily analyzed using SPSS (version 24.0). Table 1 presents descriptive statistics (e.g., mean, SD, Cronbach's alpha, skewness, and kurtosis) and intercorrelations among the variables examined in the present study. The skewness and kurtosis values for all variables fell within the acceptable threshold of ± 2 (Kim, 2013), indicating no substantial deviations from normality. Additionally, Cronbach's alpha coefficients for all variables exceeded .70, indicating acceptable reliability (Dörnyei, 2007). The results of the Shapiro–Wilk and Kolmogorov–Smirnov tests further supported the assumption of normality.

Table 1 Descriptive statistics and bivariate correlations

	1	2	3	4	5	6	7	8	9
1. Positive Beliefs	1								
2. Negative Beliefs	-.087	1							
3. Cooperative Orientation	.270**	-.199**	1						
4. Competitive Orientation	.144*	.030	.060	1					
5. Autonomy	.289**	-.013	.064	.202**	1				
6. Motivation	.303**	-.183*	.173*	.314**	.352**	1			
7. Behavioral Engagement	.369**	-.090	.308**	.581**	.348**	.486**	1		
8. Emotional Engagement	.318**	-.071	.201**	.413**	.342**	.533**	.728**	1	
9. Cognitive Engagement	.366**	.092	.290**	.351**	.339**	.415**	.608**	.508**	1
Cronbach's α	.92	.91	.82	.76	.70	.73	.80	.93	.85
Mean	3.58	2.10	3.39	3.63	3.58	3.30	3.89	4.07	3.58
SD	.831	1.507	.797	1.362	.784	.823	.789	.815	.931
Skewness	-.373	.949	-.372	-.891	-.221	-.336	-.692	-1.010	-.473
Kurtosis	.032	-.684	.213	-.416	-.262	-.045	.583	1.376	-.025

Table presenting descriptive statistics and bivariate correlations among nine variables: Positive Beliefs, Negative Beliefs, Cooperative Orientation, Competitive Orientation, Autonomy, Motivation, Behavioral Engagement, Emotional Engagement, and Cognitive Engagement. The table includes Cronbach's alpha (α), mean (M), standard deviation (SD), skewness, and kurtosis for each variable. Correlation coefficients are displayed in a matrix format, with significant correlations marked by * $p < .05$ and ** $p < .01$

Independent samples *t*-tests revealed no significant gender differences in positive beliefs ($t = -1.378$, $p = 0.170$), negative beliefs ($t = -1.184$, $p = 0.238$), cooperative orientation ($t = -0.388$, $p = 0.699$), competitive orientation ($t = -0.726$, $p = 0.469$), behavioral engagement ($t = -1.385$, $p = 0.168$), emotional engagement ($t = -1.628$, $p = 0.105$), cognitive engagement ($t = -1.612$, $p = 0.109$), and motivation ($t = -1.608$, $p = 0.109$). However, a significant gender difference was found in autonomy ($t(185) = -2.592$, $p = .010$), indicating that female Duolingo users exhibited greater autonomy than male users. To assess common method bias (CMB), Harman's (1976) single-factor test was conducted. The analysis revealed that a single factor accounted for only 18.94% of the total variance, well below the critical threshold (e.g., 50%), indicating that CMB does not pose a significant threat to the validity of the findings.

The heterotrait–monotrait (HTMT) ratios were calculated to assess discriminant validity among the study constructs (Table 2). The HTMT values ranged from 0.012 to 0.724, all well below the conservative threshold of 0.85 (Henseler et al., 2015). These results indicate that each construct is empirically distinct from the others, supporting adequate discriminant validity. Although the association between motivation and engagement yielded the highest HTMT value (0.724), it remained within acceptable limits, suggesting that while these constructs are conceptually related, they are not redundant. The Fornell–Larcker criterion was also used to assess discriminant validity by comparing the square root of AVE with inter-construct correlations. The results showed that this criterion was satisfied for all constructs except for motivation and engagement, where the correlation ($r = 0.735$) exceeded the square root of AVE for engagement ($\sqrt{\text{AVE}} = 0.696$), indicating potential overlap. However, this is theoretically justifiable given the close relationship between motivation and engagement. Overall, all HTMT values were below the recommended threshold, supporting acceptable discriminant validity.

Using AMOS (version 24.0), we conducted structural equation modeling with maximum-likelihood estimation to test the preliminary model. As illustrated in Fig. 1, the initial hypothesized model, which included all potential paths, yielded poor model fit: $\chi^2 = 35.108$, $df = 12.000$, $\chi^2/df = 2.926$, CFI = 0.953, PClose = 0.016, RMSEA = 0.101.

Therefore, the model was refined by removing non-significant paths and then retested. The paths in the initial model were theoretically justified based on prior research; however,

Table 2 HTMT Results for the study variables

Construct	1	2	3	4	5	6	7
1. Positive Beliefs	—						
2. Negative Beliefs	0.348	—					
3. Autonomy	0.350	0.065	—				
4. Motivation	0.361	0.187	0.640	—			
5. Engagement	0.414	0.196	0.515	0.724	—		
6. Cooperative Ori	0.310	0.074	0.043	0.197	0.312	—	
7. Cooperative Ori	0.154	0.417	0.261	0.012	0.007	0.044	—

Table presenting Heterotrait–Monotrait ratio (HTMT) results for seven study variables: Positive Beliefs, Negative Beliefs, Autonomy, Motivation, Engagement, Cooperative Orientation, and Competitive Orientation. The table is organized as a lower-triangular correlation matrix, with each numbered column (1 through 7) corresponding to one of the seven constructs listed in the rows. Reported HTMT values range from approximately .01 to .72, and diagonal cells are marked with dashes to indicate no value is reported there

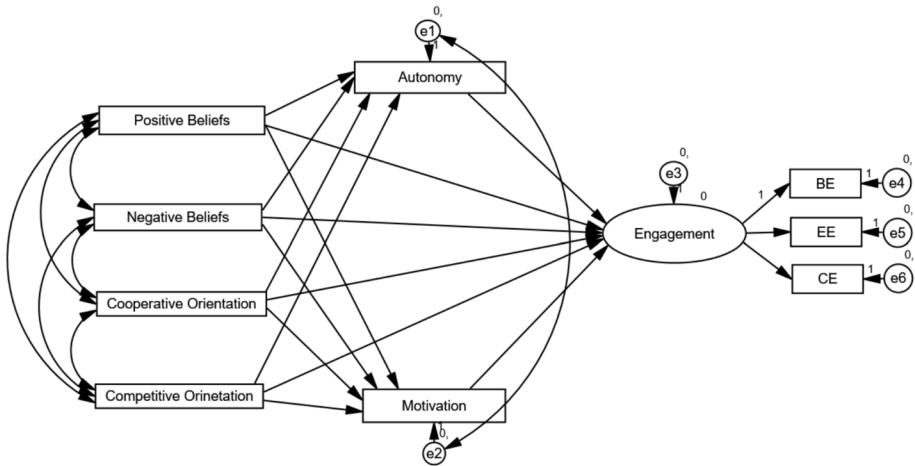


Fig. 1 The initial hypothesized model. Diagram of the initial hypothesized structural equation model illustrating the proposed relationships among Positive Beliefs, Negative Beliefs, Cooperative Orientation, and Competitive Orientation as independent variables, Autonomy and Motivation as mediators, and Engagement as the outcome variable. Engagement is further broken down into Behavioral Engagement (BE), Emotional Engagement (EE), and Cognitive Engagement (CE). Arrows indicate direct and indirect paths, and error terms (e1 to e6) are included for observed variables

several paths did not reach statistical significance in this sample. In line with SEM guidelines for parsimony, these non-significant paths were removed, indicating that the theorized relationships were not empirically supported in the present dataset. The revised model demonstrated an acceptable fit to the data, as indicated by the following goodness-of-fit indices: $\chi^2 = 45.142$, $df = 17.000$, $\chi^2/df = 2.655$, $CFI = 0.943$, $PClose = 0.017$, $RMSEA = 0.076$ (see Fig. 2).

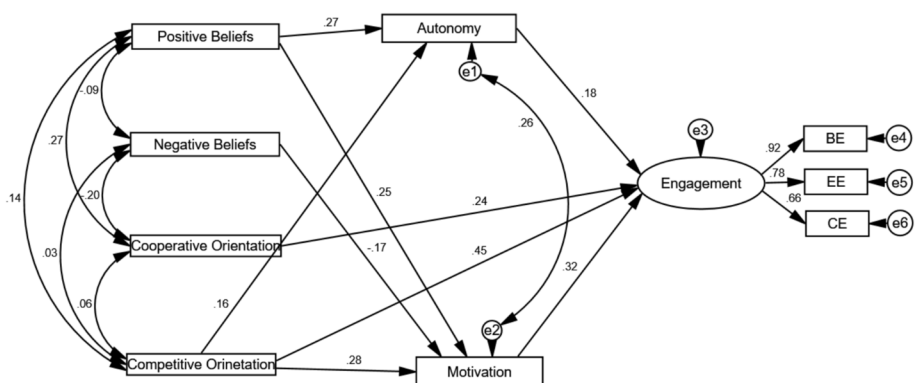


Fig. 2 The final model with significant paths. Diagram of the final structural equation model illustrating the relationships among Positive Beliefs, Negative Beliefs, Cooperative Orientation, Competitive Orientation, Autonomy, Motivation, and Engagement. Arrows indicate direct and indirect paths with standardized path coefficients. Engagement is further divided into Behavioral Engagement (BE), Emotional Engagement (EE), and Cognitive Engagement (CE). The model shows significant pathways from beliefs and orientations to autonomy and motivation, which in turn predict engagement

The direct effect estimates are presented in Table 3. The findings showed that positive competition beliefs significantly and positively predicted both autonomy ($\beta=.250, p<.001$; small effect size; Cohen, 1992) and motivation ($\beta=.248, p<.001$; small effect size). In contrast, negative competition beliefs negatively predicted motivation ($\beta=-.095, p<.01$; small effect size) but did not significantly predict any other variables. Moreover, competitive orientation emerged as a significant positive predictor of autonomy ($\beta=.095, p<.05$; small effect size), motivation ($\beta=.173, p<.001$; small effect size), and engagement ($\beta=.239, p<.001$; small effect size). In comparison, cooperative orientation exhibited only one significant direct path, to engagement ($\beta=.214, p<.001$; small effect size). Additionally, engagement was directly and positively predicted by autonomy ($\beta=.170, p=.001$; small effect size) and motivation ($\beta=.280, p<.001$; small effect size).

Furthermore, 5,000 bootstrap resamples were used to assess indirect pathways to engagement in the mediation model. Table 4 presents standardized (β) and unstandardized (B) coefficients, along with effect size estimates for all indirect paths. The findings showed that positive competition beliefs predicted engagement through both autonomy ($\beta=.049, p<.01$; small effect size) and motivation ($\beta=.080, p=.001$; small effect size), whereas negative competition beliefs predicted engagement only through motivation ($\beta=-.055, p<.01$; small effect size). In addition, competitive orientation indirectly and significantly predicted engagement, with both autonomy ($\beta=.030, p<.05$; small effect size) and motivation ($\beta=.091, p=.001$; small effect size) mediating. However, cooperative orientation had no indirect effects on engagement among Duolingo's multiple language learners. Although most effect sizes were small, even these effects can be practically meaningful in cumulative learning environments like Duolingo, where small motivational or autonomy-related shifts can compound over time.

Discussion

The results of this study showed no significant direct effects of either positive or negative beliefs about competition on Duolingo learners' engagement. This suggests that perceiving competition as a source of performance enhancement, personal growth, or innovation

Table 3 Estimates for the direct effects

Path	<i>B</i>	β	<i>CR</i>	<i>p-value</i>	<i>f</i> ²
Positive Beliefs → Autonomy	.250	.256	3.834	.000	.066
Positive Beliefs → Motivation	.248	.247	3.740	.000	.065
Negative Beliefs → Motivation	-.095	-.171	-2.706	.007	.009
Competitive Orientation → Motivation	.173	.283	4.299	.000	.030
Competitive Orientation → Autonomy	.095	.164	2.371	.018	.009
Competitive Orientation → Engagement	.239	.449	7.943	.000	.060
Cooperative Orientation → Engagement	.214	.235	4.412	.000	.047
Autonomy → Engagement	.170	.184	3.247	.001	.029
Motivation → Engagement	.280	.323	5.474	.000	.085

Table presenting direct effect estimates from the structural equation model. It includes six columns: Path, Unstandardized Coefficient (*B*), Standardized Coefficient (β), Critical Ratio (*CR*), *p*-value, and Effect Size (*f*²). The table lists direct paths from Positive Beliefs, Negative Beliefs, Cooperative Orientation, Competitive Orientation, Autonomy, and Motivation to Engagement, Autonomy, and Motivation. Significant paths are indicated with corresponding *p*-values and effect sizes

Table 4 Estimates for the indirect effect

Indirect path	β	<i>B</i>	Lower	Upper	<i>P</i> value	<i>f</i> ²
Positive Beliefs → Autonomy → Engagement	.049	.043	.014	.090	.003	.002
Positive Beliefs → Motivation → Engagement	.080	.069	.032	.124	.001	.006
Negative Beliefs → Motivation → Engagement	-.055	-.026	-.049	-.012	.008	.003
Competitive Orientation → Autonomy → Engagement	.030	.016	.005	.036	.014	.000
Competitive Orientation → Motivation → Engagement	.091	.049	.026	.079	.001	.008

A 95% bias-corrected CI (based on 5000 bootstrap samples) that excludes zero indicates significant indirect effects

Table presenting indirect effect estimates from the structural equation model. It includes two sections, each with columns for Indirect Path, Standardized Coefficient (β), Unstandardized Coefficient (*B*), 95% Confidence Interval (Lower and Upper bounds), *p*-value, and Effect Size (*f*²). The first section reports indirect effects of Positive and Negative Beliefs on Engagement via Autonomy and Motivation. The second section reports indirect effects of Competitive Orientation on Engagement via Autonomy and Motivation. All paths include significance levels and effect sizes

(Kesebir et al., 2019) does not automatically translate into L2 engagement. In traditional contexts, beliefs about competition directly influence outcomes such as persistence and achievement (Burguillo, 2010). However, in self-paced, gamified language-learning environments, these beliefs may be insufficient to predict engagement. Supportive psychological mechanisms are also necessary. Consequently, learners' motivation and autonomy must be considered to translate these beliefs into engagement.

Positive beliefs about competition predicted engagement indirectly and modestly through both autonomy and motivation, whereas negative beliefs predicted engagement negatively only through motivation. Students who endorsed positive competition beliefs had greater autonomy and higher intrinsic motivation, which in turn enhanced their engagement. This pattern aligns with self-determination theory, in which internalized values and the satisfaction of psychological needs reinforce sustained engagement in learning (Noels, 2023; Ryan & Deci, 2017). By contrast, students with negative competition beliefs exhibited lower motivation, which in turn limited their engagement. This finding aligns with research indicating that perceiving competition as threatening promotes performance-avoidance goals, anxiety, and avoidance of achievement settings (Zhao & Lian, 2024). These results imply that the impact of competition is less about its actual presence and more about how it aligns with students' need for autonomy and self-determined goals. The small indirect effect sizes also indicate that competition beliefs exert a supportive rather than dominant influence on learner engagement.

The results also showed that cooperative and competitive orientations directly and positively predicted engagement, though with small effect sizes. This indicates that both orientations contribute to engagement, but their influence is modest. Cooperative students likely benefited from shared goals, mutual support, and positive interdependence (Deutsch, 1949; Johnson & Johnson, 2009), which in turn supported self-efficacy, well-being, and persistence (Gocłowska et al., 2017; Herrmann, 2013; Roseth et al., 2008). Competitive students, in turn, might have been driven by performance-approach goals that focus effort on outperforming their peers (Elliot, 2020), a dynamic also observed in gamified MALL contexts, where leaderboard features spur higher persistence and autonomous practice (Li & O'Rourke, 2022). This finding challenges the common pedagogical belief that only cooperation enhances engagement (Oxford, 1997) and suggests that, when structured constructively, competition can also promote engagement in L2 learning activities.

The results of the mediation analysis revealed that competitive orientation predicted engagement indirectly and modestly through both autonomy and motivation. These results suggest that competitiveness can be internalized as self-improvement goals, which, in turn, enhance participation and communication in L2 (Johnson et al., 2014; Li & O'Rourke, 2022). This is possible because when students compete with their peers, they often discover more explicit motivational forces in their environment that energize and enhance their interest in learning languages to outperform their peers. This increased motivation can lead learners to become more proactive, encouraging them to take initiative and act autonomously, seek opportunities to learn their L2, and become more engaged in the learning process. This heightened engagement can, in turn, foster a commitment to their language learning experience. Although the indirect effects were statistically significant, their small effect size suggests that competitive orientations may promote engagement through broader motivational processes.

In contrast, the results indicated that cooperative orientation did not significantly predict engagement through the mediators. This suggests that the positive effects of cooperative orientation on engagement may operate more directly through social and relational processes rather than through heightened autonomy or motivation. While autonomy and motivation mediated the competitive pathway, they did not explain the cooperative one. One plausible explanation, grounded in self-determination theory (Ryan & Deci, 2017), is that cooperative orientation operates primarily through the need for relatedness rather than autonomy. Cooperative learners may be driven less by internal self-regulation or individual motivation and more by feelings of connection, belonging, and mutual support. In cooperative contexts, engagement may arise from the satisfaction of social bonds (e.g., encouragement from peers or shared progress) rather than from autonomous choice or intrinsic reward. Therefore, autonomy and motivation might not capture the principal mechanism through which cooperation enhances engagement. This distinction aligns with findings that cooperative structures primarily influence engagement through peer support and shared responsibility (Dindar et al., 2021; Roseth et al., 2008), whereas competitive structures depend more on individual goal pursuit and self-regulation (Elliot, 2020). Thus, the motivational mechanisms linking cooperative orientation to engagement differ from those underlying competitive orientation.

Furthermore, the cultural diversity of the present sample has important implications for interpreting the findings. Because Duolingo users come from a wide range of cultural backgrounds, their beliefs about competition and learning orientations are likely shaped by broader sociocultural values. Prior research grounded in cross-cultural psychology suggests that individuals from collectivist cultures (e.g., East Asians) often view cooperation as a moral and social obligation, whereas those from individualist cultures (e.g., North American or European contexts) tend to perceive competition as a motivating force (Markus & Kitayama, 1991). However, some recent studies have reported the opposite pattern, finding that collectivist groups can display higher competitive tendencies than individualist ones (e.g., Wu & Talhelm, 2024). Accordingly, these cultural orientations may shape how learners interpret and respond to Duolingo's gamified features. The platform's design is largely individualized, yet it incorporates social components that may be experienced differently across cultural groups. For instance, some learners may perceive competitive features as empowering and autonomy-supportive, whereas others may find cooperative aspects more engaging, depending on their cultural background. In this study, the significant effects of both cooperative and competitive orientations on engagement may reflect such cultural variability within the sample, suggesting that learners from different cultural backgrounds respond to gamified elements in distinct ways. These potential cross-cultural variations

underscore the importance of developing culturally responsive gamified learning environments that allow users to engage through both individual and social pathways.

We also need to note that although the model demonstrated acceptable fit and the paths in the study, the indices were not fully optimal. This suggests that additional variables or alternative structural pathways may help explain engagement. Future studies with larger samples could explore refinements to the model or alternative specifications to improve overall model fit.

Pedagogical implications

The findings of this study have several implications for language educators, curriculum designers, and developers of gamified learning platforms such as Duolingo. First, the results highlight the need to create learning environments that balance competitive and cooperative elements. Because both orientations were shown to promote engagement, albeit through different mechanisms, teachers and platform designers should allow learners to alternate between competitive (e.g., leaderboards) and cooperative (e.g., team tasks) features based on their motivational profiles. Offering such choices can enhance learners' perceived autonomy, which was found to be a crucial mediator of engagement. Moreover, because cooperative and competitive orientations may differ across cultural contexts, offering flexible configurations that let learners choose between the two modes can promote inclusivity and sustain motivation.

Second, the findings indicate that learners' beliefs about competition significantly influence their engagement and emotional experiences in digital learning environments. Specifically, students who viewed competition as an opportunity for personal growth reported higher engagement and persistence, whereas those who perceived it as interpersonal rivalry exhibited greater anxiety and reduced motivation. These results suggest that competition beliefs, whether positive or negative, are not fixed dispositions but can be developed through classroom discourse and digital design choices. Thus, educators can reframe competition as an opportunity for self-improvement (i.e., positive competition beliefs) rather than interpersonal rivalry by emphasizing mastery goals, tracking personal progress, and self-comparison rather than other-comparison. This approach can mitigate anxiety associated with negative beliefs about competition, thereby supporting intrinsic motivation and engagement. Therefore, teacher education programs should prepare instructors to recognize individual differences in learners' beliefs about competition and orientations.

Finally, the mediating effect of motivation in this study underscores the importance of digital and curriculum designers creating digital tasks that are intrinsically rewarding and contextually meaningful. Learners may show greater engagement when activities align with authentic communicative goals and offer opportunities for autonomy and self-regulation. Thus, educators should design digital learning environments that connect directly to real-world applications, encourage self-directed learning, and allow students to monitor their own progress.

Limitations of the study

This study has several limitations. First, it relied on a convenience sample of participants who voluntarily completed the questionnaire. Although the sample reflected considerable demographic diversity among Duolingo users, self-selection bias may have

influenced the findings, as those who agreed to participate may differ systematically from those who declined in motivation, engagement, or attitudes towards competition. As such, the sample may not be fully representative of all Duolingo users. Therefore, caution is warranted when generalizing the results to the broader Duolingo user population. Second, the cross-sectional design precludes causal inference; that is, the observed relationships between variables cannot be interpreted as evidence of causation. Third, the study relied exclusively on self-report measures, which are susceptible to biases such as social desirability and subjective interpretation of items. In addition, self-report measures may not fully capture learners' actual behavioral engagement; therefore, future research could complement self-report measures with behavioral or trace data from Duolingo, such as streaks, time-on-task, and completed lessons, to better assess engagement and triangulate findings. Fourth, because all variables in this study were measured using self-report scales, the results may be affected by common method variance (CMV). Although the study used validated scales and anonymity to reduce response bias, future research should incorporate multi-method data (e.g., behavioral logs from Duolingo and longitudinal designs) to minimize this limitation. Finally, although the sample size ($N=191$) meets the minimum threshold for structural equation modeling based on recommended item-to-parameter ratios (Kline, 2023), it remains on the lower end for complex mediation models. Thus, future studies with larger and more diverse samples would enhance the generalizability of the findings.

Suggestions for future research

The results of this study open several avenues for further research. For example, future research can explore links between beliefs and orientations toward competition and cooperation and other variables related to student interaction, such as willingness to communicate. Moreover, researchers are encouraged to investigate how beliefs about competition relate to other motivational constructs, such as L2 grit (Ansari, 2026). It is plausible that learners with different types of competition beliefs exhibit distinct profiles of persistence and effort in language learning. Positive and negative beliefs about competition can also be associated with different emotional experiences. Therefore, future research should investigate how beliefs about cooperation and competition relate to various L2 emotions, such as shame, enjoyment, and anxiety. Furthermore, incorporating qualitative research methods, such as interviews and reflection journals, alongside statistical analyses can contribute to our understanding of how learners' belief systems, social orientations, motivation, and sense of autonomy interact and how these interactions lead to engagement or disengagement in Duolingo's digitally gamified language-learning environment. Although the present research did not examine AI-enabled or virtual learning environments, its findings regarding self-regulated motivation, autonomy, and engagement might inform future studies exploring these dynamics under AI-supported conditions (Castro-Lopez et al., 2025; Khan et al., 2025). As technological integration continues to evolve toward AI-driven education, future investigations might examine how the relationships between competition beliefs, orientations, and motivational constructs examined in this study unfold with intelligent learning systems and chatbots (Alvarez-Blanco et al., 2023; Yigci et al., 2025).

Conclusion

This study examined whether beliefs about competition (positive vs. negative) and learning orientations (cooperative vs. competitive) predicted engagement among Duolingo learners, with autonomy and motivation as mediators. The findings indicate that these beliefs and orientations do not operate in isolation; rather, their influence on engagement is largely indirect, mediated by key psychological mechanisms—autonomy and motivation. More specifically, positive beliefs about competition significantly predicted higher autonomy and motivation, which, in turn, predicted higher engagement. Conversely, negative beliefs about competition were associated with lower motivation, which, in turn, correlated with lower engagement. By contrast, competitive orientation predicted engagement both directly and indirectly through autonomy and motivation, suggesting that when learners internalize competitive beliefs as self-improvement goals, they are more likely to regulate their learning, seek out learning opportunities, and persist through challenges. In contrast, cooperative orientation was directly related to engagement but showed no significant indirect effects via motivation or autonomy, suggesting that the benefits of cooperative orientation may stem from immediate social and relational processes, such as peer support and shared responsibility, rather than from heightened autonomy or motivation.

The present study holds significant theoretical and practical value, offering new insights into gamified language learning. This research extends the literature on gamification by integrating constructs rarely studied together in an informal digital environment: competition beliefs and learning orientations. Whereas most studies focus on the effects of gamified features themselves, this study emphasizes how learners' psychological interpretations of those features shape engagement, offering a more user-centered perspective on gamified language learning. To showcase the study's theoretical value, the findings contribute to self-determination theory (Ryan & Deci, 2017) and engagement research by indicating that autonomy and motivation play central roles in mediating the effects of competition beliefs and learning orientations, highlighting their importance as key psychological mechanisms driving engagement in gamified learning environments. The study also informs the practical design of language learning applications. The findings enable language curriculum designers and educators to implement balanced gamification strategies that accommodate both competitive and cooperative learners, rather than assuming a one-size-fits-all approach. In doing so, they can ensure that game elements effectively support learners' autonomy and motivation, thereby enhancing engagement and improving learning outcomes. Overall, the findings of this study provide valuable insight, indicating that gamified L2 learning is most effective when educators and language platform designers promote autonomy-supportive, motivationally rich, and socially balanced environments in which competition and cooperation coexist constructively.

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Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

AI-assisted technologies in the writing process During the preparation of the final draft of this manuscript, the authors used Copilot to copy-edit parts of the text. The authors reviewed and revised all content as needed and take full responsibility for the final version of the publication.

Competing interests The authors declare no competing interests.

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- Jabbari, N., Zarrinabadi, N., & Amini, F. (2026). Grit as the predictor of flow and buoyancy among Duolingo multiple language learners: the mediating roles of perceived competence and competitiveness. *Journal*

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