

Exploring the Flow Experience of EFL Learners in Technology-Enhanced Self-Regulated Language Learning Using the Experience Sampling Method

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ABSTRACT

Flow, a subjective state of optimal engagement and immersion, is characterized by a balance of perceived challenges and skills, interest, attention, and a sense of control (Csikszentmihalyi, 1990). Investigating flow in language learning can provide valuable insights into effective learning processes and contexts (Egbert, 2003). Self-regulated learning is a proactive learning approach where learners establish learning objectives and actively regulate their cognition, motivation, and behavior (Pintrich, 2000; Zimmerman, 1990). This study explores the flow experience of English as a foreign language (EFL) learners in technology-enhanced self-regulated language learning (SRL) using the experience sampling method. Through event-contingent sampling, 26 EFL learners from a Chinese university documented their flow experiences over an eight-week period, reporting the duration, engagement, and subjective experiences each time after completing English learning activities outside the classroom. Results demonstrated the prevalence of flow in SRL activities despite a challenge–skill imbalance, with approximately half of the participants consistently experiencing flow. Furthermore, the state of flow induced more engagement in and commitment to self-regulated English learning. Intense flow was strongly associated with interest-driven reading and vocabulary learning via mobile applications and media, as well as with grammar drills. However, general variations of flow across time suggested that flow did not necessarily motivate participants to seek greater challenges and improve their skills. Individual variations of flow were explored, highlighting the complexity of flow, which was influenced by diverse individual factors.

Keywords: the flow experience, self-regulated learning, technology-enhanced self-regulated language learning, EFL learning, experience sampling method

INTRODUCTION

A positive psychology (PP) perspective in second language acquisition (SLA) helps understand the full picture of positive and negative experiences concerning language learning (Gabryś-Barker & Gałajda, 2016; MacIntyre et al., 2016; MacIntyre & Mercer, 2014). Research on language learning has increasingly focused on diverse learner experiences and individual strengths, such as emotions (e.g., Dewaele & Dewaele, 2017; Dewaele & MacIntyre, 2014; Li et al., 2018), grit (e.g., Teimouri et al., 2022; Pawlak et al., 2022), and growth mindset (e.g., Lou & Noels, 2019). Flow, another key concept in PP, has yet to receive extensive attention, particularly in the context of language learning beyond the classroom setting. Given the distinct sociolinguistic features in the English as a foreign language (EFL) context – where learners often face limited target language exposure, comprehensible input, and opportunities for output – self-regulated language learning (SRLL) outside the classroom provides additional language exposure and addresses various individual learning needs, thus enabling the appearance of flow in EFL learning.

The state of flow is characterized by “merging action and awareness” when the activity is within a person’s ability to perform, “entering of attention” during competitive endeavors, “loss of ego” where the self-construct diminishes, “control of action and environment” meaning adequate skills to meet the environmental demands, “demands for action and clear feedback,” and “autotelic” nature (Csikszentmihalyi, 2014a, pp. 138–145). Although this intrinsically rewarding experience may not occur frequently in everyday life, it can be achieved under certain conditions. Having a clear set of immediate goals, opportunities for intense concentration, confidence due to a perceived balance of challenge and skill, clear feedback that one is succeeding, and a sense of control are all conducive to flow. In this state, individuals not only lose self-consciousness but also experience a distorted perception of the passage of time (Csikszentmihalyi, 1990).

Flow has been documented in EFL classrooms in a variety of tasks and contexts, such as second language (L2) writing (Cho, 2018), speaking (Czimmermann & Piniel,

2016; Piniel & Ritecz, 2022), intercultural contact (Aubrey, 2017a, 2017b), and during emergency remote teaching in the COVID-19 pandemic (Dewaele et al., 2022). It has also been studied in relation to emotions (Dewaele & MacIntyre, 2022a; Piniel & Albert, 2019), motivation, and self-efficacy (Piniel & Albert, 2017). However, most of these studies focused on classroom-based language learning with teacher support. Flow experiences in EFL learning outside the classroom, where learners independently regulate their learning, remain underexplored.

Self-regulated learning (SRL) is an active, intentional process in which learners set specific goals for their learning and strategically regulate their cognition, motivation, and behavior in response to both their goals and the contextual demands of their environment (Pintrich, 2000). This self-regulatory process consists of three cyclical phases. The forethought phase involves task analysis, such as goal setting, and self-motivation, including self-efficacy beliefs. The performance phase demands self-control, such as attention focusing and strategies, and self-observation, including self-recording. The self-reflection phase focuses on self-judgment and self-reaction, when there is conscious awareness of feelings of satisfaction, adaptive or defensive responses (Zimmerman, 2000, 2002).

Table 1 reveals a profound alignment between the components of flow and the SRL process. For instance, the clear goals established in SRL constitute one of the flow conditions. Self-motivation, an essential factor in regulating the SRL process, concurrently enhances the likelihood of experiencing flow. This is further reinforced by a sense of control, amplifying learners’ attention and engagement. In addition, the enjoyment and satisfaction derived from the flow state contribute to the positive self-evaluation in SRL, thereby facilitating a virtuous cycle of language learning and development. In light of these perceived overlaps, this paper aims to investigate the flow experience in SRLL outside the classroom, with the goal of understanding learners’ subjective experiences and identifying factors that facilitate and hinder both flow and SRLL.

Table 1. *Main Components of the Flow Experience and Phases in Self-Regulated Learning*

Components of flow (Csikszentmihalyi et al., 2005; Egbert, 2003; Li et al., 2021)	Self-regulated learning (Zimmerman, 2002)	
Flow antecedents		Forethought phase
Challenge–skill balance	Self-motivation	Task analysis
Clear goals	Self-efficacy	Goal setting
Immediate feedback	Outcome expectations	Strategic planning
	Intrinsic interest/value	
Flow state		Performance phase
Intense focus	Self-observation	Self-control
A sense of control	Self-recording	Imagery
Lack of self-consciousness	Self-experimentation	Self-instruct
		Attention focusing
		Task strategies
Flow outcomes		Self-reflection phase
Enjoyment	Self-reaction	Self-judgment
Distortion of time passing	Self-satisfaction/affect	Self-evaluation
	Adaptive/defensive	

LITERATURE REVIEW

Technology-Enhanced Self-Regulated Language Learning

Given the importance of learner autonomy and motivational control, Dörnyei (2005) proposed that SRL enables learners to take responsibility for their own progress. Oxford (2016) integrated SRL in her strategic self-regulation model, emphasizing the regulation of cognitive, motivational, social, and affective learning strategies. Studies on SRL have been closely linked with language learning strategies. Zhang and Zou's (2022) review on strategies and teacher support in SRL concluded that the application of SRL strategies proves effective not only in improving academic language skills, but also in boosting affective states, including self-efficacy and motivation (e.g., Csizér & Tankó, 2015). Emotions play a significant role in the self-regulation process. Positive emotions, such as enjoyment, enhance motivation and engagement, while negative

emotions, such as anxiety and frustration, hinder learning by reducing attention and effort (Boekaerts, 2011).

The self-regulatory process has been shown to increase both motivation and academic achievement (Lam, 2015; Schunk & Zimmerman, 1998). For instance, in six months of self-regulated extensive listening, high achievers demonstrated greater involvement, more substantial L2 listening development, and enhanced metacognitive skills (Zeng & Goh, 2018). Similarly, language portfolios used as self-regulation interventions resulted in higher goal orientation, task value, academic self-efficacy, and self-regulatory efficacy, as well as better instructor evaluations (Ziegler, 2014), along with increased intrinsic motivation and more accurate self-assessment (Ziegler & Moeller, 2012). Furthermore, the use of SRL strategies was positively associated with greater self-efficacy in English writing (Bai & Guo, 2018; Bai et al., 2020). Su and colleagues (2019) also confirmed the positive relationship between students' online self-regulation and their learning attitudes in a wiki-based learning environment. Their

analysis revealed that among the three cyclical phases, goal setting significantly predicted the perceived usefulness and self-efficacy, while self-evaluation predicted learners' affective states and behaviors during task completion.

In contexts beyond the classroom, learners leverage different resources, like technologies, travel, cultural exchanges, and real-life interactions to develop their proficiency (Benson, 2011). In recent years, emerging technologies, such as mobile applications and streaming services have blurred the boundaries between classroom instruction and out-of-classroom learning. Yang and colleagues (2023) revealed that technological integrations positively influence language learning outcomes, affective experiences, and the development of SRL skills. Technologies used in vocabulary learning (e.g., Chen et al., 2019; Lei, 2018), writing practice (e.g., Karami et al., 2019; Lin et al., 2022), speaking (Ahn & Lee, 2016), and integrated language classrooms (Shyr & Chen, 2018), have been found to facilitate learning outcomes. For instance, mobile-assisted language learning empowered Japanese and Hong Kong foreign language learners to engage in SRL, boosting time spent on learning tasks, levels of satisfaction, and self-measured achievement (Kondo et al., 2012; Lai & Gu, 2011). Innovative technologies, such as a mobile learning system incorporating speech recognition technology (Ahn & Lee, 2016), a digital reading annotation system (Chen et al., 2014), an English vocabulary learning application with SRL mechanism (Chen et al., 2019), and an AR (augmented reality) context-aware ubiquitous writing application (Lin et al., 2022) have been utilized to cultivate learners' positive attitude and willingness to communicate, with the research showing significantly higher learning performance and motivation. In addition to applications, widespread multimedia language learning resources, such as podcasts (Naseri & Motallebzadeh, 2016) and YouTube videos (Wang & Chen, 2020), offer easily accessible digital materials that are more interesting and interactive.

In summary, the literature documents a range of facilitating effects of technology-enhanced SRL on developing learners' language proficiency, learning attitudes, self-efficacy, and motivation. Nevertheless, there remains a scarcity of studies investigating flow, the optimal state, in the self-regulatory process and its impact on SRL.

Flow in Language Learning

Flow is defined as “a subjective state that people report when they are completely involved in something to the point of forgetting time, fatigue, and everything else but the activity itself” (Csikszentmihalyi et al., 2005, p. 600). In language learning, experiencing flow enhances both motivation and learning effectiveness, fostering perseverance in educational pursuits (Abbott, 2000). Egbert (2003) published the first study of flow in SLA. She examined flow experiences of learners in the Spanish classroom and found support for the existence of flow in foreign language classrooms. Egbert proposed a model linking flow to language acquisition, suggesting that flow is more likely to occur when certain conditions are met: (1) learners perceive the target language tasks as interesting and appropriately challenging relative to their language skills; (2) they have clear goals and sufficient time for completion; (3) they receive immediate feedback; and (4) they maintain control with minimal interruptions. Flow experiences are posited to enhance language performance through increased repetition, motivation, satisfaction, time dedicated to learning, and a greater willingness to take risks. The challenge–skill balance is perceived as one of the prerequisites of flow. Imbalances, with skills significantly surpassing challenges, may lead to boredom, while the converse, when skills fall short of challenges, may induce anxiety (Csikszentmihalyi, 2014b; Whalen, 1997).

Flow has been examined in various language learning tasks, with speaking and writing the most studied. Czimmermann and Piniel (2016) explored general flow and task-specific flow in an EFL class where participants were required to finish a writing and speaking task by creating a story with picture prompts and sharing the story with other learners. They found that uninteresting or overly challenging tasks were likely to impede flow, resulting in anti-flow experiences, such as boredom and anxiety. Conversely, in a study by Aubrey (2017a), task-based interactions involving inter-cultural contact had a significant positive effect on flow, and participants used more turns in interaction. Additionally, flow was found to be linked to attention, enjoyment, control, a perceived balance of challenge and skill, and a sense of achievement (Aubrey, 2017b). Cho (2018) employed a repeated measures design to explore the effects of task complexity and modality on learners' perception of task difficulty, skill, and their balance, as well as their flow experiences. Both

task complexity and modality were found to have influenced flow, with writing being more conducive to inducing flow compared to speaking. Similarly, Zuniga and Payant (2021) also demonstrated that collaborative oral and writing tasks enhanced flow, particularly through interaction, with task repetition further contributing to increased flow by boosting learners' interest. Alsayed-Ahmad and Albert (2022) found that learners experienced flow during writing tasks, with specific task features, including topic, genre, length, instructions, and time limits, affecting the flow experience. Using an experience sampling method, Zuniga (2023) examined flow experiences in a wide range of tasks at random moments throughout a semester, revealing that certain task characteristics, including novelty, dyadic participant structure, gamification, interactive nature, and communication technologies significantly promoted flow, while other features, such as task duration and modality had less influence. Additionally, Ghanbaran and colleagues (2023) found that computer-mediated communication enabling synchronous audio or face-to-face interaction generated more flow compared to text-based synchronous communication.

Beyond writing and speaking tasks, Amini and colleagues (2016) reported that learners experienced flow in vocabulary learning tasks and that the level of flow significantly correlated with short-term and long-term vocabulary retention. Reading, identified as one of the passive attending activities, has been reported to produce flow experiences (Csikszentmihalyi, 2014b). Similarly, EFL reading can also generate such flow experiences. When allowed to find books with appropriate perceived difficulty that provided pleasure in reading, learners were motivated to become engaged in the activity, thus generating flow (Arai, 2022). Based on weekly diaries and interviews, Bodea and Trofimovich (2023) identified 15 flow states reported by participants, including taking an exam and studying grammatical forms.

Flow has been explored not only in individual experiences, but also in a shared context. For instance, Ibrahim and Al-Hoorie (2019) found that when learners with a certain degree of autonomy worked collaboratively in a group where a group identity formed and personal values were attached, shared and sustained flow was likely to occur. Study contexts also play a role in flow. Wu and Albert (2024) found that Chinese EFL learners in Hungary

experienced more flow during writing tasks, whereas their peers in China reported more anti-flow. Apart from in-person EFL classroom learning, learners experienced flow during their emergency remote learning during COVID-19, though for a significantly shorter time, which was only linked to attitude toward the teacher (Dewaele et al., 2022). Moreover, learners of languages other than English reported a significantly higher proportion of class time in a flow state than EFL learners (Dewaele & MacIntyre, 2022b).

Language learners' flow experiences have been linked to other learner variables, such as self-efficacy and motivation. Piniel and Albert's (2017) structural equation model revealed that flow and motivation mutually reinforced each other, where a high level of motivation in language learning fostered the likelihood of flow and improved learners' self-efficacy. Similarly, Hong and colleagues (2017) used an online learning game to assist students in learning Chinese radicals, revealing positive correlations between students' learning progress, intrinsic motivation, online learning self-efficacy, and their flow experiences. Jia and colleagues (2024) further explored the fluctuations of flow and self-efficacy over time through weekly diaries, identifying an upward trend in flow and a steady level of self-efficacy, with self-efficacy consistently predicting flow over time.

Studies have also explored the flow experience with learner emotions, particularly foreign language enjoyment (FLE) and foreign language classroom anxiety (FLCA). Dewaele and MacIntyre (2022a) found that FLE was a significantly stronger predictor of the frequency of flow experiences than FLCA, with the frequency, intensity, and duration of flow increasing as learners advanced in their foreign language proficiency. Importantly, the flow state helped learners tolerate a certain level and variations of anxiety, given that enjoyment was the dominant emotion. Albert (2022) also revealed that those in the flow state were likely to experience more positive emotions, such as enjoyment and curiosity, and lower levels of negative emotions, including anger and boredom. In addition, foreign language boredom (FLB) has been found to be a significant negative predictor of flow, while FLCA has no significant negative effect on flow (Dewaele et al., 2023). Similarly, Lu (2024) explored the relationships among FLE, foreign language anxiety (FLA), willingness to communicate (WTC) and flow, reporting that FLE significantly predicted flow and WTC, and that WTC positively contributed to flow, while FLA had limited negative effects on flow.

Researchers have also investigated flow from a broader perspective, focusing on its antecedents, experiences, and outcomes. Li and colleagues (2021) studied the flow experiences of 219 Chinese EFL learners using a game-based vocabulary learning application, proposing that flow antecedents included both learner and contextual factors, such as the challenge–skill balance, clear goals, feedback, and game playability. The flow experience itself involved concentration, intrinsic motivation, and enjoyment, leading to outcomes, such as perceived learning and satisfaction. Their research highlighted the positive effects of challenge–skill balance, clear goals, and playability on concentration, while feedback significantly enhanced intrinsic motivation. Perceived learning was positively influenced by the enjoyment derived from the flow experience. Similarly, Liu and Song (2021) explored these three stages of flow in digital language learning through English dubbing. They reported significant differences in flow antecedents, including skills, challenges, and clear goals between the high performing group and the low performing group, while there were no significant differences in their flow experiences and their outcomes.

Experience Sampling Method

A variety of approaches have been employed to measure flow. Flow questionnaires, adopting a componential framework, assess multiple dimensions of flow (see Albert, 2021, for a review of questionnaires). They have been frequently used in flow research in language learning (Aubrey, 2017a; Cho, 2018; Cox & Montgomery, 2019; Czimmermann & Piniel, 2016; Dewaele et al., 2022; Hong et al., 2017; Li et al., 2021; Piniel & Albert, 2017). In addition to questionnaires, interviews (Abbott, 2000; Alsayed-Ahmad & Albert, 2022; Ibrahim & Al-Hoorie, 2019), along with open-ended surveys (Dewaele & MacIntyre, 2022a; Ibrahim & Al-Hoorie, 2019; Jacobs & Morgan, 2022) offer deeper insights of learners' flow experiences. Furthermore, mixed methods (Egbert, 2003; Liu & Song, 2021) and observations (Ibrahim & Al-Hoorie, 2019) have been used to collect comprehensive data on flow.

Another questionnaire-based method used to capture flow in everyday life is the experience sampling method (ESM), also known as ecological momentary assessment (EMA). This research method examines individuals' experiences and behaviors during their daily lives by

repeatedly measuring their feelings, thoughts, actions, contexts, and activities as they are happening (Larson & Csikszentmihalyi, 1983, 2014). Participants are asked to provide systematic self-reports at different occasions throughout a day or over several weeks. ESM proves particularly useful in capturing the experience in real life and in real time, affording an opportunity to examine intra-individual fluctuations and the connection of contexts and subjective experiences (Hektner et al., 2007).

Before data collection, an ESM protocol needs to be established, determining the study duration, assessment frequency, sampling scheme, questionnaire density, and devices to be used. The sampling scheme is a central feature of ESM, specifying three major ways to collect data. The first is interval-contingent sampling, also referred to as fixed sampling, where participants complete self-reports at regular intervals or at the same time every day. This structured approach allows researchers to assess experiences over time and emphasizes reflexivity. The second is signal-contingent sampling, or random sampling, where participants are signaled at random times to report experiences. This approach focuses on spontaneity, providing real-time engagement data. The third is event-contingent sampling, or event-focused sampling, where participants complete a self-report following a particular event (Hektner et al., 2007; Myin-Germeys & Kuppens, 2022). It is particularly useful to capture the effects of specific events or incidents (Hektner et al., 2007; Myin-Germeys & Kuppens, 2022). ESM proves especially beneficial for educational research by capturing experiences, affect, and actions in the moment with repeated measures, thus affording a better understanding of how educational contexts shape learning and its outcomes (Zirkel et al., 2015).

In applied linguistics research, a handful of empirical studies have employed ESM (Elahi Shirvan et al., 2020; Khajavy et al., 2021; Pawlak et al., 2016; Zuniga, 2023). Zuniga (2023) collected participants' experiences from a flow questionnaire based on Egbert (2003) and a task description questionnaire, aiming to capture learners' subjective experiences and to record task characteristics. The questionnaires were administered randomly after completing language learning tasks in class. Pawlak and colleagues (2016), using interval-contingent sampling, investigated the fluctuations of WTC during conversation classes where learners responded to requests to rate their

WTC every 5 min. Khajavy and colleagues (2021) employed signal-contingent sampling, exploring the dynamic relationship among WTC, FLA, FLE. In a third study, with a time-based sampling scheme of EMA, the dynamics of FLE were explored across different timescales: seconds, minutes, weeks, and months (Elahi Shirvan et al., 2020). Regarding ESM tools, Arndt (2023) developed and validated the *Informal Second Language Engagement Questionnaire*, and the Lang-Track-App to facilitate the implementation of ESM in second language acquisition research (Arndt et al., 2023).

In summary, the literature on flow in language learning highlights its occurrence across various tasks, particularly in writing and speaking, with factors, like task complexity, modality, and other task characteristics influencing flow experiences. Research has found that learners who engage in interactive tasks, as well as those who find a balance between challenge and skill, are more likely to experience flow, enhancing their motivation and learning outcomes. While flow has been extensively studied in classroom settings, few studies have focused on the flow experience outside the classroom. Moreover, there has been no prior research using the ESM to investigate flow in SRL. In this study, SRL is operationalized as technology (or media)-enhanced language learning outside classrooms, wherein learners regulate their English learning in setting language goals, engage in various learning activities (such as reading, listening, speaking, vocabulary, or grammar), use devices (such as personal computers, mobile applications), and make decisions on the timing and duration of their learning. Using the ESM, this study addresses the following three research questions:

- (1) What English learning activities do participants prefer during their self-regulated language learning?
- (2) What is the frequency and intensity of the flow state during English activities in self-regulated language learning?
- (3) How do different activity varieties contribute to the flow experience and the duration of engagement?
- (4) How does the flow state evolve over time in the process of self-regulated language learning, both generally and individually?

METHOD

Participants

The participants for the study were 26 students (19 females and 7 males) from an intact class enrolled in a preparatory English course at a Chinese university. This year-long required course was held twice weekly, with each session lasting 90 min and focusing on reading and grammar. The participants were chosen through convenience sampling for easy accessibility (Dörnyei, 2007) and better monitoring of their SRL. The mean age of the participants was 18.2 years ($SD = 1.76$). On average, they had been learning English for 6.5 years ($SD = 2.91$). All participants had learned English as a foreign language in formal classroom settings and followed a traditional grammar-based and test-oriented approach during their secondary education. Participants had taken the *Chinese College Entrance Exam*, scoring below-average to average (ranging from 55 to 118 out of 130, $M = 81.85$) in the English portion of this exam. As a result, they were considered as lower-intermediate to intermediate EFL learners.

Instruments

This study adopted event-contingent sampling in ESM, wherein participants reported their English learning activities, time spent on them, and their experiences of flow each time after engaging in English learning. The questionnaire was adapted from Cho (2018) and was condensed to meet the appropriate questionnaire density for ESM, considering the repeated nature of participant responses (Myin-Germeys & Kuppens, 2022). It aimed to explore four dimensions of learner experience: perceived task difficulty, perceived skill, the flow experience, and the outcome of flow. Components of flow, interest, attention, and control were measured following Egbert (2003). The outcomes of flow, including learners' enjoyment and satisfaction, were also accessed due to their significance in sustaining the experience and evaluating SRL (Dewaele & MacIntyre, 2022a; Zimmerman, 2002). Participants were requested to rate their agreement with the statements on a 7-point Likert scale, with 1 meaning *totally not agree* and 7 meaning *totally agree*. The questionnaire items were translated to Chinese, back-translated into English, and refined by the first author and her colleagues who are bilingual professionals in English education. Additionally,

items were piloted with other English learners before being administered to the participants. All items were presented to the participants in both Chinese and English. Table 2 displays the reliability coefficients for the scales in the questionnaire.

Table 2. *Reliability Coefficients and Number of Items for the Scales*

Scales	Cronbach's alpha	Number of items
Total	0.965	14
Difficulty and skill	0.908	3
Interest	0.896	3
Attention	0.918	3
Control	0.687	3
Enjoyment and satisfaction	0.788	2

Procedure

The data were collected concurrently with the progression of the English course, in which the requirement for out-of-class language learning was explicitly communicated to the students. First, a briefing session was conducted to explain and demonstrate SRLL, and the data collection method ESM, referred to as an “electronic diary.” Participants were informed that all the data generated would be used for scientific research and that they had the right to retract their data if they chose not to have it used. Digital resources, including language learning applications, websites, podcasts, and streaming accounts were provided.

Second, following the principles in SRLL, participants independently tested their general vocabulary size using vocabulary learning applications or websites from at least two different sources, and completed a listening test and a reading test. Based on the test results, they set their language learning goals. Then, participants negotiated their goals and learning plans with their instructor. They self-regulated their learning in freely selecting learning activities, determining the duration of engagement, the frequency of activities, and specifying the depth they hoped to learn. The English learning activities were coded into eight categories: reading, listening, speaking, writing, vocabulary, grammar,

test-related exercise, and media. Following each learning session, participants reported the categories, accompanied by a brief description of the activities undertaken. Participants could choose to do one category of activity or opt for multiple categories within one language learning session. For instance, a student might choose to engage in news reading one day, while dedicating another day to closely listening to a Technology, Entertainment, and Design (TED) talk and doing dictations. They might also prefer to watch an English movie, with the option to study the new vocabulary after watching it. In addition to the digital resources provided by the instructor, they were given the freedom to select any applications or streaming sources for learning English, as long as they specified them in their learning plan. Participants were required to engage in learning at least four times a week and complete the questionnaires, with the order of items being randomized each time to avoid response bias.

Finally, the researchers checked the data for compliance every week and provided feedback and guidance on the clarity of reports every two weeks. Students were encouraged to write down any reflections on and evaluations of their cognitive, affective, and motivational experiences. Their notes were also collected for further analysis.

Data Analysis

The data analyzed in this study were collected for the first eight weeks, comprising responses on each of the 56 days. A total of 1,062 records were collected, and after excluding data from two participants who failed to comply with at least 70% of the required reports, 1,041 language learning sessions were included for analysis. Each participant contributed to the data set in varying degrees. To assess the impact of the challenge–skill balance on the occurrence and intensity of flow, a balance score was calculated using the same equation as in Cho (2018): $\text{balance} = \text{perceived difficulty} + \text{skill} - (\text{difficulty} - \text{skill})$. This equation assumed that the optimal challenge–skill balance emerges when both perceived difficulty and skill are high, as opposed to states of boredom (when skill significantly exceeds challenge) or anxiety (when skill substantially lags behind difficulty, Csikszentmihalyi & Csikszentmihalyi, 1988). Both quantitative and qualitative data were collected. Quantitative data encompassed the measurements of

perceived difficulty and skill, flow components, and outcomes of flow, as well as frequencies and durations of English learning activities. Qualitative data consisted of the descriptions of activities, coded in categories, content, devices, and participants' notes on their subjective language learning experiences. First, descriptive statistics were calculated to understand the general flow levels in SRL. Next, inferential statistical analyses were conducted to discern the effects of varied activities, and challenge–skill balance on the flow experience. Finally, the variations in inter-individual and intra-individual flow over time were examined.

RESULTS

Learning Activities in Self-Regulated Language Learning

All English learning activities were categorized into eight groups, and data were processed using multiple response analysis. A total of 2,433 responses were collected and analyzed. Table 3 presents the distribution of responses across categories, along with the corresponding percentage of cases for each category. Vocabulary learning activities emerged as the most frequently chosen category, with 725 responses, accounting for 29.8% of the total responses. Following closely, media and reading categories had substantial representations respectively at 17.6% ($n = 427$) and 16.4% ($n = 400$) of cases. Grammar and listening also had notable percentages at 11.5% ($n = 280$) and 10.8% ($n = 262$), while speaking received 10.0% ($n = 243$) of responses. Writing and test were the least selected categories at 2.4% ($n = 58$) and 1.6% ($n = 38$) respectively.

Brief descriptions of activities reported by participants were coded based on content, sources, and devices employed. The most frequently chosen vocabulary learning activities predominantly occurred via diverse vocabulary learning applications, wherein learners selected embedded or self-created word books, set the daily quota of new words to be learned and scheduled word review sessions. Prominent vocabulary learning applications used by the participants included Baicizhan, Bubeidanci, Shanbeidanci, and Kuakebeidanci (see Appendix A for a list of applications). Language learning involving media, the second most frequently chosen category, was further divided into two subtypes: entertainment-focused and

learning-focused. Participants reported engaging in entertainment-focused activities, such as watching English animations, documentaries, dramas, movies, and English short videos, with or without subtitles, through platforms including Bilibili (a YouTube-like video-sharing platform), Douyin (TikTok), Xiaohongshu (a social media platform), TED talks, as well as listening to English songs, and playing video games. Conversely, learning-focused activities involved learning words, expression, and sentences through video clips.

Following vocabulary and media, reading encompassed a wide range of activities, including extensive reading by personal interest, such as short essays, stories, novels (e.g., *The Little Prince*, *Becoming Beauvoir*, *Harry Potter*), close reading of interesting passages or selected texts from their EFL textbook, news reading, reading with Bilibili Content Creators, and reading TED scripts. Similarly, listening activities mirrored the diversity seen in reading, incorporating extensive listening by interest, textbook listening, TED talks, listening tests, such as the College English Test (CET) Band 4 (a standardized English proficiency test in China for college students), listening to audio books, English songs, and subscriptions on Bilibili. These learning activities were predominantly facilitated through comprehensive language learning applications, such as Keke English, specialized reading or listening applications, such as Everyday English Listening, news applications such as China Daily, the streaming video platform Bilibili, WeChat public accounts, and various language learning websites.

Given participants' limited proficiency and the negligence of speaking skills in secondary education, speaking activities participants engaged in primarily involved reading-aloud textbook passages and passages of interest after listening or reading. Some participants opted for singing English songs, practicing pronunciation, reciting textbook passages, and engaging in dubbing activities using applications like Peiyinxiu and Qupeiyin. Writing activities included writing English diaries, copying and summarizing new words, expressions, well-written sentences and paragraphs, translating from Chinese to English, as well as composing reflective notes on their English learning experiences. Grammar and test-related learning focused on understanding, learning, reviewing, and practicing drills from the textbook and from real or mock tests in CET4.

Table 3. Results of Frequencies of Learning Activities in Multiple Responses Analysis

		Responses		% of cases
		N	%	
Learning activity ^a	Vocabulary	725	29.8%	69.6%
	Media	427	17.6%	41.0%
	Reading	400	16.4%	38.4%
	Grammar	280	11.5%	26.9%
	Listening	262	10.8%	25.2%
	Speaking	243	10.0%	23.3%
	Writing	58	2.4%	5.6%
	Test	38	1.6%	3.7%
Total		2,433	100.0%	233.7%

Note. ^aDichotomy group tabulated at value 1.

Since one language learning session might involve more than one category of activities, various combinations of categories emerged. 37.85% involved solely one type of activity, followed by 25.65% engaging in two activities. 19.69% and 16.81% involved doing three types and four or more types of activities, respectively.

The results of combinations of activities (see Appendix B) revealed distinct preferences among participants. When they focused on a single category of English learning activities, they were more likely to concentrate on vocabulary, reading, watching English videos, or grammar drills. In instances of dual-category engagement, popular combinations included vocabulary and media, vocabulary and grammar, reading and speaking, reading and vocabulary. For participants embracing three, four or more simultaneously, there was a preference for combining reading, vocabulary, media, and grammar learning.

Flow Frequency and Intensity in Self-Regulated Language Learning

Participants documented their English learning activities, including the duration of time, perceived challenge and skill,

the flow experience, and the subsequent enjoyment and satisfaction each time after English learning. Tables 4 and 5 provide the descriptive statistics of these variables both collectively and aggregated by individuals. Participants spent an average of 48.31 min on each session, with great variances ranging from 5 to as long as 400 min, reflecting the diversity in participants' engagement. Aggregated by individuals, the average learning time each participant spent was 51.17 min, affirming their commitment to SRL outside classrooms. The average flow in all cases and aggregated by individuals was respectively 6.06 and 5.81, both exceeding 5, the threshold level for experiencing flow in English learning, as proposed by Egbert (2003). Challenge–skill balance was low, scoring 4.21 in all cases, and 4.76 when aggregated by individuals, suggesting an imbalance between the perceived challenges and skills in the activities. Notably, the imbalance arose because participants tended to opt for activities where the challenges were far lower than the required skills. The results of flow outcomes showed that the means of enjoyment were 6.18 and 5.96 in both data sets, underscoring a profound level of enjoyment and satisfaction following the experience of flow in their learning activities.

Table 4. Descriptive Statistics of Duration, Flow, Challenge–Skill Balance, and Enjoyment

	<i>N</i>	Min.	Max.	<i>M</i>	<i>SD</i>
Time	1,041	5.00	400.00	48.31	44.82
Flow	1,041	2.67	7.00	6.06	0.96
Balance	1,041	2.00	14.00	4.21	2.49
Difficulty	1,041	1.00	7.00	2.23	1.48
Skill	1,041	2.00	7.00	6.10	1.08
Enjoyment	1,041	1.00	7.00	6.18	0.93

Table 5. Descriptive Statistics of Duration, Flow, Challenge–Skill Balance, and Enjoyment Aggregated by Individuals

	<i>N</i>	Min.	Max.	<i>M</i>	<i>SD</i>
Time–Individual	24	18.00	178.77	51.17	36.53
Flow–Individual	24	3.69	6.99	5.81	0.93
Balance–Individual	24	2.00	10.10	4.76	2.17
Difficulty–Individual	24	1.00	5.76	2.53	1.32
Skill–Individual	24	3.26	7.00	5.84	1.03
Enjoyment–Individual	24	4.39	7.00	5.96	0.86

Note. Time–Individual, Flow–Individual, Balance–Individual, Difficulty–Individual, Skill–Individual, and Enjoyment–Individual are the means of time, flow, balance, difficulty, skill, and enjoyment of individuals over eight weeks.

A K-means cluster analysis was conducted to classify flow at different intensities. Results shown in Table 6 revealed three cluster centers and subsequent analysis of variance (ANOVA) results in Table 7 demonstrated a significant difference in mean flow values across the clusters, $F(2, 1038) = 2202.23$, $p < .001$. The majority of learning activities, 680 cases (65.32%, $M = 6.65$), were classified under the High-flow group, suggesting that participants experienced flow in most of their English learning activities in SRL. A moderate level of flow was reported by 323 cases (31.03%, $M = 5.10$), while only 38 cases (3.65%, $M = 4.22$) reported minimal flow experiences.

Another cluster analysis was conducted using the aggregated data by individuals to categorize individuals based on their flow experiences, leading to the identification of three significant clusters, $F(2,21) = 57.52$, $p < .001$.

Among the participants, 11 (45.83%, $M = 6.69$) consistently experienced flow across eight weeks of learning, while 10 (41.67%, $M = 5.46$) reported a moderate level of flow. In contrast, 3 participants (12.5%, $M = 4.19$) found it hard to reach the state of flow.

Considering the small number of cases in the Low-flow group, this category was excluded from the examination of differences in the duration of activities. An independent-samples *t*-test was conducted to compare the Medium-flow and High-flow groups. Results in Table 8 demonstrated a significant disparity in the means of time spent on activities, $t(967.94) = -5.10$, $p < .001$, with a small effect size ($d = -0.29$). The High-flow group exhibited a significantly greater investment of time in activities ($M = 52.59$) compared to the Medium-flow group ($M = 39.61$).

Table 6. Results of Cluster Analysis of the Flow Experience in all Cases and by Individuals

Final cluster centers	Cases		Flow			
	<i>N</i>	%	Min.	Max.	<i>M</i>	<i>SD</i>
Low flow	38	3.65%	2.67	4.22	3.54	0.53
Medium flow	323	31.03%	4.33	5.78	5.10	0.39
High flow	680	65.32%	5.89	7.00	6.65	0.43
Total	1,041	100%				
Low-flow individuals	3	12.5%	3.69	4.53	4.19	0.44
Medium-flow individuals	10	41.67	4.90	6.04	5.46	0.42
High-flow individuals	11	45.83	6.17	6.99	6.69	0.33
Total	24	100%				

Table 7. Results of ANOVA in Cluster Analyses

	Cluster		Error		<i>F</i>	<i>p</i>
	<i>M</i> Square	<i>df</i>	<i>M</i> Square	<i>df</i>		
Flow (all cases)	389.48	2.00	0.18	1038.00	2202.23	<.001
Flow (individuals)	8.48	2.00	0.15	21	57.52	<.001

Table 8. Results of the Independent-Samples T-Test of Time Between Medium-Flow Group and High-Flow Group

	Flow Group	<i>N</i>	<i>M</i> (minutes)	<i>SD</i>	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Time	Medium	323.00	39.61	29.20	-5.10	<.001	-0.29
	High	680.00	52.59	51.03			

Effects of Activity Varieties on the Flow Experience

A correspondence analysis was conducted to examine the relationship between varying intensities of flow and categories of English activities. Figure 1 depicts a clear proximity between high flow and reading, indicating a strong positive association. Additionally, the distances between high flow and grammar, media, and vocabulary, as well as the distances between medium flow and media and vocabulary are short, implying a strong association of these

variables with flow. In other words, when participants engaged in reading activities, they were more inclined to experience flow, with grammar, media, and vocabulary learning activities also contributing significantly to flow experiences, though to a lesser extent.

A one-way ANOVA analysis was executed to explore the differences in duration of learning activities and flow across categories of activity combinations. As shown in Table 9, there were significant differences between the

category of a single activity and other categories involving two or more activities in the duration of time, $F(3,393) = 9.19, p < .001$) and flow levels, $F(3,393) = 20.89, p < .001$). These findings suggested that learners focusing on a singular activity, such as learning vocabulary, reading, or

watching English videos, were more prone to experience flow and engage longer in that activity.

Figure 1. Biplot of the Correspondence Analysis of Flow and Learning Activities

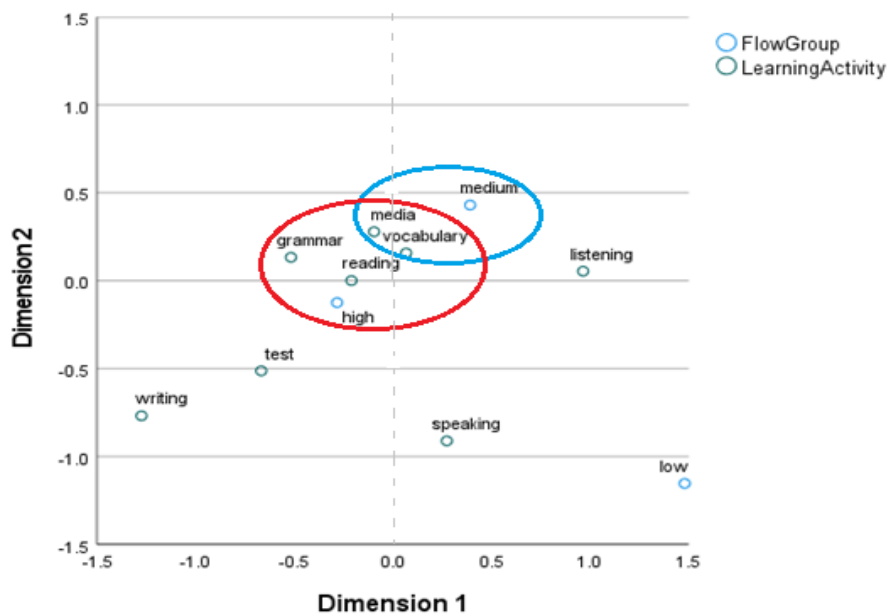


Table 9. Results of One-Way ANOVA Among Four Categories of Activity Combinations

	Time					Flow			
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>
One activity	268	60.47	58.31			6.49	0.72		
Two activities	210	41.15	43.47	(3,393)		6.02	0.93	(3,393)	
Three activities	140	43.01	34.86	9.19	<.001	5.86	1.04	20.89	<.001
Four or more activities	179	44.09	31.75			5.89	1.22		
Games-Howell Post-Hoc Test Results of Group Differences									
	One activity > Two activities					One activity > Two activities			
	One activity > Three activities					One activity > Three activities			
	One activity > Four or more activities					One activity > Four or more activities			

Challenge–Skill Balance, the Flow Experience, and Enjoyment

Given the non-normal distribution of the data, a Spearman correlation analysis was conducted to examine the relationship among flow, difficulty, skill, challenge–skill balance, and enjoyment. Results, presented in Table 10, indicated significant correlations among these variables. Flow was found to have a strong negative correlation with difficulty ($r = -.855$) and balance ($r = -.837$), underscoring

an imbalance between perceived challenges and skills during English learning. The easier the activities perceived by the participants, the more likely they experienced flow. Additionally, a strong positive correlation was observed between flow and enjoyment ($r = .903$), highlighting that higher levels of flow were associated with more enjoyment. Furthermore, the components of flow – interest, attention, and control – were all strongly correlated with both flow and enjoyment.

Table 10. Results of Spearman Correlation Analysis of Flow and Other Variables

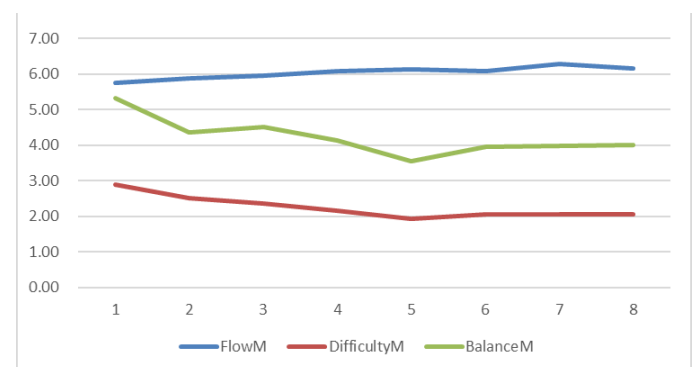
	Flow	Difficulty	Skill	Balance	Interest	Attention	Control	Enjoyment
Flow	1.00	-.855**	.896**	-.837**	.945**	.949**	.930**	.903**
Difficulty		1.00	-.847**	.986**	-.862**	-.861**	-.727**	-.848**
Skill			1.00	-.824**	.904**	.895**	.781**	.892**
Balance				1.00	-.845**	-.842**	-.704**	-.830**
Interest					1.00	.906**	.808**	.921**
Attention						1.00	.813**	.895**
Control							1.00	.785**
Enjoyment								1.00

Note. **Correlation is significant at the 0.01 level (2-tailed).

Variations of Flow Across Time: Inter-Individual and Intra-Individual

Using the ESM, participants' self-regulated English learning was systematically recorded after each learning session. Figure 2 depicts the variations of the flow experience, the perceived difficulty, and challenge–skill balance, along with the quantity and the duration of learning activities. Results suggested that the average level of flow remained relatively stable over the eight weeks with a slight increase from below 6 in the beginning week to above 6 in the eighth week. In contrast, the changes of challenge–skill balance and difficulty were more notable. Balance gradually decreased from above 5 to below 4, followed by an increase to around 4, while difficulty continuously declined from 3 to approximately 2. These trends suggested a persistent challenge–skill imbalance and a gradual reduction in task difficulty throughout the process of SRLL.

Figure 2. Variations in Flow, Challenge–Skill Balance and Difficulty Over Eight Weeks

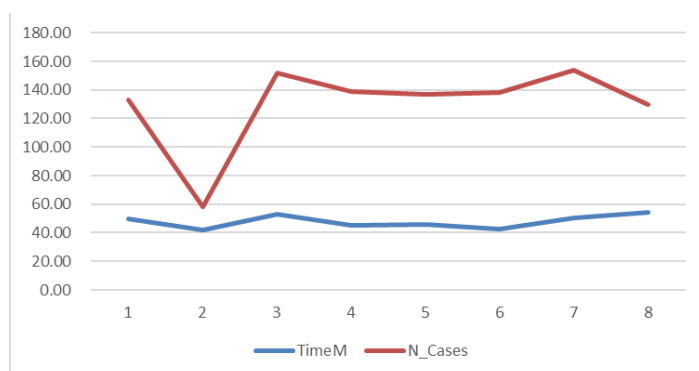


Note. FlowM=mean value of flow each week, DifficultyM=mean value of perceived difficulty each week, BalanceM=mean value of challenge–skill balance each week.

Figure 3 shows the quantity and the duration of learning activities. The average time devoted to learning across the eight weeks displayed minimal variations, ranging within 40 to 60 min. Conversely, the number of cases exhibited more changes, particularly with a sharp drop in the second week when there was a week-long holiday after the commencement of data collection. Subsequent weeks witnessed a notable surge, a modest decline, an increase, and a more visible decrease toward the end.

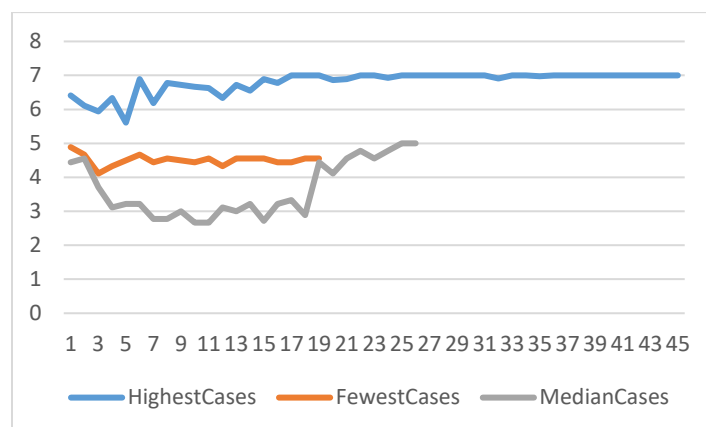
Three participants were selected to examine the individual variations of their flow experiences. Participant 8 reported the highest number ($n = 130$ for 45 days) of learning sessions; Participant 16 reported the median number ($n = 34$ for 26 days) of cases; while Participant 14 contributed one of the fewest numbers ($n = 22$ for 19 days). Figure 4 illustrates the fluctuations in their flow experiences. Both Participant 8 and Participant 14 encountered a decline in flow during the first few days, gradually experiencing an upswing until reaching a stable level. In contrast, Participant 16 experienced more variations in her flow states, starting above 4, then dipping to 3 and below, before eventually rising to around 5. Participant 8 constantly experienced a higher level of flow and contributed the highest number of sessions, while Participant 14 and Participant 16, with a low to moderate level of flow, engaged in fewer English learning activities.

Figure 3. Variations of Number of Cases Reported and Duration of Activities Over Eight Weeks



Note. TimeM=mean value of duration (minutes) each week, N_Cases=mean value of reported learning sessions each week.

Figure 4. Individual Variations in Flow Over 45 Days in Eight Weeks



Note. HighestCases=the flow variation of Participant 08, MedianCases=the flow variation of Participant 16, FewestCases=the flow variation of Participant 14.

DISCUSSION

The Flow Experience in Self-Regulated Language Learning

The first research question explored the frequency and intensity of flow during out-of-class SRL activities. After setting goals primarily on improving vocabulary, reading, listening, and speaking proficiency, participants regulated the variety, duration, and affective experiences in language learning. Vocabulary learning through mobile applications emerged as the most frequently chosen category. Extensive reading via comprehensive English learning applications and with Bilibili Content Creators, as well as watching English videos and movies on Bilibili, were among learners' top choices. Participants dedicated an average of about 50 min per learning session, generally experiencing flow in the majority of their learning activities. The findings revealed learners' preferences in their SRL outside the classroom and highlighted the enhanced role of technology support (Chen et al., 2019; Lei, 2018; Naseri & Motallebzadeh, 2016; Wang & Chen, 2020; Yang et al., 2023). During these learning activities, participants experienced a high level of flow in two thirds of them ($n = 680, 65.32\%$). For individual learners, nearly half of the participants ($n = 11, 45.83\%$) consistently maintained a state of flow throughout their engagement in English learning. Flow intensity was identified as a significant factor influencing the duration of

engagement in learning activities. Individuals in the High-flow group spent significantly more time on learning activities compared to those in the Medium-flow group. This aligns with previous studies on the facilitating role of flow in motivating and sustaining language learning (Abbott, 2000; Amini et al., 2016; Aubrey, 2017a; Egbert, 2003; Hong et al., 2017; Piniel & Albert, 2017). The experience of flow promoted learners' time of engagement, thus, granting them more contact with and more exposure to the language they were learning. The autotelic nature of the flow experience makes it "addictive" (Csikszentmihalyi, 2014b, p. 216), pushing people to perform better, and perform the activity repeatedly (Trevino & Webster, 1992).

Past literature emphasizes the critical role of challenge–skill balance in flow, especially high-skill high-challenge leading to flow (Arai, 2022; Aubrey, 2017b; Egbert, 2003; Philp & Duchesne, 2016), and high-skill low-challenge leading to boredom (Csikszentmihalyi, 2014b; Whalen, 1997). In contrast, the findings of the current study showed that despite an imbalance favoring perceived skills over difficulty, with the latter being far lower, these perceived easy activities did not lead to boredom in the self-regulatory learning process; instead, they contributed to a state of flow. For learners with lower-intermediate and intermediate proficiency, easy learning activities ensured that they had sufficient skills to complete tasks comfortably and maintain their control, thus leading to flow (Bodea & Trofimovich, 2023). This finding supports Cho's (2018) argument that the role of challenge–skill balance in flow might not be as substantial as previously thought. Other factors, such as learner motivation, tasks characteristics, and contexts may interact with the influence of balance on flow (Abbott, 2000; Cox & Montgomery, 2019; Jacobs & Morgan, 2022; Wu & Albert, 2024). In the present study, learners' motivation, proficiency, and contextual factors played a role.

First, although learners were granted autonomy in regulating their learning outside the classroom, the SRL was initiated by the instructor and driven primarily by extrinsic motivation, as it was part of the course requirements. This differs from the typically positive relationship between flow and intrinsic motivation (Hong et al., 2017). Second, given the participants' limited English proficiency, new vocabulary and complex structures in challenging tasks may interrupt their concentration (Mandigo & Thompson, 1998), thus impeding the flow

experience. In contrast, the seemingly "safe tasks," such as learning 20 words on mobile applications, reading extensively for personal interest, or doing grammar drills, fulfilled the conditions of interest, concentration, and control, offering satisfaction of working toward their goals. Third, Zuniga and Payant (2021) and Zuniga (2023) found that collaborative tasks involving meaningful interactions were more likely to produce flow experiences. However, SRL in this study was carried out individually, without interaction with other learners. Easy activities, such as learning vocabulary on applications, interest reading, and learning with media, helped sustain interest and attention, reduce anxiety and foster enjoyment (Dewaele & MacIntyre, 2022a; Dewaele et al., 2023; Lu, 2024), ultimately leading to the experience of flow.

Effects of Activity Varieties on the Flow Experience

The second research question explored the effects of activity varieties on flow. Reading, grammar drills, vocabulary learning, and watching English videos were found to be closely associated with the experience of flow. Reading for pleasure, reading texts with interest or for personal or intellectual enrichment, provided the concentration, control, and enjoyment conducive to flow (Mcquillan & Conde, 1996). For reading in a foreign language, participants found themselves in the state of flow as long as the perceived difficulty of the reading was within their capability of understanding and they were not under time constraints (Arai, 2022; Kirchoff, 2013) – both available in SRL outside classrooms. Apart from reading, learning vocabulary on applications, the most frequently chosen activity, shared features with a virtual reality (VR) game-based English mobile learning application that notably enhanced learners' game engagement and experience in SRL, showing that the interactive feature of VR and challenges of game-based design facilitated entry into the state of flow and increased their motivation to learn (Chen & Hsu, 2020; Zuniga, 2023). The gamified features provided by vocabulary learning applications, the entertainment derived from watching English videos and movies, and the leisure inherent in extensive reading align with the play and soothing functions that were most commonly available in flow activities (Csikszentmihalyi, 2014a).

Interestingly, grammar learning, often perceived as dull, could also lead to flow (Bodea & Trofimovich, 2023). The preference of grammar learning in this study showed that for lower-intermediate and intermediate EFL learners, reviewing grammatical rules and doing drills induced a state of flow due to the sense of control gained through mastering rules and the satisfaction of correctly doing grammatical exercises. Nevertheless, autonomy-supporting contexts that offer opportunities to exercise autonomy and self-expression, integral to the SRL process in this study, were more conducive to flow than other controlled environments (Abbott, 2000; Whalen, 1997).

Another notable finding was that over a third of learning activities (37.85%) centered on one single category of activity, such as vocabulary, reading, watching video, or grammar drills. When learners were engaged in one type of activity in one learning session, they were more likely to experience flow compared to doing two or more activities simultaneously. Moreover, the duration of engagement in one activity was significantly longer than when multiple activities were involved. The concentration on a self-selected, interesting, and manageable activity enabled participants to exert total control over what they learned, losing their self-consciousness, and experiencing enjoyment and satisfaction, fostering a state of total involvement and absorption (Csikszentmihalyi, 2014a).

General and Individual Variations of Flow Across Time

To answer the third research question, the use of the ESM in a repeated design allowed for the accumulation of both collective and individual data on participants' flow experiences to explore their temporal dynamics over the eight weeks. Generally, instead of an upward trend, such as that identified in Jia et al. (2024), the level of flow remained high and stable across time, suggesting that the self-regulatory process of language learning outside classrooms provides conditions for the occurrence of flow. SRL could be considered as adjunct to formal language instruction (Karakaya & Bozkurt, 2022). However, along with time, there was a decline in the levels of balance and difficulty. Participants initially tried some difficult tasks, but later learning activities became easier. This trend could be attributed, in part, to the operation of SRL in the study where participants were required to finish a minimum of

four learning sessions per week as a course requirement. This external motivation likely influenced participants to opt for activities that were within their comfort zone. The consistence of being in flow across time sustained participants' engagement in English learning after class (Hong et al., 2017; Jia et al., 2024; Piniel & Albert, 2017, 2019). However, in contrast to the proposition that the optimal experience is expected to drive people to continually engage in new and higher challenges (Csikszentmihalyi & Larson, 1984), in this study, the state of flow was not motivating enough to prompt participants to try higher challenges, suggesting that the flow derived from comfort, and little challenge might have limited impact on improving language skills.

Regarding involvement across the eight weeks, the time spent on activities witnessed minor ups and downs, while the learning sessions demonstrated more notable changes. Data in this study were collected along with the natural progression of an English course within an academic semester. During the semester, there was a week-long holiday in the fifth week of the academic calendar. The significant drop in reported English learning sessions during this period indicated a potential interruption in the continuity of out-of-class SRL on non-school days, highlighting the importance of monitoring, scaffolding, and supervision from instructors to sustain learners' motivation during the SRL process (Hromalik & Koszalka, 2018; Pintrich, 2004).

In terms of individual variations, participants' diverse trajectories offer a glimpse into the multifaceted dynamics of flow experiences during SRL. Due to the limit of space, three individuals were selected for analysis in the present paper. All of them experienced initial surges and plunges as they adapted to SRL. Participant 8 emerged as the most highly engaged learner, starting high in flow, experiencing some fluctuations, but sustaining the state of flow along the way. She was mainly engaged in the reading of self-chosen novels, the studying of texts from the EFL textbook, and vocabulary learning through an application. The consistency in engaging with these activities, perceived as within her skill level, facilitated a continual experience of flow, enjoyment, and satisfaction, thereby maintaining unwavering commitment over the eight-week period.

Participant 16, who met the quantity requirement and contributed a median number of cases, demonstrated a more

varied pattern of flow experiences. Her fluctuations showed a U-shaped curve, indicating that her experiences of flow started at a moderate level, gradually decreased to as low as hardly experiencing any flow, then surged back to the moderate level. Engaging in various learning activities, including listening and reading-aloud on Bilibili, practicing listening and speaking on specialized English mobile applications, such as dubbing on Qupeiyin, and learning vocabulary, she exhibited fluctuations in flow corresponding to the task difficulty. Reading and grammar learning, perceived as less challenging, allowed for greater possibilities of flow, while more challenging listening and speaking activities impacted concentration and control, diminishing the likelihood of experiencing flow. Despite experiencing limited flow, Participant 16 showcased a willingness to try various challenging activities.

Participant 14, who fulfilled only 70% of the required reports, remained stable in experiencing a moderate level of flow, revealing that his experience of flow failed to enhance his engagement in English learning. He mainly engaged in vocabulary learning on an application, reading EFL texts, and grammar drills, mostly situated outside the authentic context of English use, unable to elicit a high level of interest, attention, and control, as well as enjoyment and satisfaction. The limited variety of activities, less intense level of flow experience, and lower enjoyment and satisfaction contributed to Participant 14's unsatisfactory involvement in SRL. In summary, individual flow variations underscore the complexity of the flow experience in SRL, affected by the types of learning activities, personal preferences on meeting challenges, and external factors, such as course requirements and teacher monitoring (Sato & Storch, 2022).

CONCLUSION AND LIMITATIONS

Using the ESM, this study investigated EFL learners' flow experience across time during their self-regulatory process of language learning, enhanced by diverse language learning mobile applications and media platforms. Initiated by the course instructor, SRL in this context empowered learners to define their own objectives, select learning activities, and self-regulate the learning frequency and duration, emotional responses, as well as learning materials and platforms. Findings supported the prevalence of flow

experiences in various learning activities, with approximately half of the participants consistently attaining flow state in out-of-class SRL activities. The intensity of flow influenced participants' engagement in learning, that is, the more intense flow they experienced, the longer they were likely to engage in learning. The autonomy afforded to learners in selecting activities and materials aligned with their interest, the control over the difficulty and completion of tasks, the enjoyment and satisfaction collectively contributed to an optimal learning experience. Intriguingly, the study uncovered that even with a challenge-skill imbalance, participants could still experience flow as long as they possessed sufficient skills for the activities. Noteworthy activities associated with high flow included reading for pleasure through applications or video-sharing platforms, learning on vocabulary applications, and engaging in grammar drills, confirming the facilitating role of technology and media in promoting learner engagement and affective experiences. Data collected through ESM revealed general and individual variations of flow. Over time, the overall flow remained stable with minor fluctuations, while the perceived difficulty gradually diminished, indicating that the consistent flow did not propel learners to seek new challenges. Findings suggested that individual flow experiences may enhance learners' engagement in learning. However, learners' involvement was also influenced by various factors, including the interruption of non-school days, the instructor's monitoring, personal preferences for learning activities, and motivations in SRL.

Despite insights into the occurrence, intensity, and influencing factors on the flow experience in SRL provided by the current study, some limitations should be acknowledged. First, the use of ESM, while offering repeated assessments of flow over time, relied solely on retrospective reporting through a questionnaire after each learning session. Future research can incorporate other methods (see Albert, 2021) to enhance the accuracy and depth of capturing the optimal flow experience. Second, the participants were chosen from an intact English class based on convenience sampling. Most of them were from one province in China and had lower-intermediate to intermediate English proficiency. Generalization of findings should remain tentative as learners' subjective experiences may be influenced by a variety of cognitive, affective, and contextual factors. Third, the present study

was part of a larger ongoing project, and the data analyzed here only covered the first eight weeks. Future research will incorporate additional data and explore correlations with other affective factors. Last, as participants experiencing flow in the present study preferred easy activities, future research should investigate the impact of flow on the advancement of linguistic performance. Even so, it is hoped that the data collected across time by ESM in this study has

contributed to an enriched understanding of the flow experience in foreign language learning, particularly within the framework of self-regulated, out-of-class learning contexts. The findings underscore the importance of tailoring SRL to individual preferences and navigating external factors to foster sustained learner engagement and positive affective experiences.

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Authors' Contributions

MZ conceptualized the study and completed the data collection. MZ and BR worked on data analysis and interpretation. MZ drafted and revised the manuscript. Both authors read and approved the final manuscript.

Ethics Approval & Consent to Participate

Ethics approval for this research was not sought, as per the prevailing regulations and practices within the social studies research context in China. This research adheres to the ethical guidelines and principles outlined by the academic institution associated with the principal investigator and complies with the laws and regulations governing research in China. All participants were informed about the nature and purpose of the study. They were assured that their responses would be kept confidential and used solely for research purposes. Verbal informed consent was obtained from each participant prior to participation and data collection in the study.

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APPENDIX A. List of English Learning Websites and Mobile Applications

Applications	Websites
	Vocabulary learning
Baicizhan (百词斩)	https://www.baicizhan.com/mobile.html
Bubeidanci (不背单词)	https://apps.apple.com/cn/app/id698570469
Shanbeidanci (扇贝单词)	https://www.shanbay.com/
Quark (夸克背单词)	https://www.quark.cn/
	Comprehensive English learning apps
KeKe English (可可英语)	http://www.kekenet.com/
Shanbei English (扇贝英语)	
	Specialized English learning apps
Everyday English Listening (每日英语听力)	https://apps.apple.com/cn/app/id570118289
LiulishuoEnglish (流利说英语)	https://www.liulishuo.com/
	Dubbing apps
Peiyinxiu (配音秀) : Dubbing	https://peiyinxiu.com/
Qupeiyin (英语趣配音) : Dubbing	https://www.qupeiyin.com/
	News apps
China Daily (中国日报)	https://www.chinadaily.com.cn/
	Streaming media
Bilibili (哔哩哔哩)	https://www.bilibili.com/
	Social media platforms
Douyin (抖音) : Short videos sharing	https://www.douyin.com/
Xiaohongshu (小红书)	https://www.xiaohongshu.com/

APPENDIX B. Results of Learning Activities Preferences

Figure 1. Summative Preferences of Combinations of Learning Activities

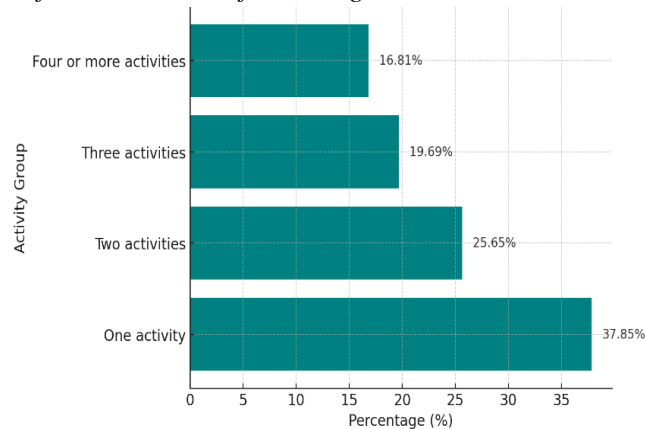


Table 1. Results of Learning Activities Combinations in Groups

Activity group		N	Min.	Max.	Sum
One activity	%	8	0.10%	22.09%	37.85%
	Count	8	1	230	394
Two activities	%	21	0.10%	5.09%	25.65%
	Count	21	1	53	267
Three activities	%	24	0.10%	3.46%	16.81%
	Count	24	1	36	175
Four or more activities	%	50	0.10%	2.88%	19.69%
	Count	50	1	30	205

Table 2. Results of Combinations of Activities in Activity Groups (One Activity, Two Activities)

Combination: one activity	Count	%	Combination: two activities (top 8)	Count	%
Vocabulary	230	22.09%	Vocabulary, Media	53	5.09%
Reading	50	4.80%	Vocabulary, Grammar	45	4.32%
Media	38	3.65%	Reading, Speaking	43	4.13%
Grammar	38	3.65%	Reading, Vocabulary	29	2.79%
Listening	26	2.50%	Reading, Media	26	2.50%
Speaking	6	0.58%	Listening, Vocabulary	15	1.44%
Test	5	0.48%	Listening, Media	9	0.86%
Writing	1	0.10%	Grammar, Test	8	0.77%

Table 3. Results of Combinations of Activities in Activity Groups (Three Activities, Four or More Activities)

Combination: three activities (top 8)	Count	%	Combination: four or more activities (top 8)	Count	%
Reading, Vocabulary, Media	36	3.46%	Reading, Listening, Speaking Vocabulary, Grammar, Media	30	2.88%
Listening, Speaking, Vocabulary	34	3.27%	Reading, Listening, Vocabulary, Media	28	2.69%
Vocabulary, Grammar, Media	28	2.69%	Reading, Vocabulary, Grammar, Media	21	2.02%
Speaking, Vocabulary, Media	8	0.77%	Reading, Listening, Vocabulary, Grammar, Media	18	1.73%
Listening, Vocabulary, Media	8	0.77%	Reading, Listening, Speaking, Vocabulary, Media,	16	1.54%
Reading, Listening, Media	8	0.77%	Reading, Speaking, Vocabulary, Media	9	0.86%
Reading, Grammar, Media	7	0.67%	Listening, Speaking, Vocabulary, Media	8	0.77%
Reading, Vocabulary, Grammar	7	0.67%	Reading, Listening, Speaking, Writing, Vocabulary, Grammar Media	8	0.77%