International Journal of Research Studies in Education
2025 Volume 14 Number 16, 173-189

Not a one-size-fits-all pedagogy: Evaluating flipped learning efficacy through the lens of learner cognitive style

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Received: 6 October 2025 **Revised**: 29 October 2025 **Accepted**: 31 October 2025
Available Online: 1 November 2025 **DOI**: 10.5861/ijrse.2025.25280

ISSN: 2243-7703
Online ISSN: 2243-7711

OPEN ACCESS

Abstract

Flipped Classroom Model (FCM) research often treats pre-class design as pedagogically neutral, presuming equal benefits for all learner types. This study challenges that assumption by demonstrating that individual cognitive-style differences substantially influence the effectiveness of pre-class strategies—the decisive stage for developing the declarative linguistic knowledge that underpins in-class proceduralization and eventual automatization. Employing a mixed-methods design, the study examined input-exposure flipping among Iranian EFL undergraduates, classified via the Group Embedded Figures Test as field-dependent (FD) or field-independent (FI) and assigned to either flipped or non-flipped instructional conditions. Quantitative analyses indicated that the Flipped–FI group achieved the highest speaking-proficiency gains, while qualitative findings illuminated the mechanisms behind this advantage. Evidence from classroom observations, interviews, learner journals, and raters' evaluations showed that the FIs engaged analytically with pre-class materials, integrating micro-level linguistic forms with overall meaning and restructuring them into cohesive semantic–syntactic–phonological units. This deep, organized encoding reduced cognitive load, supported fluent and accurate in-class performance, and maximized proceduralization opportunities in collaborative communicative tasks. In contrast, the FDs adopted a holistic attentional orientation, prioritizing gist over autonomous, form-focused noticing. Their shallow encoding increased in-class cognitive load, heightened anxiety, and diverted class time to remedial explanations—limiting the shift from declarative to procedural knowledge. By connecting stage-specific processing differences in attention, encoding depth, and retrieval efficiency to cognitive style, this study offers a plausible explanation for inconsistent outcomes in prior FCM research and underscores the need for cognitive-style-responsive pre-class design to fully realize the flipped model's communicative aims.

Keywords: flipped classroom model, pre-class input exposure, EFL speaking proficiency, cognitive style, field dependence/independence

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1. Introduction

Although the flipped classroom model (FCM) is widely recognized for its pedagogical value (Irianti et al., 2024; Izadpanah, 2022; Li et al., 2025; Magala et al., 2025; Marisga, 2025; Pratiwi et al., 2022; Wu et al., 2023; Zhong, 2024), its optimal application in second language (L2) learning—particularly for enhancing oral proficiency—remains unsettled. By shifting foundational content delivery, often through recorded videos or other pre-class materials, outside the classroom, FCM reserves in-class time for communicative tasks and authentic language use (Bergmann & Sams, 2012; Thuong, 2018; Xin & Zhang, 2024). This approach relies on providing prerequisite linguistic input before face-to-face sessions to establish the knowledge base required for accurate and fluent speech. The effectiveness of this design depends on the quality of pre-class instructional design, as it determines learners' ability to retrieve and apply linguistic knowledge during cognitively demanding, communicative activities. Consequently, pre-class preparation serves as a pivotal stage in developing declarative knowledge, enabling subsequent proceduralization and, ultimately, automatization of language skills in classroom interaction.

Some scholars—drawing on Krashen's (1985) input hypothesis —advocate for authentic, comprehensible input as the pre-class linchpin, arguing that meaningful exposure is sufficient for triggering oral language gains. However, empirical findings in this regard are mixed: while some research findings support input-rich pre-class activities as sufficient preparatory mechanisms equipping students for complex real-time interaction, others indicate that implicit exposure alone often falls short in developing the foundational linguistic competencies essential for higher order cognitive and communicative activities. Critics, drawing on frameworks such as Skill Acquisition Theory (SAT; see DeKeyser, 2015), question the efficacy of implicit, input-based strategies for facilitating learners' mastery of basic declarative knowledge and its proceduralization without the support of explicit instruction.

One possible reason for such inconsistency in the literature is the insufficient consideration of learners' cognitive styles. In second language acquisition (SLA), field dependence/independence (FD/FI) is known to influence language processing (Kafipour & Khoshnood, 2023; Farangi et al., 2025; Heidari, 2022; Rassaei & Ravand, 2024), particularly in implicit knowledge acquisition (Mahvelati, 2020). FD/FI cognitive styles refer to the extent to which learners' perception and processing are influenced by contextual clues, with field-dependent learners tending to process information holistically and field-independent learners exhibiting a more analytical, detail-oriented approach (Griffiths & Soruç, 2020; Rassaei 2015; Shao et al., 2024). Nonetheless, no FCM research has examined whether FD and FI learners benefit differently from implicit, input-based pre-class strategies. This oversight may contribute to mixed findings, as approaches suited to one cognitive profile can yield limited gains for another. Addressing this gap is essential for aligning FCM design with cognitive differences and enhancing its impact on oral proficiency.

Given these gaps, the present study addresses a critical need in the literature by investigating the impact of FCM-based, pre-class input exposure—delivered without explicit linguistic instruction—on EFL learners' speaking proficiency, with a particular focus on the moderating role of FD/FI cognitive styles. This research is especially significant in view of the persistent difficulties EFL learners face in developing oral proficiency, a challenge well documented in prior scholarship (Mahvelati, 2021; Phanwiriyarat et al., 2025; Zhong, 2024). By illuminating whether and how individual cognitive styles mediate the effectiveness of input-based FCM approaches for speaking development, this study seeks to inform the design of more responsive, individualized pedagogical frameworks, thereby advancing both theory and practice in FCM and L2 education.

2. Literature review

2.1. Theoretical foundations of FCM and the role of digital technologies

FCM, rooted in constructivist and social constructivist theories (Piaget, 1970; Vygotsky, 1978), prioritizes active, experiential learning and collaborative knowledge construction. Consistent with learner-centered pedagogy, it shifts responsibility for content engagement to students, fostering autonomy through self-directed pre-class preparation and promoting deeper cognitive and interactive involvement during lessons. Grounded in sociocultural theory, the Input Hypothesis (Krashen, 1985), interactionist approaches (Long, 1996), and the Output Hypothesis (Swain, 1993), FCM emphasizes meaningful interaction, sustained participation, and integration of receptive and productive skills for SLA. Digital technology plays an enabling role in FCM, with integration of Computer-Assisted Language Learning and Mobile-Assisted Language Learning. These tools facilitate flexible access to materials in online environments, allowing learners to engage with input independently before class, thus preserving in-class time for communicative, interactive, and proficiency-deepening activities.

2.2. From Bloom's taxonomy to pre-class preparation

The transition from traditional, teacher-led instruction to pre-class, online delivery in FCM draws on Bloom's (1964) taxonomy, shifting lower-order tasks (e.g., vocabulary recall, grammar recognition) outside the classroom to reserve in-person sessions for higher-order skills such as analysis, synthesis, and creative application through peer and instructor collaboration. While this sequencing supports deeper learning, its optimal design for EFL speaking development is debated. Disagreement persists over whether pre-class mere exposure sufficiently prepares learners for complex oral tasks. The debate is divided between input-based learning advocates and SAT proponents, the latter emphasizing structured, form-focused support to avoid slow and unpredictable linguistic progress.

Advocates of implicit, input-based strategies, drawing from the Input Hypothesis (Krashen, 1985), Connectionism (Rumelhart & McClelland, 1986), Usage-Based Learning (Tomasello, 2003), and Complexity Theory (Larsen-Freeman, 1997), emphasize that abundant, comprehensible input fuels subconscious pattern recognition and primes learners' internal systems for language acquisition. Such input-rich environments encourage gradual emergence of linguistic competence and neural adaptation conducive to fluency. In an FCM context, this approach frames pre-class exposure as an immersion phase, reserving class sessions for communicative practice, contextualized use, and reactive focus-on-form interventions, thereby consolidating intuitions gained through exposure.

2.3. Empirical evidence of pre-class input exposure's role in EFL speaking development

Empirical studies examining pre-class activities for EFL speaking proficiency indicate both potential and limitations of input immersion. Research by Amiryousefi (2019), Demir and Mirzaie (2023), Santhanasamy and Yunus (2022), and Teng (2017) demonstrates that embedding exposure to authentic and comprehensible language resources within pre-class activities can enhance speaking ability and confidence across varied learner demographics, even without explicit form-focused instruction. Similarly, Hashemifardnia et al. (2021), Pratiwi et al. (2022) and Sheerah and Yadav (2022) report improvements in complexity, accuracy, fluency, attitudes and autonomy through implicit content-driven preparation. This trend is also reflected in the Philippine educational landscape. For instance, a study by Junio and Bandala (2018) with senior high school students found that an FCM approach, predicated on pre-class material engagement, improved oral communication skills, although logistical challenges like internet accessibility were noted. These findings align with broader evidence from the region (e.g., Rivera & Flores, 2024), suggesting that pre-class input exposure is a viable strategy for fostering learner autonomy and enhancing specific language competencies among Filipino learners.

Nevertheless, counterevidence exists. Chen and Hwang (2020) found that input exposure alone was less effective in improving overall speaking performance and subskills such as lexical resource and coherence, compared to interventions incorporating structured cognitive activation (e.g., concept mapping). Lee and Wallace

(2018) also observed negligible statistical gains in speaking under FCM conditions when compared to traditional teaching, despite increased engagement. Yeşilçınar (2019) further found that gains were significant only for linguistic features directly addressed through explicit pre-class instruction. These findings collectively suggest that cognitively activating and organizational strategies can amplify the effectiveness of input immersion in aiding EFL speaking development.

2.4. The overlooked role of FD/FI cognitive style

A notable gap in the current FCM research is the limited consideration of learners' cognitive styles—specifically FD and FI—as mediating factors in instructional effectiveness. SLA studies highlight FD/FI as influential in language processing and implicit knowledge acquisition (Farangi et al., 2025; Heidari, 2022; Rassaei & Ravand, 2024), potentially explaining inconsistent FCM outcomes. FD learners depend on external cues, adopt a global processing orientation, and require structured support, which may hinder performance in autonomous, analytical tasks. Conversely, FI learners demonstrate strong analytical abilities, intrinsic motivation, and the capacity to restructure complex information for individual goals, benefiting from less guided, detail-oriented contexts (Hansen & Stansfield, 1981; Heidari, 2022; Rassaei & Ravand, 2024; Shao et al., 2024; Tinajero et al. 2012). Instructional designs that overlook these differences risk favoring one cognitive style over another, thereby affecting learning gains. Integrating FD/FI awareness into the FCM design may enhance adaptability and effectiveness across diverse learner profiles.

These differences have notable pedagogical implications: FI learners tend to excel in autonomous, self-regulated environments, while FD learners benefit more from externally structured, cooperative contexts. Empirical evidence suggests that FD learners respond well to instructional designs featuring explicit objectives, clear guidance, teacher-led scaffolding, and externally structured frameworks, which facilitate the systematic processing and long-term retention of language input, while FI learners demonstrate greater adaptability to implicit, self-directed, and analytically demanding approaches requiring ambiguity tolerance, inferential reasoning, and self-generated organizational frameworks (Farangi et al., 2025; Kafipour & Khoshnood, 2023; Mahvelati, 2020; Mehdipour-Kolour & Ali, 2024; Rajagopalan et al., 2015; Shao et al., 2024; Stansfield and Hansen, 1983; Zhang, 2004; Zhou et al., 2015). Although some researchers (Meguro, 2020; Griffiths & Sheen, 1992) have questioned the direct influence of FD/FI on instructional effectiveness, the prevailing consensus underscores the value of cognitively congruent pedagogical designs.

2.5. FD/FI and information processing

FD/FI distinctions manifest across the three stages of information processing—attention, encoding, and memory retrieval (Tinajero & Páramo, 1998). Building on Goodenough's (1976) hypothesis, supported by subsequent studies (for example, Frangi et al., 2025; Heidari, 2022; Jia et al. 2014; Mahvelati, 2020; Rajagopalan et al. 2015; Shao et al., 2024; Zhou et al. 2015), FDs are more prone to distraction from salient but irrelevant stimuli, overlooking subtler features within complex contexts. Conversely, FIs demonstrate greater resistance to distracting cues, enabling them to detect relevant patterns more effectively. These attentional differences align with their processing preferences: FDs adopt a global, context-oriented approach, while FIs employ analytical, detail-focused strategies. Such variations extend beyond the sensory-memory stage into working memory and long-term retrieval processes. Selective attention, as noted by Lang (1995), underpins efficient information encoding, while the depth of cognitive processing, highlighted by Craik and Lockhart's (1972) Levels-of-Processing theory, influences retrieval success. Empirical findings suggest that FIs often outperform FDs in working memory tasks due to their capacity to reorganize new input in light of prior knowledge. Under high cognitive load, these differences become even more pronounced (Heidari, 2022; Mahvelati, 2020). Overall, FD and FI represent contrasting, stable information-processing orientations that can account for variability in learning outcomes, providing a cognitive-style lens for understanding individual differences in educational contexts.

3. Identified literature gaps and rationale for the present study

Despite the centrality of pre-class learning design in FCM and the established influence of cognitive style in SLA, a critical gap persists at their intersection. While prior research on FCM effectiveness for oral proficiency has yielded inconsistent findings, this variability may be attributed to a significant oversight: the failure to consider learners' cognitive styles as a moderating variable. A review of the literature indicates that no empirical research has systematically investigated whether the benefits of implicit, input-based pre-class strategies in flipped EFL speaking instruction are contingent upon learners' FD/FI profiles.

Considering the divergent needs and strengths of FD and FI learners, overlooking these variables risks limiting the efficacy and generalizability of FCM models. The novelty of this study, therefore, lies in its direct examination of this unexplored interaction. This research therefore seeks to examine the impact of FCM-based pre-class input exposure (PCIE)—delivered without explicit linguistic instruction—on speaking proficiency, with specific attention to whether and how FD/FI differences mediate its effectiveness. To achieve this objective, the present study investigates the following research question:

- To what extent, and in what ways, do FD and FI cognitive styles influence the effectiveness of PCIE in a flipped classroom model for improving Iranian EFL learners' speaking proficiency?

4. Methodology

4.1. Research design

The present study employed a quasi-experimental mixed-methods design, giving equal weight to quantitative and qualitative strands. The quantitative data were collected through pre- and post-test speaking assessments, while the qualitative insights from journals, interviews, observations, and raters' evaluative notes examined FD and FI learners' lived experiences, engagement patterns, and attributions regarding PCIE in FCM. Integrating experimental and qualitative case investigations provided a nuanced understanding of how FD/FI cognitive styles influenced both the extent and nature of speaking performance gains.

4.2 Participants

The participants were intermediate-level EFL students (57 males, 23 females, aged 21–25; L1 Persian) enrolled in an English communication course at an engineering university in Iran. They were assigned to four groups (n = 20 per group) according to their cognitive style and the employed instructional method: Flipped–FD (experimental), Flipped–FI (experimental), Non-flipped FD (control), and Non-flipped FI (control).

4.3 Ethical considerations

Institutional approval was granted by the university's Education and Research Committee, and informed consent was obtained from the participants. Anonymity and confidentiality were rigorously preserved throughout the study.

4.4. Instruments

4.4.1 Placement test

The Oxford Placement Test 2 (Allan, 2004) was administered prior to the experiment to verify the participants' English proficiency and ensure group homogeneity, yielding a Cronbach's alpha reliability coefficient of .89.

4.4.2 Speaking performance test

Pre/post measures employed a multi-task, rubric-based speaking assessment (monologue, dialogue, and picture description) scored on fluency, accuracy, lexical range, and coherence, using an analytic scoring rubric adapted from IELTS (Cronbach's $\alpha > 0.85$).

4.4.3 Group Embedded Figures Test

The participants' FD and FI cognitive styles were identified using the Group Embedded Figures Test (GEFT; Witkin et al., 1971). The instrument, a paper-and-pencil measure of the ability to detect simple shapes embedded within complex geometric figures, has a reported reliability of 0.82 and its reliability in the present study was 0.81. Each correctly identified simple form was awarded one point, producing a possible score range of 0–18. Classification into FD or FI groups followed Scardamalia's (1977) criterion: FD when scoring less than one-quarter of a standard deviation below the sample mean, and FI when exceeding one-quarter of a standard deviation above the mean.

4.4.4 Reflective journals

This method was employed to gain insight into the behaviors and cognitive processes of the FD and FI learners during both pre-class and in-class stages. The participants documented their thoughts and actions while engaging with pre-class materials and participating in in-class tasks, and, in order to obtain sufficient data for saturation, the teacher-researcher required all the participants to keep a journal.

4.4.5 Interviews

Semi-structured Persian-language interviews with the FD and FI participants addressed gaps or ambiguities in their journals and explored their recall and retrieval of linguistic items from the pre-class materials during the in-class and post-intervention stages, eliciting perceptions, strategies, and posttest reflections. The data were independently coded and thematically analyzed by the researcher and a second expert using Krueger's (2014) framework, with discrepancies resolved through discussion. The instrument content and face validity were confirmed via expert panel feedback and subsequent revisions.

4.4.6 Classroom observations

Serving as both teacher and researcher, the instructor recorded unstructured observations of interactional patterns, engagement, language use, and behavior, providing qualitative evidence that informed the FD–FI comparisons, deepened understanding of their in-class speaking performance after pre-class input exposure, and supported posttest interpretation alongside other qualitative measures.

4.4.7 Raters' evaluative notes

The posttest evaluative notes by speaking test raters captured the FD and FI learners' fluency and coherence, pronunciation, and grammatical-lexical accuracy. These narrative comments highlighted their individual strengths and challenges, enabling a deeper examination of the FD–FI differences in the post-intervention speaking performance.

All the instruments underwent content and face validity evaluation by an expert panel.

4.5 Research procedure

The intervention comprised 38 sessions of 105 minutes each, held thrice weekly. An introductory orientation familiarized the participants with the course framework, the nature of speaking tasks, and the IELTS-aligned assessment rubric. A pretest was administered to establish baseline speaking proficiency and to enable subsequent evaluation of the instructional impact. All groups were taught by the same instructor using uniform materials to ensure instructional consistency.

In the experimental conditions—the FD and FI groups receiving PCIE—an additional orientation addressed strategies for managing out-of-class learning demands, mitigating potential declines in motivation noted in prior research (Lan, 2024). The instructor demonstrated practical routines for integrating video- and audio-based English input into daily activities, thus promoting consistent exposure. The pre-class engagement consisted of thematically relevant, authentic audiovisual materials (e.g., interviews, dialogues, short talks) presented alongside transcripts and teacher-generated resources hosted on an online platform. These materials were purposefully designed to immerse learners in contextualized language use without explicit linguistically-focused instruction, thereby encouraging meaning-focused preparation and natural language uptake prior to class. The students reviewed the resources in advance, developed collaborative dialogues inspired by the content, rehearsed them in pairs, and

submitted the recordings two days before the relevant session. To promote consistent preparatory work, participants were also notified that weekly comprehension quizzes would be administered on the pre-class material, aligning with evidence supporting sustained pre-class engagement in flipped learning (Chen Hsieh et al., 2017). Given evidence highlighting the pedagogical value of teacher presence in the pre-class stage (Gondra & Aguiló-Mora, 2024), the instructor offered online office hours to sustain such support.

During class sessions, the teacher addressed content-related queries, reviewed submitted role plays using IELTS criteria, and facilitated both teacher- and peer-provided feedback. The instruction then prioritized communicative output through debates, collaborative problem-solving tasks, topic-based discussions, short monologues, simulated IELTS interviews, and situational role-plays. The activities were informed by social constructivist principles, leveraging peer interaction and scaffolding. The learners engaged in whole-class and small-group discussions that extended ideas from the pre-class input. The teacher provided targeted feedback on grammar, vocabulary, fluency, coherence, and content development, and encouraged reciprocal peer support to consolidate learning.

In the control conditions (Non-Flipped-FD and Non-Flipped-FI), the students received the same materials exclusively during the in-class periods, with no pre-class exposure or asynchronous input. Lessons followed a communicative approach in which the teacher presented content, scaffolded comprehension, and facilitated collaborative activities identical to those in the flipped groups. Feedback was provided regularly, and, as in the experimental groups, peer feedback was encouraged.

Each instructional week concluded with a task card assignment prompting individual presentations in the subsequent session. Upon completion of the intervention, all participants undertook a posttest employing the same speaking assessment protocol as in the pretest. Subsequently, semi-structured interviews were conducted with members of the FD and FI experimental groups and continued until data saturation was reached.

5. Results and discussion

5.1 Quantitative results

Preliminary assumption checks confirmed suitability for parametric analysis: Shapiro–Wilk tests indicated normally distributed residuals ($ps \geq .159$) supported by inspection of Q–Q plots, Levene's tests found homogeneity of variances for the pretest ($F(3, 76) = 0.54$, $p = .658$) and posttest ($F(3, 76) = 1.21$, $p = .314$), and sphericity was met (Mauchly's $W = 1.00$). A 2 × 4 mixed-design ANOVA with *Time* (pretest, posttest) and *Group* (Flipped–FD, Flipped–FI, Non-flipped–FD, Non-flipped–FI) yielded a significant main effect of Time, $F(1, 76) = 668.56$, $p < .001$, partial $\eta^2 = .898$, indicating substantial improvement across all groups. Crucially, the Time × Group interaction was significant, $F(3, 76) = 44.66$, $p < .001$, partial $\eta^2 = .638$, indicating that the magnitude of improvement differed among groups (see Table 1).

Table 1
Omnibus Mixed-Design ANOVA

Effect	F(df1, df2)	*p*	Partial η^2	Interpretation
Time	668.56 (1, 76)	< .001	.898	Large
Time × Group	44.66 (3, 76)	< .001	.638	Large

Given the significant interaction, follow-up analyses were conducted (see Table 2). One-way ANOVAs confirmed equivalent baseline performance ($p = .714$), but significant posttest differences ($F(3, 76) = 6.33$, $p = .001$). Tukey HSD, as shown in Table 3, revealed the Flipped–FI significantly outperformed the Flipped–FD ($p = .008$), Non-flipped–FD ($p = .001$), and Non-flipped–FI ($p = .005$). No other contrasts were significant ($ps \geq .957$).

Table 2
One-Way ANOVA for the Pretest and Posttest

Dependent Variable	F(df1, df2)	*p*	Partial η^2	Interpretation
Pretest	0.46 (3, 76)	.714	.018	Negligible
Posttest	6.33 (3, 76)	.001	.200	Large

Table 3
Descriptive statistics and Tukey post hoc comparisons (n = 20 per group)

Time	Group	Mean	SD	Post hoc
Pretest	Flipped–FD	4.89	.21	Flipped–FD=Flipped–FI=Non-flipped–FD= Non-flipped–FI
	Flipped–FI	4.86	.27	
	Non-flipped–FD	4.92	.22	
	Non-flipped–FI	4.95	.29	
Posttest	Flipped–FD	5.24	.24	Flipped–FI > Flipped–FD= Non-flipped–FD= Non-flipped–FI
	Flipped–FI	5.57	.33	
	Non-flipped–FD	5.19	.28	
	Non-flipped–FI	5.23	.37	

The FI–Flipped group achieved the greatest gains in speaking proficiency, whereas the Flipped–FDs improved only marginally, with outcomes similar to their non-flipped peers. The forthcoming qualitative strand will explore cognitive, affective, and behavioral factors to explain these differential effects.

5.2. Qualitative findings

The qualitative analyses, integrating the classroom observations, interviews, learner journals, and rater evaluations, clarified the cognitive mechanisms shaping the observed statistical patterns. The findings indicated that FD/FI orientations significantly influenced the learners' outcomes, countering Meguro's (2020) claim of their irrelevance to L2 learning. The FIs and FDs processed pre-class materials, approached the linguistic input, and applied it in speaking tasks differently, aligning with cognitive style theory. Consistent with Davis and Cochran (1989), Mahvelati (2020), Shao et al. (2024), and Tinajero and Páramo (1997), these variations emerged across three sequential processing stages—attentional orientation, depth of working-memory encoding, and retrieval efficiency—impacting the classroom engagement, linguistic accuracy, and posttest retention.

5.2.1 Sensory processing: attentional orientations

The FI learners exhibited analytic attentional style: They attended to both global meaning and micro-level linguistic features—lexical items, grammatical structures, and pronunciation cues—beyond the explicit task requirements. Their attentional orientation was shaped less by the teacher-defined goals and more by self-imposed objectives, consistent with earlier findings on FI learners' autonomy and analytical style (Farangiet al., 2025; Heidari, 2022; Guisande et al., 2007; Rajagopalan et al., 2015; Rassaei & Ravand, 2024; Yousefi, 2011; Zhou et al., 2015). Hence, they often engaged in self-directed detail-oriented noticing, pattern extraction, and pronunciation refinement, transforming content-driven materials into opportunities for analytical form noticing. The pre-class role-play preparation appeared to further enhance their attention to linguistic details, prompting them to revisit the overlooked forms for accurate and fluent dialogue performance. As one FI student reflected:

> *When my partner and I were putting our dialogue together, we focused on the words connected to the topic, how the sentences were put together, and saying everything the right way. We had to keep an eye on all of that to make our dialogue work.*

By contrast, the FDs exhibited a predominantly global attentional orientation, prioritizing overall meaning over linguistic detail unless the latter directly impeded comprehension. In the absence of explicit prompts to attend to linguistic features, they defaulted to content scanning during the input processing. Performance monitoring during pre- and in-class production indicated that they frequently replaced target items with alternative phrasing, drew on prior knowledge, or used L1 translation—behaviors that limited integration of the new structures and confirmed their minimal engagement with the embedded linguistic forms. While the pre-class role plays facilitated

noticing of the linguistic items among the FIs, they exerted minimal influence on the FDs because the use of these items was not explicitly required. This strong reliance on the external standards and reinforcement appeared central to their reduced engagement with the linguistic details, directing attention toward fulfilling the perceived task demands rather than pursuing autonomous form–meaning analysis. Consequently, much of the form-rich pre-class input remained unnoticed. As one FD participant explained:

> *Our teacher told us to review the videos and materials to prepare a class dialogue. Since a comprehension test was coming, I focused on the main ideas and difficult words or structures that affected my understanding*.

These results align with the established portrayals of FDs as holistic processors responsive to externally imposed expectations and limited in spontaneous restructuring of input (Jonassen & Grabowski, 2012; Mehdipour-Kolour & Ali, 2024; Rassaei & Ravand, 2024), confirming that instructional designs demanding autonomous extraction of detailed linguistic information pose persistent challenges for this learner profile (Mahvelati, 2020; Tinajero et al., 2012). Overall, the FD–FI disparity underscores how cognitive style, motivation, and task design jointly shape sensory-stage attentional allocation.

5.2.2 Working memory: depth of encoding and linguistic restructuring

Once the linguistic elements were noticed in the pre-class phase, the two groups diverged in how these elements were organized and stored. The FI learners' encoding was characterized by semantic processing coupled with linguistic restructuring: they linked the new lexical, grammatical, and phonological patterns to prior L2 knowledge, made cross-linguistic contrasts, built semantic–syntactic–phonological bundles, and integrated lexis, grammar, and phonology into organized mental schemas. In contrast, the FD learners' encoding lacked such restructuring; it was predominantly semantic, without detailed lexical, grammatical, or phonological encoding, as comprehension of the main ideas sufficed to meet the externally defined learning goal. The same pattern emerged when the teacher drew the learners' attention to their linguistic errors by providing corrective feedback during the in-class phase.

The FIs' deeper elaboration facilitated meaningful encoding and organization in working memory, consistent with prior findings on their cognitive restructuring advantage (e.g., Heidari, 2022; Mahvelati, 2020; Rassaei & Ravand, 2024; Shao et al., 2024). Moreover, the quantitative evidence of FIs' superiority aligns with semantic-network models, which predict greater retention when information is integrated through elaborated connections.

5.2.3 In-class behavior: proceduralization and engagement

The classroom observation data revealed a consistent performance gap between the FI and FD learners. Entering class with both conceptual and linguistic preparation, the FIs produced longer and more accurate discourse, used the course-introduced lexical and grammatical structures more extensively, maintained greater consistency in accurate pronunciation, engaged more actively in peer correction, exhibited lower anxiety and participated more willingly and confidently in the speaking tasks with minimal teacher prompting. Their deeper pre-class form processing lowered the real-time cognitive load (Sweller, 2011), enabling more spontaneous interaction and maximizing in-class communicative practice. This preparedness also created greater opportunities for proceduralizing the pre-class-acquired knowledge, aligning with the flipped model's intent to reserve class time for higher-order communicative tasks (Bloom, 1964).

In contrast, the FDs, while conceptually familiar with the lesson topics, arrived with unresolved language gaps due to their pre-class preparation approach, which prioritized content comprehension over form mastery. Their participation was cautious, feedback roles were avoided due to uncertainty regarding their linguistic accuracy, and reliance on teacher scaffolding was high. Notably, the classroom observations revealed that the FDs displayed greater anxiety and lower confidence than their FI counterparts during the speaking tasks, and the interview data indicated that this heightened anxiety was attributed to their inadequate linguistic preparation. As one FD participant remarked,

I became stressed out when I was not able to convey my opinions in English.

The teacher's notes documented recurring L1-influenced errors, shallow uptake of the course-introduced forms, and lower overall accuracy—patterns consistent with Cognitive Load Theory, whereby inadequate pre-class encoding elevates working-memory demands during production. Consequently, in-class time was often absorbed by remedial form correction and explanation, reducing opportunities for extended interaction and thereby slowing—or even preventing—the transition from declarative to procedural skill. As a result, the FD group's speaking practice time was substantially lower than that of the FIs.

For the FIs, the flipped sequence successfully fulfilled its design principle: shifting lower-level skills out of class freed lesson time for authentic practice. For the FDs, however, the same sequence resembled traditional instruction in practice, as much class time reverted to teacher-fronted didactic explanation and corrective intervention. These findings indicate that the communicative potential of FCM is contingent on pre-class linguistic readiness. Without securing this, especially for learners whose cognitive style limits independent form processing, the inversion of instruction does not yield greater interactional gains. Thus, aligning pre-class input strategies with cognitive style emerges as a pedagogical necessity—one that ensures flipped learning environments truly reallocate class time toward proceduralization, interaction, and the automatization of linguistic resources.

5.2.4. Memory retrieval: rapid access and accurate output

The raters' posttest evaluations and learners' interview data converged in confirming greater retrieval efficiency among the FIs. While not all forms were retained perfectly, the raters noted that the FIs accessed the lexical, grammatical, and phonological forms introduced during the intervention more rapidly and accurately, yielding greater fluency, coherence, and reduced L1 interference. Their higher posttest scores were attributed to deeper pre-class input processing and encoding of the target forms which were reinforced through repeated and contextualized in-class activation via role plays, peer feedback, and spontaneous discussion. These patterns reflect the selective-attention advantage documented by Davis and Cochran (1982), Heidari (2022), Jia et al. (2014), Rassaei & Ravand (2024) and Shao et al. (2024), and align with the Levels-of-Processing framework (Craik & Lockhart, 1972), which links durable recall to initial processing depth.

By contrast, the FDs exhibited frequent retrieval failures, vague form recall, and heavy reliance on L1 translation, introducing persistent syntactic errors, awkward collocations, and pronunciation lapses. Under communicative pressure, shallow initial encoding hindered form retrieval, prompting default use of direct Persian-to-English translation. This slowed production and produced Persian-like syntactic structures and lexical choices, diminishing naturalness and coherence. Consistent with Lang's (1995) contention that less efficient selective attention impedes working-memory encoding, the FDs' partial and often inaccurate adoption of linguistic items failed to yield marked accuracy gains compared to their non-flipped counterparts.

The interview findings illuminated the cognitive style–specific memory processes. The FIs reported that consistent pre-class engagement and repeated in-class application, reinforced by the in-class corrective feedback, promoted organized storage and retrieval of the target forms. The FDs, conversely, struggled to recall the intervention items, attributing this to the limited in-class practice and insufficient explicit, form-focused pre-class input. These self-reports aligned with the raters' observations of greater L1 interference and less fluent delivery in the FDs' posttest performance. While both groups experienced some Persian–English transfer, its frequency and negative effect were notably higher among the FDs, whose translation reliance hindered accuracy and fluency. The FIs, employing translation selectively, integrated forms more flexibly and achieved clearer, more accurate, and fluent discourse.

5.3 Integrated discussion

The quantitative findings revealed that PCIE improved only the FIs' speaking proficiency, whereas the FDs' gains did not significantly differ from those of their non-flipped peers. The qualitative analyses attributed this divergence to cognitive-style–driven processing patterns. The FI participants engaged analytically with the

pre-class materials, integrating global message comprehension with detailed linguistic analysis, extending beyond the task requirements. In line with prior research (Heidari, 2022; Guisande et al., 2007; Rajagopalan et al., 2015; Rassaei & Ravand, 2024; Shao et al., 2024;Yousefi, 2011), they set self-imposed goals, undertook autonomous noticing, and actively re-examined the lexical, grammatical, and phonological aspects, transforming the content-focused tasks into form-learning opportunities. Conversely, the FDs processed the input holistically, addressed form only when meaning was unclear, and relied predominantly on the teacher's guidance (Chen & Macredie, 2002; Farangi et al., 2025; Jonassen & Grabowski, 2012; Mahvelati, 2020), resulting in limited engagement with the embedded linguistic features.

These initial sensory-stage attentional differences influenced the depth of working-memory encoding. The FIs integrated the new lexical, grammatical, and phonological patterns with their existing L2 knowledge through L1–L2 comparisons, forming semantic–syntactic–phonological units and consolidating structured mental representations. As documented in prior cognitive-style research (Guisande et al., 2007; Mahvelati, 2020; Spiro & Tirre, 1980), this restructuring yielded stronger retention and more accurate application. The FDs, in contrast, relied on largely semantic encoding, neglecting the linguistic integration. Meeting externally defined comprehension goals left their declarative base underdeveloped. SAT (DeKeyser, 2015) predicts that such limited declarative knowledge constrains proceduralization, a pattern borne out in the classroom data.

The in-class performance further amplified these disparities. The FIs' linguistic preparedness reduced the cognitive load (Sweller, 2011), enabling accurate, spontaneous participation, frequent peer feedback, and sustained interaction. Their confidence, built through the systematic pre-class preparation and role-play rehearsal, fostered effective peer correction and collaborative support, which, in alignment with Sato's (2017) dual model (see Mahvelati, 2021 for detailed discussion), positively affected their speaking performance. Repeated, contextualized use of the target forms in the role plays, discussions, and feedback exchanges facilitated distributed, scaffolded practice, expediting proceduralization and automatization. Conversely, the FD group, despite conceptual familiarity, exhibited unresolved linguistic gaps, uncertainty, infrequent peer feedback, reliance on teacher correction, and persistent L1-driven errors. These behaviors curtailed opportunities for higher-order communicative activities, reducing the efficiency advantage the flipped model aims to deliver.

The posttest retrieval performance reflected the cumulative effect of the earlier stages. The FIs recalled the lexical, syntactic, and phonological patterns more quickly and accurately, with reduced Persian interference, owing to the repeated pre- and in-class activation consistent with the distributed practice principle of spaced repetition (Ebbinghaus, 1913). The FDs' shallow initial encoding hindered access, producing frequent retrieval failures and heavy reliance on Persian–English translation, which slowed speech and introduced unnatural collocations and syntax. This heavy L1 transfer underscores that retrieval efficiency depends critically on earlier attentional engagement and memory restructuring, and that deficits at these stages cannot be compensated for by in-class exposure alone.

Theoretically, the findings regarding the efficacy of mere pre-class input exposure align with input-based acquisition models—such as the Input Hypothesis (Krashen, 1985), Usage-Based Learning (Tomasello, 2003), and Connectionist frameworks (Rumelhart & McClelland, 1986)—only for learners whose cognitive style affords autonomous, analytic processing. In the FI group, the input processed through self-regulated, detail-oriented engagement fostered subconscious form–meaning mapping, pattern detection, and emergent linguistic competence, a trajectory also interpretable through Complexity Theory perspectives (Larsen-Freeman, 1997) emphasizing iterative adaptation. From a SAT perspective (DeKeyser, 2015), their engagement across pre- and in-class contexts enabled repeated, scaffolded practice that deepened encoding, supported proceduralization, and, through distributed exposure, fostered automaticity in accordance with memory consolidation principles (Ebbinghaus, 1913).

Conversely, The FD group's performance undermines the assumed universality of input-based models in EFL contexts with limited authentic L2 exposure. Under implicit, form-unmarked input conditiond, their holistic,

externally oriented processing hindered noticing and encoding, supporting the SAT's view that proceduralization stagnates without early declarative scaffolding. This challenges claims in the FCM literature that pre-class input alone suffices for all learner types (Amiryousefi, 2019; Santhanasamy & Yunus, 2022; Sheerah & Yadav, 2022). Unlike the FIs—whose gains aligned with prior findings (Demir & Mirzaie, 2023; Hashemifardnia et al., 2021; Pratiwi et al., 2022)— the FDs' outcomes resembled the non-flipped controls, corroborating Yeşilçınar's (2019) findings that explicit pre-class linguistic scaffolding is essential. Consistent with research rejecting input-only sufficiency (Chen & Hwang, 2020; Lee & Wallace, 2018), cognitively activating, explicit awareness-raising tasks before class, coupled with structured in-class production, are crucial for realizing Bloom's (1964) intended sequencing of foundational knowledge mastery before higher-order application. Moreover, across cognitive styles, minimizing negative L1 transfer demands repeated integration of target structures into speaking practice.

The mediating role of L1 interference and affective readiness further clarifies these disparities. Insufficient form internalization among the FDs increased negative transfer and anxiety, reducing fluency and accuracy, whereas better-prepared FIs experienced reduced anxiety and enhanced collaborative engagement, aligning with sociocultural theory (Vygotsky, 1978). Collectively, these findings suggest tailoring flipped instruction to learners' cognitive styles in EFL contexts: : implicit, content-driven materials suit FI learners' strengths, whereas FD learners benefit from explicit, linguistically focused pre-class tasks—targeted vocabulary, pronunciation, grammar, guided noticing, and retrieval prompts—to build the declarative foundations necessary for effective in-class proceduralization. Without such adaptation, the pre-class stage cannot fulfil the flipped model's aim of maximizing communicative practice time, leaving FD learners' outcomes indistinguishable from those of traditional instruction.

6. Conclusion

This study explored how to optimize pre-class strategies within FCM for EFL speaking development, with a particular focus on FD/FI cognitive style differences in EFL contexts with limited communicative exposure. The findings revealed that the efficacy of implicit, content-rich pre-class input without explicit linguistic guidance depended on the learners' cognitive styles. The FIs leveraged their autonomy, analytic orientation, and detail-sensitivity to transform the implicit input into usable linguistic resources. By contrast, the FDs, whose processing favors global meaning, reliance on external guidance, and minimal self-initiated restructuring, gained conceptual familiarity from the same materials but failed to convert such exposure into robust declarative linguistic gains, resulting in weaker proceduralization and retrieval efficiency than their FI counterparts and yielding post-test outcomes comparable to those of the non-flipped cohorts. These cognitive-style distinctions shaped attentional allocation, depth of encoding, and retrieval efficiency, which in turn determined the pedagogical impact of the flipped model. The findings suggest that flipping without explicit, pre-class linguistic guidance risks amplifying inherent cognitive-style advantages, thereby benefiting certain learners disproportionately.

While these conclusions are supported by the converging evidence from the statistical gains and various qualitative sources, they remain bounded by contextual and methodological constraints. The study's Iranian undergraduate EFL sample limits generalizability to other age groups, proficiency levels, or ESL environments with richer ambient inputThe cognitive style classification relied on the GEFT, and the learning effects were examined only in speaking, leaving other learning styles, skills, and cross-skill interactions unexplored.The flipped design itself represented one specific instantiation of implicit PCIE, and alternative or hybrid models might shift the distribution of benefits across the cognitive styles. These limitations invite replication in varied contexts, multi-method style diagnostics, longitudinal follow-up to gauge the durability of gains, and expansion into integrated-skills assessment.

The practical implications are clear: in mixed-style EFL classrooms, achieving equitable learning outcomes requires significant differentiation at the pre-class stage. For practitioners (teachers and material developers), this challenges the one-size-fits-all application of FCM and calls for a move towards a cognitively differentiated model. This involves designing dual-track pre-class materials: offering FI learners the implicit, meaning-driven input they process effectively, while providing FD learners with the explicit, form-oriented scaffolding they need. This

scaffolding should include concrete tools such as guided tasks focusing explicitly and directly on targeted vocabulary, with pronunciation guides, guided grammar-noticing tasks, and retrieval practice prompts to build their declarative knowledge. In low-input EFL contexts such as Iran, where authentic L2 exposure beyond the classroom is scarce, this targeted support for FD learners is especially critical. By ensuring all learners arrive with sufficient linguistic readiness, teachers can dedicate in-class time to its intended purpose: higher-order communicative procedures rather than remedial instruction.

For learners, the implications are equally significant, as cultivating an awareness of their own cognitive style can directly alleviate affective obstacles to language learning. Educating learners about their own cognitive styles can demystify learning challenges and empower them to adopt personalized strategies. Most importantly, providing FD learners with the appropriate pre-class support directly addresses the heightened anxiety reported in this study, ensuring they enter the classroom feeling more confident and prepared. This, in turn, is crucial for fostering meaningful in-class engagement, boosting motivation, and optimizing retention in communicative activities for all students. Furthermore, these principles can inform educational technology, where adaptive learning systems could detect attentional patterns during pre-class engagement and dynamically adjust scaffolding in real time, aligning instructional input with each learner's processing style.

Finally, future research should test these cognitively differentiated designs across diverse linguistic and cultural contexts to refine theoretical frameworks and generate empirically grounded guidelines for cognitive-style-sensitive flipped instruction in EFL and beyond.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. No artificial intelligence (AI) tools were used.

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