

Social-comparison-based pedagogies for language learning through ludicization technology: Effects of pluralist learning and conformity-driven designs on performative and affective factors

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ABSTRACT

This study investigates how three social-comparison-based pedagogies: autonomous competitive framing (ACF), autonomous competitive framing with social reinforcement (ACF-SR), and pluralist learning (PL), influence performative and affective dimensions of educational-technology-supported language learning. Grounded in Social Comparison Theory, these pedagogies are compatible with ludicization settings implemented by Habitica as the educational technology. The empirical pedagogical interventions elicit the comparative analyses of the performative factor (Post-intervention language learning outcomes) and affective factors (openness, agency, and engagement). The one-way ANCOVA controlling for pretest performance demonstrates that learners in the PL group achieve the highest language performance, followed by those in the ACF, and finally by those in the ACF-SR groups. The K-means clustering analysis produces emergent affective profiles significantly aligning with the predefined pedagogical grouping. The Kruskal-Wallis analysis based on the three distinct affective configurations indicates that learners in the PL achieve higher openness, agency, and engagement than those in ACF, which features low agency, and ACF-SR, which features the lowest levels of all affective factors. Theoretically, these findings address how visibility, authority, and conformity pressures reshape social comparisons under ludicized learning conditions. Regarding pedagogical discussions, this study reflects on how social comparison can be reconstructed into performative and affective empowerment through ludicization as a holistic social-psychological process based on educational technology. In conclusion, this study reflects the facilitation of diversity-featuring pluralist learning in educational-technology-mediated language learning enhancement and the debilitation of conformity-driven designs in learning initiatives without performative or affective empowerment.

Keywords: *Educational technology, Language learning, Ludicization, Pluralist learning, Social comparison.*

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Highlights of this paper

- ACF and ACF-SR focus on vertical and normative comparisons, while PL emphasizes lateral comparisons to support diversity-driven, personalized development.
- Ludicization is a social-psychological process to reconstruct social comparisons.
- PL shows greater performative language facilitation than ACF and ACF-SR, and greater affective facilitation in openness, agency, and engagement.

1. INTRODUCTION

Educational technology has been transforming university language instruction through enriched multimedia content, collaborative assistant tools, and socially reinforced learning environments (Kim, Yu, Detrick, & Li, 2025). Since numerous platforms for educational purposes enable socialization processes involving peer endorsement, instructor voice, badges, and visible cues (Wang et al., 2023) socialization in educational-technology-supported settings is assumed to foster engagement and motivation, thereby enhancing language learning (Poupard, Larrue, Sauzéon, & Tricot, 2025). However, the instructional designs that should have aimed to socialize language learners may pressure learners toward conformity, reduce autonomy, and discourage critical reflection, thereby debilitating deeper language development (Al Fraidan & Aldawsri, 2025).

As a dominant theory in learning-related studies, Sociocultural Theory posits that language learning is inherently mediatable through social interaction (Vygotsky, 1978) via scaffolding by more knowledgeable others, peer collaboration, dialogic feedback, and situated language use (Lantolf & Thorne, 2006). However, despite the fundamental benefits of socializing, Sociocultural Theory still assumes that all social interaction types have equal facilitating effects. Notably, authority and dominance in the social configuration do not help language learners sharpen their ability to reflect, dissent, or develop self-regulated language development (Sheffler & Cheung, 2024). Thus, socializing does not foster critical reflection or language-utterance experimentation but cultivates superficial compliance that reduces learners' volition of autonomous engagement with language tasks (Leduc & Bouffard, 2017; Veenstra & Lodder, 2022).

To capture the paradox of the potentially debilitating effects of socializing, this study concentrates on Social Comparison Theory (Festinger, 1954) as the central theoretical framework. According to Social Comparison Theory, individuals' evaluations of their abilities, opinions, and performance are based on comparisons with others (Noroozi, Schunn, Schneider, & Banihashem, 2025). In educational settings, while these comparisons can contribute to distinct performative and affective influences, social comparisons structured to heighten perceived inferiority or restrict acceptable viewpoints would lead to diminished self-efficacy, anxious perceptions, and avoidance of learning behaviors (Lu, Ma, & Yan, 2024).

The effects of social comparisons are transferable to educational technology-supported contexts. When social comparisons are based on apparently unattainable objectives, they often decrease learners' perceptions of well-being and engagement (Namaziandost, Çakmak, & Ashkani, 2025). Besides, comparative cues, e.g., "likes", "best comments", or visible compliance, would lead to pressure to conform rather than to a willingness to engage in exploratory learning behaviors (Smith, 2023). Additionally, strong institutional hierarchies increase conformity-driven social comparisons by prompting learners to align with perceived authority-endorsed interpretations to avoid negative responses (Ez-zizi, Divjak, & Milin, 2024; Thibaud, 2025). Thus, Social Comparison Theory explains the mixed impacts of socializing on individuals' states and behaviors, which are associated with language learners' risk-taking, critical thinking, and problem-solving engagement.

Regarding social interactions in language learning, most studies still focus on Sociocultural Theory, which assumes the uniformly beneficial effects of socializing processes based on meaningful mediation and scaffolded

development (Lantolf & Thorne, 2006; Vygotsky, 1978). The avoidance of overly uniform effects of social interactions requires investigating whether comparative socializing mechanisms, especially those entwined with authoritative designs, may undermine language learning outcomes. Since social interactions may exhibit multifaceted features, the effects of social interactions on language learning can also be analyzed in terms of differences across learner profiles and learning dynamics.

Thus, these statements elicit the subsequent research gaps. Firstly, despite updates to the implementation of educational technology in language learning, many studies investigating its effects have continued to focus on Sociocultural Theory, which may exhibit excessive uniformity in explaining the effects of social interactions in language learning. Secondly, in line with the need to investigate potentially mixed effects of social interactions, research is extensible from the perspective of Social Comparison Theory, which paves the way for comparative social interactions in educational-technology-supported language learning. Thirdly, since social comparisons involve multiple subtypes, e.g., vertical (Comparing with others perceived as better/worse than oneself), normative (Comparing with perceived norms of a group), and lateral (Comparing with others perceived similar to oneself for self-evaluation) comparisons based on target persons perceived as the authoritative existences (Kryston, Tamborini, & Prabhu, 2025; Leduc & Bouffard, 2017; Ramos Salazar, Garcia, Huntington, & Brooks, 2025; Tanaka, 2023) associated with distinctive influences on learning, analyses are conductible for exploring multifaceted mechanisms of authority-oriented comparative social interactions in language learning.

Aligning with previous research gaps, this study aims to empirically examine how social interactions influence educational technology-supported language learning outcomes. In the contexts involving learning contents bridged by educational technology, social interactions with explicit comparison cues can be classified into 1) “authoritative content framing” (ACF) that allows single-narrative input without peer endorsements and 2) “authoritative content framing with social reinforcement” (ACF-SR) that combines single narrative with visible conformity cues, e.g., peer alignment, supported answers, or social approvals. In contrast, social interactions without explicit comparison cues reflect the inherent features of variety-oriented interactions, eliciting “pluralist learning” (PL) that ensures learners’ exposure to multiple perspectives. Thus, compatible with educational-technology-supported language learning, ACF, ACF-SR, and PL are the target pedagogies to concretize the multifaceted effects of social interactions on language learning outcomes.

Overall, grounded in Social Comparison Theory, this study examines the effectiveness of socializing designs in educational-technology-supported language learning. In contrast to seemingly constant facilitating effects of social interactions on language learning outcomes, socially reinforced authority structures would suppress learners’ affective engagement and performative achievement.

2. LITERATURE REVIEW

This section reviews core concepts of social-comparison-based pedagogies implementable through educational technology, and elicits research hypotheses to examine their instructional efficiency.

2.1. Three Social-Comparison-Based Pedagogies Through Educational Technology

Social Comparison Theory, proposed by Festinger (1954) demonstrates that people innately engage in social comparisons, deeply embedded in meaningfully mediated environments employing educational technology (Noroozi et al., 2025). Aligning with Social Comparison Theory, educational technology serves as a platform for realizing diversity- and authority-oriented learning paths and pedagogical designs associated with comparison styles (Lu et al., 2024). Corresponding to distinct social comparison modes and distinct ways of utilizing educational technology,

the following three instructional approaches are educational-technology-supported pedagogies that are expected to yield different language learning outcomes.

Authoritative content framing (ACF) is an instructional approach that delivers teaching content as a single, authoritative narrative or interpretation (Ez-zizi et al., 2024). Based on ACF, learners receive polished, teacher- or institution-generated materials that leave little room for alternative perspectives or learner-generated insights (Uccelli, 2023). In line with Social Comparison Theory, ACF establishes a vertical comparison environment in which learners compare themselves to an abstract authority, an idealized identity representing correctness and legitimacy (Sheffler & Cheung, 2024). Educational technology in the ACF style, e.g., intelligent tutoring systems or ludicized platforms with fixed feedback, risks strengthening the one-directional nature of knowledge flow (Kim et al., 2025). In the context of language learning, ACF would debilitate higher-order learning outcomes, e.g., pragmatic competence, intercultural sensitivity, and critical language awareness, and amplify the authoritative framing to turn learning into a conformity-oriented pursuit rather than an exploratory experience (Bai & Hew, 2025).

Authoritative content framing with social reinforcement (ACF-SR) is the extended version of ACF by introducing explicit cues, e.g., likes, peer endorsements, and instructors' approvals, reflecting the superficial alignment between guided socialization and authoritative narratives (Thibaud, 2025). According to Social Comparison Theory, ACF-SR aligns with normative comparison, which encourages learners to calibrate their beliefs or performance to the observable social consensus (Wang et al., 2023). Social-media-featuring educational platforms may involve pervasive calibration-inducing cues, e.g., badges of top learners, rewards for peer-voted best explanation, and artificial-intelligence-aggregated consensus comments (Bai & Hew, 2025). These mechanisms reflect the integration of vertical comparison (to authority) and normative comparison (to collective norms), conducive to a hybrid environment of reinforced conformity induced by socializing persuasions (Kryston et al., 2025). Educational technology in the ACF-SR style concretizes the seemingly socializing but inherently conformity-featuring mechanisms through competition-inducing leaderboards, public scoring systems, and real-time peer reactions (Thibaud, 2025). In the context of language learning, although these elements are incentives to motivate learners to progress, misuse of them would inherently reinforce performative anxiety and reduce spontaneous enthusiasm for meaningfulness-oriented learning (Al Fraidan & Aldawsri, 2025).

In contrast to ACF and ACF-SR, pluralist learning (PL) is a variety-oriented instructional approach to advocating the coexistence of multiple perspectives without explicit hierarchical or normative cues (Cheng, 2024). In line with Social Comparison Theory, PL represents a lateral comparison environment that encourages learners to engage with diverse inputs, e.g., peer-generated interpretations, culturally diverse language use, and multimodal feedback, without explicit or forceful guidance toward an authoritative comparison target (Ramos Salazar et al., 2025). PL proceeds based on exploration-stimulating designs such as open-ended discussion forums and dynamic narrative constructions (Meşe, Aydemir, Solak, Gök, & Bolat, 2025). Educational technology in the PL style sustains learners' sustainable intrinsic motivation to achieve incremental, self-actualization-oriented learning progress (Poupard et al., 2025). In the context of language learning, learners' cooperative acts of knowledge co-construction reflect lateral comparisons in which learners make volitional cooperative attempts with others for self-evaluation, self-identification, and self-actualization (Tanaka, 2023).

Overall, aligning with Social Comparison Theory, ACF, ACF-SR, and PL, these reflect distinct social comparison environments in educational technology, forming a continuum from conformity-driven to autonomy-driven learning. ACF emphasizes traditional top-down instructional models, and ACF-SR adds designs that

promote social conformity through observable reinforcement. In contrast, PL highlights diverse, independent, and agency-cultivating explorations.

2.2. Ludicization as the Educational-Technology-Supported Approach to Realizing the Social-Comparison-Based Pedagogies

Since educational technology enables learners to participate in immersive, interactive, and meaningfully mediated environments, innovative educational-technology-supported language learning has emerged as a reflection of learner-centered language learning (Zhong, 2025). Among these pedagogical innovations, ludicization, i.e., the transformation of pedagogical practices into playable, exploratory, and intrinsically motivating experiences to induce learners' self-initiated behaviors (Sanchez, Young, & Jouneau-Sion, 2017) is an instructional approach to embedding real-life development into virtual-setting accomplishments and enhancing learning associated with facilitated affective states (Lipińska, 2024). In the context of language learning, ludicization involves restructuring learning into game-like experiences that involve socializing activities, which are essential components of language development (Namaziandost et al., 2025). Thus, ludicization is theoretically compatible with socializing-featuring language learning, in which learners engage in social comparisons, thereby illuminating how distinct ludicization designs can instantiate the three social-comparison-based pedagogies.

The operationalization of ludicization focuses on playable experiences that involve social referencing, e.g., players' comparisons of progress, interpretations, and outcomes (Yudintseva, 2023) suggesting that ludicization naturally accommodates social comparison dynamics (Yasuda & Goegan, 2025). Ludicization is compatible with the pedagogical style of ACF when the operationalization of ludicization focuses on authority-centric design that prompts learners to interact with fixed narrative systems by providing immediate correctness feedback and reward scores for single, official interpretations of language inputs (Veenstra & Lodder, 2022). Ludicized language learning can offer rewards to learners identified as having accomplished the learning tasks based on pre-programmed canonical answers (Kassenkhan, Moldagulova, & Serbin, 2025). In this case, ludicization produces the vertical comparison structure associated with ACF.

In contrast, ludicization is compatible with the pedagogical style of ACF-SR when its operationalization focuses on social conformity cues, such as peer rankings, reaction emojis, and cooperative missions, to promote learners' alignment with popular answers (Smith, 2023). Stimulated by social-conformity-oriented activities, learners strive to match the authoritative model and seek social validation from peers, reflecting a hybrid comparison model that merges vertical and normative evaluations (Leduc & Bouffard, 2017). Social feedback in ludicized activities drives learners to engage in comparison-oriented learning but may undermine self-regulated processing (Xiao & Hew, 2024). In this case, ludicization mirrors the normative comparison pressures associated with ACF-SR.

Conversely, ludicization is compatible with the pedagogical style of PL when its operationalization emphasizes exploration-based, choice-driven, and feedback-diverse tasks to encourage learners to navigate multiple paths and interpretations without fixed correct routes (Latre-Navarro, Quintas-Hijós, & Sáez-Bondía, 2025). Adjustable mechanisms in ludicized designs pave the way for diverse learning paces through collaborative meaning-making and problem-solving (Shi, Sitthiworachart, & Hong, 2024). Open-ended and dialogical activities foster learners' cognitive flexibility and communicative adaptability (Austermann, Blanckenburg, Blanckenburg, & Utesch, 2025). Ludicized language learning enables learners to experience genuine communication-oriented learning and encounter diverse models of performance without explicit evaluative hierarchy (Zhang & Hasim, 2023). In this case, ludicization corresponds with lateral comparison associated with PL.

Overall, ludicization provides an educational-technology-supported context for implementing ACF, ACF-SR, and PL compatible with social comparisons, necessitating the evaluation of these pedagogical implementations.

2.3. Performative and Affective Factors to Analyze the Social-Comparison-Based Pedagogies Implemented by Ludicization

In line with ludicization as a pedagogical enabler for visualizing the social comparisons embedded in ACF, ACF-SR, and PL for language development associated with affective states, the instructional designs are empirically analyzable along the dimensions of performative and affective factors. Language learning outcomes reflect the performative dimension. Aligning with Social Comparison Theory, social comparisons that alter self-evaluation standards influence learner initiative to make performative progress (Löytömäki, Ohtonen, & Huttunen, 2024). In the cases of ACF and ACF-SR, which highlight the dominant role of authority and conformity, learners may initially display higher accuracy due to structured feedback but reveal lower knowledge transfer (Bai & Hew, 2025; Thibaud, 2025). In contrast, in the case of PL, learners achieve exposure to varied exemplars to stimulate performance generalization and facilitate adaptive language use (Dahri, Yahaya, & Vighio, 2025). These statements elicit the following hypotheses about performative outcomes of these three social-comparison-based pedagogies implementable through ludicization.

Hypothesis 1 (H₁): Learners in the PL condition outperform those in the ACF and ACF-SR conditions on language learning outcomes.

The affective factors include openness, agency, and engagement, each of which represents an indispensable feature of ludicized language learning. Openness reflects learners' willingness to explore novel ideas and perspectives, associated with intercultural competence and language adaptability in language learning (Hausen, Möller, Greiff, & Niepel, 2022). Novel ludicization mechanics to transform learning into explorative playable activities require learners' openness to innovative learning experiences (Latre-Navarro et al., 2025). Aligning with Social Comparison Theory, lateral comparison, as a feature of PL, promotes curiosity rather than defense, fostering sustainable openness (Ramos Salazar et al., 2025; Tanaka, 2023). In contrast, vertical or normative comparisons, as the features of ACF and ACF-SR, evoke cognitive closures due to learners' security in the official narrative (Kryston et al., 2025; Leduc & Bouffard, 2017). These statements reflect the assumed differences in openness across the three pedagogical conditions, which lead to the following hypotheses.

Hypothesis 2 (H₂): PL contributes to learners' higher openness than ACF and ACF-SR.

As an indispensable element in educational-technology-supported learning, agency reflects learners' sense of ownership and control over their learning (Mameli, Grazia, Passini, & Molinari, 2022). In ludicized language learning, agency manifests through learners' meaningful choices and self-regulated progression (Shi et al., 2024). Aligning with Social Comparison Theory, flexible and non-hierarchical comparison targets sustain learners' self-efficacy and personal authorship (Cheng, 2024). Thus, ACF is assumed to limit agency through prescriptive pathways, and ACF-SR reinforces this restriction by embedding conformity incentives (Smith, 2023; Xiao & Hew, 2024). In contrast, PL is assumed to foster agency through autonomy-encouraging environments (Latre-Navarro et al., 2025). These statements reflect the assumed differences in agency across the three pedagogical conditions, which lead to the following hypotheses.

Hypothesis 3 (H₃): PL contributes to learners' higher agency than ACF and ACF-SR.

Engagement is the affective state that integrates behavioral participation, cognitive effort, and emotional investment (Alonso-Tapia, Merino-Tejedor, & Huertas, 2023). In ludicized language learning, engagement mediates the pedagogical designs and learning outcomes (Yudintseva, 2023). Aligning with Social Comparison Theory, distinct comparison environments differently affect engagement (Lu et al., 2024; Yasuda & Goegan, 2025).

Vertical or normative comparisons in the pedagogical styles of ACF and ACF-SR motivate efforts but potentially provoke withdrawal when learners perceive the comparisons unattainable (Kryston et al., 2025; Leduc & Bouffard, 2017; Namaziandost et al., 2025). In contrast, lateral comparisons in PL pedagogical style enhance sustainable, self-referential engagement (Lipińska, 2024). These statements reflect the assumed differences in engagement across the three pedagogical conditions, which lead to the following hypotheses.

Hypothesis (H₁): PL contributes to learners' higher engagement than ACF and ACF-SR.

Overall, these hypotheses constitute a theoretically and empirically coherent framework for capturing the performative outcomes and the affective dynamics of social-comparison-based pedagogies grounded in ludicization.

3. METHODOLOGY

This section describes the methodological designs of this study.

3.1. Participants and Empirical Procedure

The empirical procedure has recruited 150 participants (81 females and 69 males) with an average of 19.890 (Standard deviation (SD) = 1.126). These participants are undergraduate students whose majors are not related to foreign language or foreign studies from a comprehensive university in China. Based on the balanced sample distributions, participants are randomly assigned to one of the three groups, each containing 50 participants and employing one social-comparison-based pedagogy (ACF, ACF-SR, and PL). The implementation of these pedagogies proceeds through Habitica, a digital application for managing learning quests, tracking progress, and recording user interactions.

The empirical procedure involves three stages: pre-, while-, and post-intervention stages (see Figure 1). At the pre-intervention stage, participants take a pre-intervention language test to assess their prior language proficiency (English in this study). Then, at the while-intervention stage, participants in the three groups simultaneously attend the eight-week instructional interventions of the College English course based on the corresponding social-comparison-related pedagogies. Three college English teachers are assigned to the corresponding groups to accomplish the parallel teaching tasks. When participants finish the instructional interventions, the post-intervention stage begins through a post-intervention language test to assess their post-intervention language learning performance and a self-rating questionnaire to assess their affective factors (Openness, agency, and engagement). Language test performance is rated by the teachers in the College English course for the corresponding groups, while affective states are rated by the participants themselves using the self-rating items.

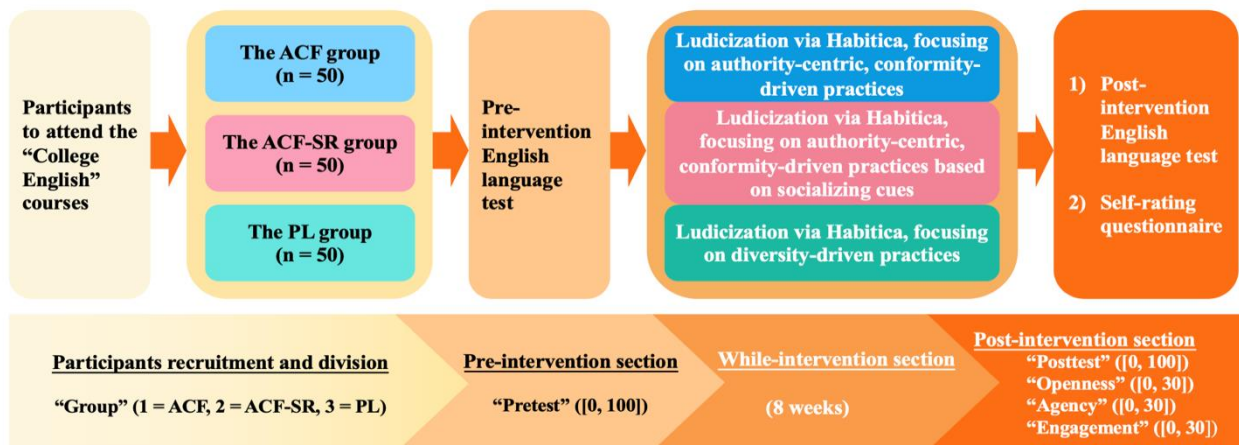


Figure 1. Empirical procedure.

3.2. Instruments and Variables

Habitica is a digital application that serves as an educational technology to operationalize the ludicization designs of the three social-comparison-related pedagogies. Based on Habitica, each pedagogical group employs distinct learning quests, feedback loops, and social-comparison mechanisms. While ACF emphasizes authority-centric pursuits and ACF-SR reinforces them through socializing cues, PL focuses on diverse learning paths, eliciting the categorical variable “Group” (1 = ACF, 2 = ACF-SR, and 3 = PL).

Two parallel versions of an English proficiency test, adapted from the College English Test Band 6 as the official source of English proficiency measurement, serve as the instruments for pre- and post-intervention language proficiency. Each test contains 25 listening comprehension multiple-choice questions, 10 reading comprehension multiple-choice questions, 10 reading comprehension matching questions, 10 cloze questions, and one writing question. The pre- and post-intervention measures of language performance yield the continuous variables “Pretest” and “Posttest”, respectively, each in the $[0, 100]$ range. While “Pretest” serves as a covariate to control for confounding effects of baseline proficiency differences, “Posttest” serves as a dependent variable to demonstrate learning outcomes after the pedagogical intervention, employing the corresponding social comparison mechanics via ludicization.

The self-rating questionnaire consists of 18 items that assess the affective factors of openness (“Openness” measured by items O1-O6), agency (“Agency” measured by items A1-A6), and engagement (“Engagement” measured by E1-E6). Each self-rating item is on a 5-Likert scale ranging from 1 (“Strongly disagree”) to 5 (“Strongly agree”). Since the measures of these affective-factor variables are from the sums of the corresponding item ratings, each affective factor is in a range of $[0, 30]$. The item statements to measure “Openness”, “Agency”, and “Engagement” are adapted from validated sources of [Hausen et al. \(2022\)](#); [Mameli et al. \(2022\)](#) and [Alonso-Tapia et al. \(2023\)](#) respectively.

The questionnaire items meet the demands for reliability and validity. Regarding reliability, since all the affective-factor variables show Cronbach’s alpha values greater than 0.800 and do not change much after the removal of a specific item, all measures demonstrate strong internal consistency and meet the reliability criterion ([Morgan, Barrett, Leech, & Gloeckner, 2020](#)). Validity is analyzable through factor loading analysis based on the Kaiser-Meyer-Olkin measure > 0.700 of 0.927 and the significance level (sig.) of the Bartlett’s test (sig. < 0.001). Since the factor analysis produces the consistency between the clusters according to the highest factor loadings of the items and the original grouping of the items, all measures meet the demand of validity ([Morgan et al., 2020](#)).

3.3. Statistical Approaches

Using IBM SPSS Statistics 29, two statistical approaches aim to test the hypotheses and elucidate the performative/affective effects of social-comparison-based pedagogies implemented through ludicization on language learning. The first statistical approach is the one-way Analysis of Covariance (ANCOVA) to examine the effect of the independent variable “Group” on the dependent variable “Posttest” while controlling for “Pretest” as the covariate. Since participants’ English proficiency may vary, using the covariate increases the accuracy of identifying explanations and isolates the genuine effect of the predefined pedagogical design on performance outcomes. The premises of one-way ANCOVA involves 1) normality of the covariate and dependent variable through the Kolmogorov-Smirnov and Shapiro-Wilk tests, 2) linearity between the covariate and dependent variable through scatterplot linear relationship, 3) homogeneity of regression slopes through non-significant interaction between the independent variable and covariate, and 4) homogeneity of variance through non-significance level of the Levene’s test ([Morgan et al., 2020](#)). Results from this statistical approach aim to test H1.

The second statistical approach is K-means clustering based on standardized scores for “Openness”, “Agency”, and “Engagement” to investigate participants’ emergent affective profiles, which form meaningful clusters corresponding to different social-comparison-based pedagogies. Since these affective-factor variables emerge from participants’ self-rated responses and represent latent affective states rather than fixed group attributes, emergent clustering reveals how participants distribute across affective factors whose dynamics are not fully grasped by the predefined categories (Ikotun, Ezugwu, Abualigah, Abuhaija, & Heming, 2023). Based on the K-means clustering results eliciting the variable “Cluster”, a cross-tabulation analysis examines whether the emergent clusters (“Cluster”) align with the predefined instructional groups (“Group”) regarding visual and statistical correspondence. Besides, since ordinal Likert scaling and ceiling effects in the questionnaire data cannot necessarily guarantee normality, the comparative approach is the Kruskal-Wallis test, a nonparametric one-way analysis of variance (ANOVA), to compare cluster-based differences across the affective factors (Morgan et al., 2020). Results from this statistical approach aim to test H2, H3, and H4.

Overall, these statistical approaches pave the path for a multi-layered understanding of how different social-comparison-based pedagogies (ACF, ACF-SR, and PL) influence performative and affective factors within ludicized ecosystems. While one-way ANCOVA provides confirmatory analysis of whether predefined pedagogical designs influence learning performance, K-means clustering accompanied by a Kruskal-Wallis test provides exploratory validation of how affective orientations emerge and align with the designed pedagogical conditions.

4. RESULTS

This section presents the statistical results from the hypothesis tests.

4.1. Results of One-Way ANCOVA

The data meet the assumptions of one-way ANCOVA as outlined in section 3.3. The Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests reveal significance greater than 0.050 for “Pretest” as the covariate (K-S: > 0.200 , S-W: 0.127) and “Posttest” as the dependent variable (K-S: > 0.200 , S-W: 0.437), which fulfills the normality assumption. Besides, the scatterplot (see Figure 2) shows that the linear relationships between “Pretest” and “Posttest” are similar across the pedagogical groups, with similar slopes, which supports the assumption of a linear relationship. Furthermore, since the interaction term “Group * Pretest” is not statistically significant (Sig. = 0.796 > 0.050), the regressive slopes between “Posttest” and “Pretest” are homogeneous across the pedagogical groups. Additionally, Levene’s test shows non-significant variance differences in the “Posttest” among the groups (Sig. = 0.197 > 0.050), which meets the assumption of homogeneous variances.

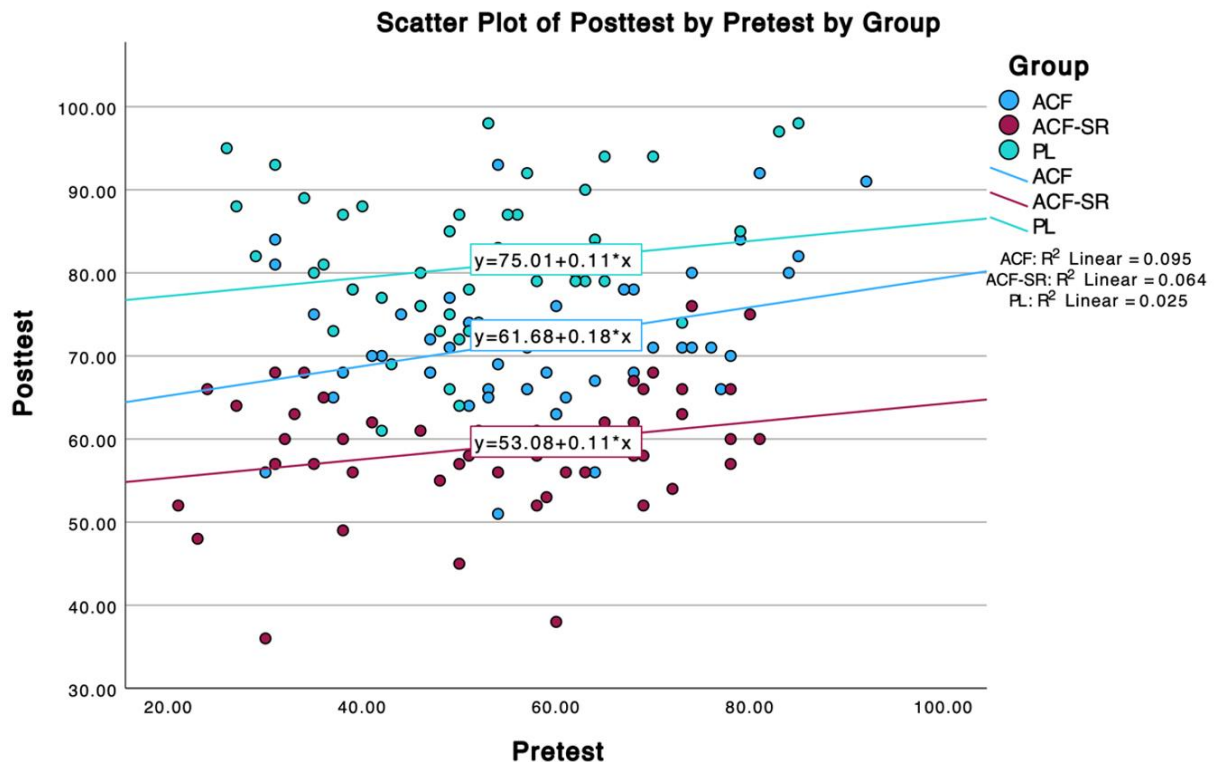


Figure 2. Scatterplot of the linear relationship between “Posttest” and “Pretest”.

Regarding descriptive statistics of unadjusted means (see Table 1), participants gain higher “Posttest” in the PL group (Mean value (M) = 80.700, SD = 9.590) than in the ACF group (M = 72.040, SD = 8.661) and in the ACF-SR group (M = 59.060, SD = 7.847). Regarding between-subjects effects based on the adjustment of covariate “Pretest” (see Table 2), the overall effect of “Group” demonstrates a statistically significant result ($F_{(df(\text{degree of freedom}) = 2, 146)} = 83.000$, sig. < 0.001), which indicates that different pedagogical groups show a significant overall difference in language performance outcomes. A significant effect of “Pretest” on “Posttest” (sig. = 0.004 < 0.050) indicates that participants’ pre-intervention language performance is associated with their post-intervention language performance, confirming the rationale of assigning “Pretest” as the covariate to exclude the confounding effect. The adjusted ANCOVA model explains 53.2% of the total variance in “Posttest” ($R^2 = 0.532$). Regarding estimates of adjusted means (see Table 1), participants gain the highest “Posttest” in the PL group (M = 81.085, SD = 1.211), followed by those in the ACF group (M = 71.520, SD = 1.217), and finally by those in the ACF-SR group (M = 59.195, SD = 1.205). Regarding post-hoc Bonferroni pairwise comparisons to control the Type I error (see Table 3), all pairs show significant mean differences (sig. < 0.001).

Table 1. Unadjusted and adjusted descriptive statistics of “Posttest”.

Group	Unadjusted estimates		Adjusted estimates			
	Mean	Standard deviation	Mean	Standard error	95% confidence interval	
					Lower bound	Upper bound
ACF	72.040	8.661	71.520 ^a	1.217	69.115	73.925
ACF-SR	59.060	7.847	59.195 ^a	1.205	56.814	61.576
PL	80.700	9.590	81.085 ^a	1.211	78.692	83.478

Note: a. Covariates appearing in the model are evaluated at the following values: Pretest = 54.507.

Table 2. Test of between-subjects effect on “Posttest”.

Source	Type III sum of squares	Degree of freedom	Mean square	F	Significance	Partial Eta squared
Corrected model	12484.077 ^a	3	4161.359	57.436	< 0.001	0.541
Intercept	44961.398	1	44961.398	620.572	< 0.001	0.810
Group	12026.944	2	6013.472	83.000	< 0.001	0.532
Pretest	621.317	1	621.317	8.576	0.004	0.055
Error	10577.923	146	72.452			
Total	770716	150				
Corrected total	23062	149				

Note: a. R squared = 0.541 (Adjusted R squared = 0.532)

Table 3. Pairwise comparisons of “Posttest” across the groups.

(I) Group	(J) Group	Mean difference (I-J)	Standard error	Significance ^b	95% confidence interval for difference ^b	
					Lower bound	Upper bound
ACF	ACF-SR	12.325*	1.717	< 0.001	8.166	16.483
	PL	-9.565*	1.730	< 0.001	-13.756	-5.375
ACF-SR	ACF	-12.325*	1.717	< 0.001	-16.483	-8.166
	PL	-21.890*	1.705	< 0.001	-26.018	-17.762
PL	ACF	9.565*	1.730	< 0.001	5.375	13.756
	ACF-SR	21.890*	1.705	< 0.001	17.762	26.018

Note: Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Therefore, participants in the PL group outperform those in the ACF and ACF-SR groups on post-intervention language learning performance, providing statistical evidence for accepting H1.

4.2. Results of K-Means Clustering and Kruskal-Wallis Analysis

Participants' affective patterns across the three social-comparison-based pedagogies emerge in a clustering based on the standardized values of “Openness”, “Agency”, and “Engagement”. Determining the optimal number of clusters depends on the elbow point in the within-cluster sum of squares (WCSS) (see Table 4). Since the elbow point indicating the slow reduction in WCSS is at three, a three-cluster solution is the best for balancing explanatory power and conciseness in emergent affective-factors-related grouping. Besides, a three-cluster solution converges to zero change after seven iterations, further indicating that this clustering solution is the most interpretable and statistically stable.

Table 4. Statistics related to within-cluster sum of squares.

The number of clustering	Affective factor	Error mean square	Degree of freedom	Error sum of squares	Within-cluster sum of squares
2	Openness	0.656	148.000	97.088	202.464
	Agency	0.202	148.000	29.896	
	Engagement	0.510	148.000	75.480	
3	Openness	0.412	147.000	60.564	115.983
	Agency	0.146	147.000	21.462	
	Engagement	0.231	147.000	33.957	
4	Openness	0.325	146.000	47.450	102.054
	Agency	0.145	146.000	21.170	
	Engagement	0.229	146.000	33.434	
5	Openness	0.259	145.000	37.555	82.505
	Agency	0.139	145.000	20.155	
	Engagement	0.171	145.000	24.795	
6	Openness	0.204	144.000	29.376	73.008
	Agency	0.139	144.000	20.016	
	Engagement	0.164	144.000	23.616	
7	Openness	0.247	143.000	35.321	71.214
	Agency	0.135	143.000	19.305	
	Engagement	0.116	143.000	16.588	

The three-cluster solution is reflected in the subsequent clusters, with distinctive features in the standard scores (see Figure 3 and Table 5). Cluster 1 ($n = 55$) features moderate openness, low agency, and moderate engagement, reflecting participants' steady willingness to achieve immersion in ludicized tasks without active self-regulation. Cluster 2 ($n = 50$) features high openness, high agency, and high engagement, reflecting participants' pronounced curiosity-driven, self-directed pursuit of motivational involvement in ludicized tasks. Cluster 3 ($n = 45$) features low openness, low agency, and low engagement, reflecting participants' limited willingness to explore new learning possibilities and their passive response to ludicized social comparisons.

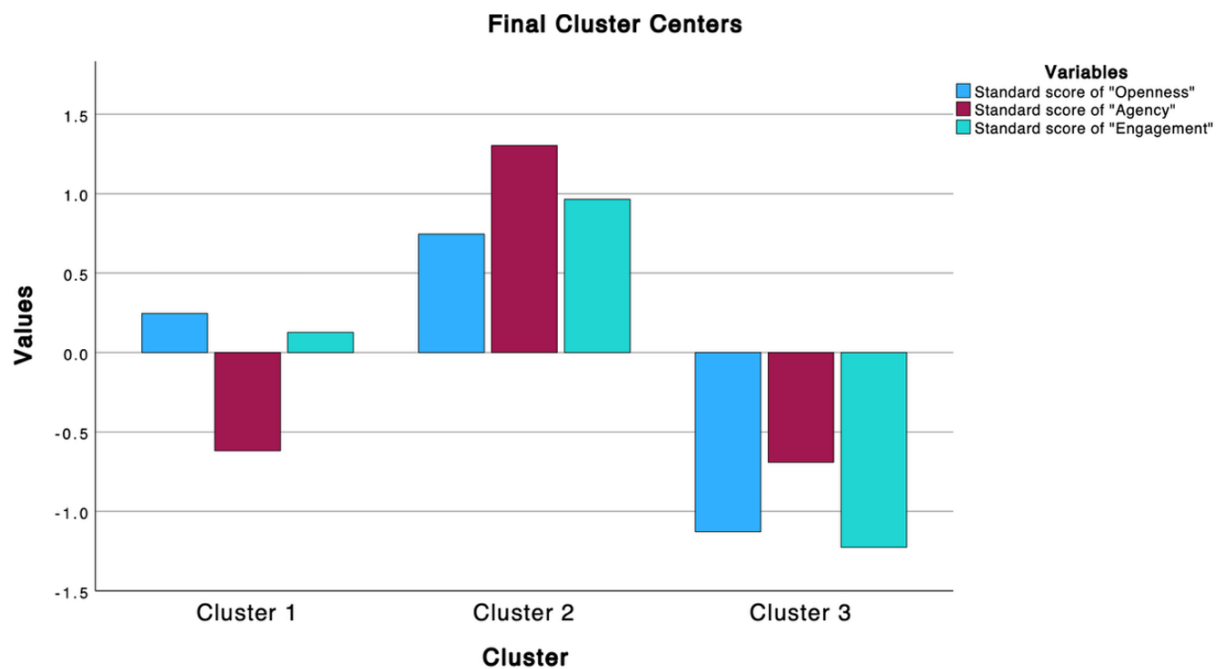
**Figure 3.** Clustering results of the affective-factor variables based on the three-cluster solution.

Table 5. Cluster-based standard scores and Kruskal-Wallis test results.

Variable	(I) Group	Standard score	Mean rank	Hypothesis test	Post-hoc pairwise comparisons		
				Significance	(J) Group	Test statistic (I-J)	Significance
Openness	Cluster 1	0.246	84.930	< 0.001	Cluster 2	-23.623	0.005
	Cluster 2	0.745	108.550		-	-	-
	Cluster 3	-1.128	27.260		Cluster 1	57.672	< 0.001
					Cluster 2	81.294	< 0.001
Agency	Cluster 1	-0.619	52.830	< 0.001	Cluster 2	-72.673	< 0.001
	Cluster 2	1.303	125.500		-	-	-
	Cluster 3	-0.691	47.660		Cluster 1	5.172	0.552
					Cluster 2	77.844	< 0.001
Engagement	Cluster 1	0.127	77.250	< 0.001	Cluster 2	-41.485	< 0.001
	Cluster 2	0.964	118.740		-	-	-
	Cluster 3	-1.226	25.310		Cluster 1	51.943	< 0.001
					Cluster 2	93.429	< 0.001

Kruskal-Wallis test verifies the statistical distinctiveness of these clusters (see Table 5). According to the null hypothesis tests, the significance levels are less than 0.001 for “Openness”, “Agency”, and “Engagement”, confirming that the distributions of these variables differ significantly across the three clusters. Regarding the mean ranks for all variables, Cluster 2 shows the highest values, followed by Cluster 1, and finally by Cluster 3. The post-hoc pairwise comparisons demonstrate that all pairs show statistically significant differences at the sig. level < 0.050, except the Cluster 1-Cluster 3 difference in “Agency” at the sig. level = 0.552 > 0.050. Thus, the emergent clusters of the affective factors are statistically distinct, which elicits meaningful reflection on differentiated patterns of social comparisons under ludicized learning conditions.

A cross-tabulation analysis contextualizes the cluster membership (Eliciting the variable “Cluster”) across the three social-comparison-related pedagogies (Corresponding with “Group”) (see Table 6). According to the distribution, almost all participants’ affective-factor-based clustering is consistent with the grouping by the social-comparison-based pedagogies via ludicization: Cluster 1 for ACF, Cluster 2 for PL, and Cluster 3 for ACF-SR. The statistically significant Pearson Chi-square value of 272.727 (df = 4, sig. < 0.001) confirms the significant association between “Group” and “Cluster”. Thus, different social-comparison-based pedagogies lead to distinct affective configurations of openness, agency, and engagement among participants, offering the rationale of the Kruskal-Wallis test finding that participants’ ratings of the affective factors are higher for the PL group (Corresponding with Cluster 2) than the ACF group (Corresponding with Cluster 1) and ACF-SR group (Corresponding with Cluster 3).

Table 6. Cross-tabulation of “group” and case number of “cluster”.

			Cluster number of cases			Total
			1	2	3	
Group	ACF	Count	50	0	0	50
		Percentage within “Group”	100.00%	0.00%	0.00%	100.00%
		Percentage within the case number of “Cluster”	90.90%	0.00%	0.00%	33.30%
	ACF-SR	Count	5	0	45	50
		Percentage within “Group”	10.00%	0.00%	90.00%	100.00%
		Percentage within the case number of “Cluster”	9.10%	0.00%	100.00%	33.30%
	PL	Count	0	50	0	50
		Percentage within “Group”	0.00%	100.00%	0.00%	100.00%
		Percentage within the case number of “Cluster”	0.00%	100.00%	0.00%	33.30%
Total	Count		55	50	45	150
	Percentage within “Group”		36.70%	33.30%	30.00%	100.00%
	Percentage within the case number of “Cluster”		100.00%	100.00%	100.00%	100.00%

Therefore, participants in the PL group outperform those in the ACF and ACF-SR groups on openness, agency, and engagement, providing statistical evidence for accepting H2, H3, and H4.

5. DISCUSSION

The results support all hypotheses and demonstrate significant differences in performative and affective dimensions across the pedagogical groups. Explicitly, PL featuring lateral comparisons shows greater pedagogical significance than ACF and ACF-SR featuring vertical and normative comparisons in the educational-technology-supported conditions. Besides, the overall outperformance of the PL group through ludicization indicates that it is a transformative mechanism for cultivating autonomy-driven learning rather than a conformity-centric procedure.

According to the ANCOVA results, participants in the PL group significantly outperform those in the ACF and ACF-SR groups in post-intervention language learning performance. This finding suggests that variety-oriented learning environments facilitate deeper language competence through learners' volitional, self-regulated evaluation and progression rather than an excessive focus on competition (Cheng, 2024; Meşe et al., 2025; Ramos Salazar et al., 2025). In contrast, the ACF and ACF-SR groups show lower language-learning outcomes. This finding is consistent with the assumed debilitating effects of authority-oriented acts or designs on exploratory problem-solving and reflective meaning-making (Al Fraidan & Aldawsri, 2025; Bai & Hew, 2025). Since problem-solving and meaning-making are essential for communicative competence in language learning (Shi et al., 2024) authority-centric pedagogies lead to a recession in autonomous pursuit of learning achievement (Kryston et al., 2025; Leduc & Bouffard, 2017; Thibaud, 2025; Veenstra & Lodder, 2022).

According to the K-means clustering and Kruskal-Wallis analyses, the emergent affective profiles exhibit significantly distinct patterns across the pedagogical groups. Participants in the PL group show the highest openness, agency, and engagement. This finding confirms that the exploration-promoting, diversity-featuring pedagogy contributes to an affective configuration conducive to sustainable learning motivation associated with substantial learning progress (Poupard et al., 2025). The ACF group shows intermediate levels of openness and engagement and a lower level of agency. This finding suggests that authoritative guidance that is not balanced with volitional immersion limits the potential for self-directed learning (Sheffler & Cheung, 2024; Thibaud, 2025; Wang et al., 2023). Besides, learner agency is a determining factor in facilitating affective states associated with learning because self-initiated regulation contributes to independent learning in language digestion, construction, organization, and utterance (Latre-Navarro et al., 2025; Shi et al., 2024). In contrast, the ACF-SR group shows the lowest scores across all affective-factor variables. This finding reflects that excessive social reinforcement and conformity cues suppress initiative, curiosity, and self-identification, leading to rigidly structured language learning that should have aligned with flexible communicative purposes rather than compliance with authoritative narratives (Smith, 2023; Xiao & Hew, 2024). The significant alignment between the emergent clusters and predefined pedagogical grouping statistically confirms the rationality of the pedagogical interventions.

The integration of these analyses offers empirical evidence for the subsequent ludicization-related implications. Firstly, ludicized learning contexts that promote cooperative diversity and learner autonomy rather than performative conformity can facilitate social comparisons (Yasuda & Goegan, 2025; Yudintseva, 2023). Self-referenced growth and exploration are critical components of learning-benefiting ludicized systems that can visualize collective progress without excessive concentration on reward-based competition (Lipińska, 2024; Namaziandost et al., 2025). Secondly, regarding the design of playable experiences based on educational technology, learners' affective empowerment through openness to learning experiences, agency in learning management, and active engagement are not merely emotional byproducts but central drivers of language development (Löytömäki et

al., 2024; Sanchez et al., 2017). Technological mediation paves the way for learners' convenient and systematic information processing and retrieval, based on their perceptions of novelty and self-regulation, for reciprocal performative-affective development (Löytömäki et al., 2024; Zhong, 2025). Thirdly, ludicization functions beyond motivational enhancement and restructures the social comparison ecology. When not excessively amplifying competitive hierarchies, ludicization can reconfigure learners' comparative orientation from vertical (to authority or better others) or normative (to social consensus) toward lateral (to cooperative others as co-constructors of meaning-making) (Latre-Navarro et al., 2025; Zhang & Hasim, 2023). This orientation reconfiguration reflects the pedagogical transformation of technology from a transmitter of correctness to a meaningful mediator of meaning-making diversity (Austermann et al., 2025; Shi et al., 2024). Educational technology can enable interactive, personally meaningful learning, thereby operationalizing Social Comparison Theory regarding autonomy-supportive socializing activities (Poupard et al., 2025; Tanaka, 2023).

The results also elicit a reflection on the limitations of Sociocultural Theory in explaining affective differentiation in socializing-featuring learning. Although Sociocultural Theory offers valuable insights into the contributions of peer-mediated tasks, dialogic tasks, and co-construction of meaning-making information to internalized mastery (Lantolf & Thorne, 2006; Vygotsky, 1978) this theory still presupposes that socializing interactions are inherently facilitating and dialogically balanced. The current findings illustrate that authority, visibility, and conformity pressure can warp interaction as the core element of language learning. Authority- or consensus-oriented social comparisons, as represented in the ACF and ACF-SR groups, may unintentionally reproduce conformity pressures that restrict learners' enthusiasm for volitional exploration (Al Fraidan & Aldawsri, 2025; Bai & Hew, 2025). Since the socializing of learning may scaffold or lead to silence depending on the comparison logic embedded within pedagogical designs, Social Comparison Theory extends the sensitivity of social comparisons whose facilitation depends on whether they contribute to interpretative independence or collective compliance (Lu et al., 2024; Noroozi et al., 2025). Properly designed ludicized learning can reframe comparisons as enjoyable explorations in which learners construct meaning through spontaneous curiosity and involvement rather than hierarchical validation (Latre-Navarro et al., 2025; Zhang & Hasim, 2023).

Apart from theoretical reflection, the results elicit the following reflections on pedagogical designs. The outperformance in the PL group demonstrates that guaranteed interpretative flexibility, volitional self-regulation, and active recognition of individual learning trajectories contribute to learners' sustained progress in learning (Meşe et al., 2025; Xiao & Hew, 2024). Ludicization offers a pragmatic platform for transforming the learning process into systematic self-chosen quests, adaptive challenges, and voluntary cooperation without distorting educational purposes (Sanchez et al., 2017). Besides, the debilitation of ACF and ACF-SR implicitly questions the overdependence on authoritative narratives and standardized correctness, which would filter learning identities and hinder initiative (Leduc & Bouffard, 2017; Sheffler & Cheung, 2024). In the pluralist context, where guidance or collective standards are redefined as open-ended frameworks, learners are active meaning-makers navigating diverse interpretative possibilities and creative knowledge constructions (Shi et al., 2024; Tanaka, 2023).

Overall, the results affirm that the effectiveness of social comparison in ludicized learning depends on the directionality, i.e., vertical, normative, and lateral comparisons. PL emphasizing lateral comparisons yields better performative and affective outcomes than ACF and ACF-SR, which emphasize vertical or normative comparisons. The results confirm the facilitation of pluralist, learner-driven, and ludicized pedagogies that foster openness, agency, and engagement as the affective foundations of sustainable language development.

6. CONCLUSION

This study investigates the effectiveness of three social-comparison-based pedagogies, i.e., authoritative content framing (ACF), authoritative content framing with social reinforcement (ACF-SR), and pluralist learning (PL), implemented through ludicization. The results show important findings that confirm all proposed hypotheses. The one-way ANCOVA shows that participants in the PL group achieve significantly higher post-intervention language-learning performance than those in the ACF and ACF-SR groups. This performance-related finding supports H1 and reflects that ludicized activities featuring collaborative progression and diversified social comparisons can optimally enhance language learning outcomes.

The K-means clustering with the Kruskal-Wallis test reveals three emergent, distinct affective clusters characterized by distinct configurations of openness, agency, and engagement. Based on the strong consistency between the clustering results and the three pedagogical groupings, the PL group (Corresponding to Cluster 2) shows the most facilitated affective configuration, characterized by high openness, agency, and engagement. These affective-factors-related findings confirm H2, H3, and H4 regarding PL's outperformance in the affective cultivations of openness, agency, and engagement. When implemented in diversity-driven, self-regulated, and exploration-oriented conditions, ludicization can foster an affectively supportive atmosphere that motivates learners' voluntary involvement and performative persistence in language learning.

In conclusion, educational-technology-mediated pluralist learning via ludicization promotes language development and facilitates affective engagement to sustain learning progress. In contrast, excessive authority-centric pedagogical designs with socializing cues that inherently promote conformity debilitate language learning by hindering the cultivation of voluntary curiosity, self-management, and spontaneous involvement.

Admittedly, this study still has several limitations for future research. Firstly, this study primarily focuses on the pedagogical effectiveness of the eight-week intervention, which may not fully explain the long-term effects on the performative and affective factors of language learning. Future research could involve longitudinal designs to explore how sustained ludicized experiences featuring distinct social comparison styles influence learners' performative and affective development. Besides, although Habitica offers a flexible platform for incorporating ludicized activities, different educational technologies with distinctive game-like mechanics may differ in pedagogical efficiency. Future research could compare different ludicization platforms integrated with adaptive feedback systems to capture finer variations in learners' social comparison behaviors and values.

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