

Perceptions of Language Service Technologies and Reference Works by Chinese Users in the Era of Generative AI

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Abstract

As paper dictionaries, digital reference works, machine-translation systems, and emerging AI-based language tools increasingly coexist, there is a need to reassess how users evaluate these resources and what kinds of lexicographic support they now require. Drawing on user reviews and questionnaire data from over one thousand Chinese learners of advanced English, this study shows that, for most of these users, traditional paper and digital dictionaries are no longer perceived as sufficient for many of their real-world tasks. Instead, they express a growing demand for more adaptive and context-sensitive forms of lexical assistance. Beyond definitions, they expect support with authentic usage, genre- and domain-related terminology, and culturally-rich language needs. The findings also suggest that recent AI technologies may reshape lexicographic practice, raising questions about the future scope of lexicography and the role of lexicographers.

Keywords: print dictionaries; mobile reference apps; translation platforms; chatbots; dictionary consultation; user reviews; closed- and open-ended questionnaires; Artificial Intelligence (AI); generative AI (GenAI); English; Chinese

1. The Impact of Generative AI on Translation and Lexicography

Recent theoretical developments suggest that lexicography is undergoing a fundamental transformation in response to digital innovations. [Tarp and Gouws \(2019\)](#) argue that the concept of lexicography must be redefined to encompass not only traditional dictionaries but also glosses and other embedded lexical explanations that appear within digital environments. This expanded perspective underscores the growing importance of integrated, context-sensitive language support tools that provide concise, just-in-time explanations directly within texts, thereby reducing the need for users to consult separate dictionary resources.

Already a decade ago, [Lew and de Schryver \(2014\)](#) pointed out that the proliferation of digital dictionaries and search engines fundamentally changed dictionary user behaviour. In the digital age, users increasingly rely on general search engines for lexical queries, often bypassing traditional dictionaries altogether. Nowadays, despite the increasing availability

of AI-driven resources, traditional lexicographic tools—including paper dictionaries, free mobile reference apps, and premium language services—remain widely used by language learners across different contexts. However, in an era where paper dictionaries, digital reference works, translation platforms, and AI-powered large language models (LLMs) coexist and collectively function as language service resources, existing research has not yet fully captured the complexity of user behaviours and preferences across these diverse reference tools. Liu et al.'s (2025) empirical evidence further confirms this complexity, showing that learners do not simply replace dictionaries with LLMs but instead develop task-oriented usage strategies, reserving dictionaries for discrete lexical queries while relying on LLMs for more integrated language tasks.

The rapid advancement of generative artificial intelligence (GenAI), particularly LLMs, has significantly transformed the fields of language learning, translation and lexicography. Studies have demonstrated that LLM-supported instruction can significantly enhance learners' language performance (Liu et al., 2024; Zhang & Huang, 2024). GenAI tools like ChatGPT, Gemini and DeepSeek have introduced new possibilities for educational assistance, language generation, and dictionary compilation. Within the field of lexicography, research on ChatGPT and Gemini has demonstrated its substantial potential in automating dictionary entry generation (de Schryver, 2023b; Lew, 2023; Rundell, 2023; de Schryver, 2024c; Lew et al., 2024; Rundell et al., 2024; de Schryver, 2025a; Marković & Stanković, 2025; de Schryver, 2026a). Lately, DeepSeek has emerged as a promising open-source alternative in lexicography, at least for Chinese (Chen et al., 2025; Han & de Schryver, 2025; Zhong, 2025), offering competitive reasoning capabilities, cost-efficiency and full technical transparency (Poo, 2025).

Research has extended AI-assisted lexicography to languages other than those spoken in Europe (especially English), to some spoken in Latin America (like Brazilian Portuguese, see de Schryver, 2023a), as well as Africa (especially Bantu languages, see de Schryver, 2024b), and of course Asia (mainly Chinese, see Chen et al., 2024; Gao, 2024; Zhang & Liu, 2024; Liu, 2025). Despite its growing application in multilingual lexicographic contexts, out-of-the-box GenAI still exhibits clear limitations in delivering fine-grained lexical distinctions, especially for low-resource languages (Jakubiček & Rundell, 2023; de Schryver, 2025b).

This article aims to address some of the current issues by collecting and analysing data from multiple sources, including *user reviews* of free and premium translation and reference apps (vs. traditional paper dictionaries), and *questionnaire responses* concerning usage purposes, tool preferences, and attitudes towards AI-based resources. By mapping today's user behaviours, consultation patterns, and perceptions, this study seeks to provide an empirical foundation for future work on the entry-generation capabilities of chatbots and its potential to develop user-centred, AI-supported lexicographic solutions.

2. Survey design

This study analysed a total of 1,538 user reviews, covering both paper dictionaries and mobile translation and lexicographic applications. While these reviews offered valuable insights into users' spontaneous feedback, they were often brief, limiting their interpretive value. To obtain more targeted and comprehensive responses from a clearly-defined user group, a separate questionnaire study was conducted, yielding 60 valid responses.

2.1 User reviews

The user reviews analysed in this study were collected from the 'Reference' category of the Apple App Store, focussing on the top-ranked free and paid applications in the China region. First, for paper dictionaries, user reviews were selected from major Chinese online shopping platforms (Taobao and Dangdang) over the past three years. Reviews solely concerning packaging, paper quality, printing layout, or logistics were excluded, resulting in a total

of 128 valid reviews. The paper dictionaries users reviewed are as follows: *Students' Practical Bilingual English-Chinese Dictionary, 5th Edition* (Kaixin LRC, 2020), *Oxford Advanced Learner's English-Chinese Dictionary, 10th Edition* (OUP, 2024), *The New English-Chinese/Chinese-English Dictionary, 2nd Edition* (Eds., 2016), *Longman Dictionary of Contemporary English (English-Chinese), 6th Edition* (Pearson, 2019), and *Collins COBUILD Advanced Learner's English-Chinese Dictionary, 9th Edition* (Collins, 2023).

Second, for free applications, reviews were collected for the following apps: Youdao Dictionary, DeepL Translate, Naver Papago – AI Translator, Baidu Translate, and Tencent Translator. A total of 990 reviews were gathered from users in mainland China, as well as in English-speaking regions that are among the most popular study destinations for Chinese students, including Hong Kong, the United States, the United Kingdom, Canada, and Singapore. Given the significantly higher download volume of the Youdao Dictionary compared to other free applications, reviews of Youdao accounted for 790 entries.

Third, for paid applications, the selected apps were: Eudic (Enhanced Version), Merriam-Webster Dictionary, and Forvo Pronunciation. A total of 420 reviews were collected from users in mainland China, Hong Kong, Macau, and Taiwan. Unlike the broader region set for free applications, the data collection for paid apps was limited to regions where users are more likely to be Chinese learners of English. This is because in other English-speaking regions such as the United States or the United Kingdom, many downloaders of these paid apps may be local users or speakers of other languages, rather than Chinese learners of English. Including those regions could therefore dilute the specificity and relevance of the data regarding Chinese learners' needs and preferences.

2.2 Questionnaire study

A 'Survey on Chinese-English Dictionary & AI-Tool Usage' targeted Chinese individuals with at least a high-school education. The questionnaire was designed using Wenjuanxing, a widely used online survey platform, and comprised 16 questions spread over five sections. Section One had six questions on personal background. Section Two focused on respondents' preferences regarding various reference tools, while Section Three examined the frequency of their language-tool usage in both daily life and academic contexts. Section Four explored participants' perceptions of AI-based language tools, particularly in terms of their functionality, reliability, and practical experience. Section Five consisted of three open-ended questions, inviting participants to freely express their reflections on dictionary use, their opinions of digital AI language tools, and their perspectives on the continued relevance and value of print dictionaries in the digital era.

The survey was primarily distributed online to Chinese students studying abroad, with the majority of participants from Ghent University in Belgium. Responses that were evidently not serious were excluded from the final dataset to ensure the reliability of the analysis. The combination of structured and open-ended questions provided both quantitative and qualitative insights into users' behaviours, preferences and attitudes towards English-Chinese dictionaries and AI-assisted language tools.

3. Analysis of the user reviews

The 1,538 user reviews are presented in Addendum A, with the raw data itself grouped into four different Excel sheets (one for the paper dictionaries, one for the free Youdao Dictionary app, one for the free machine-translation apps, and one for the paid mobile dictionary apps). This section presents the findings of our analysis of these user reviews. By focusing on user feedback for both paper dictionaries and digital translation and reference tools, we explore how users interact with different language resources and what functional

needs they emphasise in practice. The review data offer valuable insights into users' real-world behaviours, preferences and expectations when engaging with such tools.

3.1 Treemaps and key term investigation

All review texts underwent a preprocessing and cleaning procedure. Commonly used functional words, including “我” (I), “它” (it), “那” (that), “这” (this), “是” (is/are), “有” (have/has), “很” (very), “非常” (extremely), “和” (and), “也” (also), “都” (all), “的” (possessive or descriptive particle), “吧” (modal particle), and “了” (modal particle), were removed. In addition, words unrelated to lexicographic content, including those pertaining to printing and packaging, were excluded.

Treemaps representing all reviews are displayed in [Figure 1](#) and [Figure 2](#), while those specific to free applications, paid applications, and paper dictionaries are included in Addendum B. In these visualisations, Chinese characters with higher frequencies appear in proportionally larger font sizes and bigger windows, whereas less frequent Chinese characters are shown in smaller font sizes and tinier windows. Some of the less frequent Chinese characters, which are unreadable in the treemaps, can be viewed in full in the tables provided in Addendum B. Words falling below a certain frequency threshold were omitted from the treemaps altogether.

The prominence of the character “好” (good) in all treemap visualisations indicates that users generally express a positive attitude towards these reference tools. Notably, the term “翻译” (translate) appears prominently across the treemaps, suggesting that translation may represent a core function users expect from such tools. Note that, given the limited scope and brevity of quite a number of online user comments, we turned to the separate questionnaire study to gain deeper insights into users' experience in general, and AI-tool usage in particular, with an added focus on the direction Chinese to English rather than merely English to Chinese.

The frequent appearance of the characters “单词” (word), in large font within the treemaps, points to a strong user focus on vocabulary-related activities. Inspired by this, we further investigated user behaviours related to vocabulary. Specifically, we categorised such behaviours into two types: “查单词” (word lookup) and “背单词” (word memorisation).

All analyses were conducted in Python (version 3.12.7). A fuzzy keyword search was applied to identify user comments related to word-memorisation and word-lookup behaviours across the entire review dataset. Data manipulation and visualisation relied on *pandas* ([McKinney, 2010](#)), *Matplotlib* ([Hunter, 2007](#)), and *seaborn* ([Waskom, 2021](#)). For presentation consistency, some figures were subsequently redrawn in Microsoft Excel based on the same underlying data. The fuzzy keyword search revealed that word lookup was mentioned more frequently than word memorisation; see [Figure 3](#).

To further validate the behavioural differences across reference types, two-proportion z-tests were conducted for both word-lookup and word-memorisation mentions. A significant difference was found between free and paid applications in word memorisation, with paid apps showing a markedly higher proportion of memorisation mentions ($z = -6.813$, $p < 1e-11$). This result suggests that users of paid applications are more likely to engage with these tools for long-term vocabulary acquisition rather than for immediate consultation needs. The paid nature of these applications may encourage more sustained and intentional learning behaviours, such as deliberate word memorisation for academic or professional purposes, for instance for test preparation or systematic vocabulary building.

Comparisons between free and paper dictionaries revealed that paper dictionaries had a significantly higher proportion of lookup mentions ($z = -3.911$, $p < 0.001$). This finding may reflect the traditional role of paper dictionaries as authoritative reference tools, often used in more formal or structured language tasks where quick word retrieval is essential. Unlike mobile applications, which often combine multiple functionalities, paper dictionaries typically do not offer interactive features or gamified learning support, thereby reinforcing their usage primarily for word-lookup purposes.

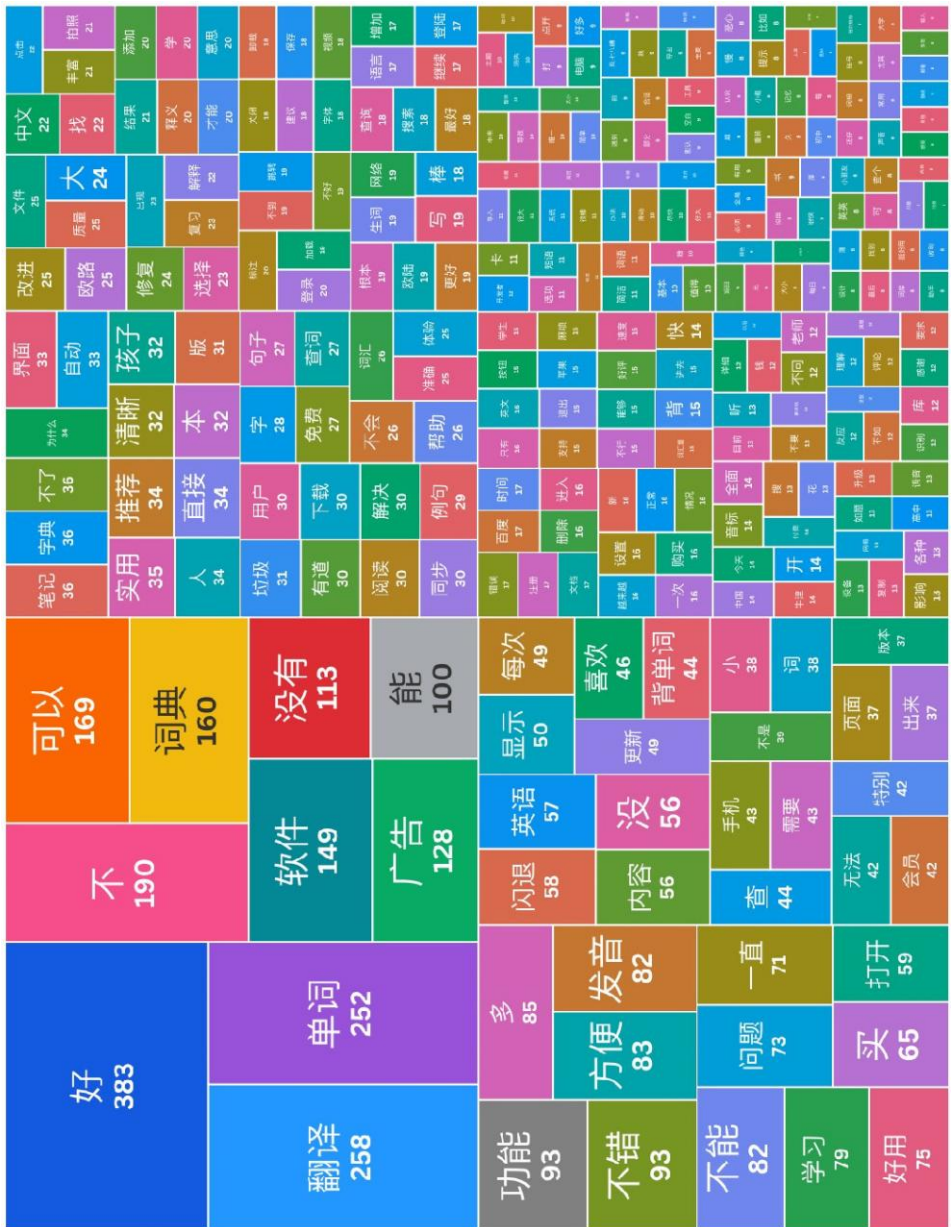
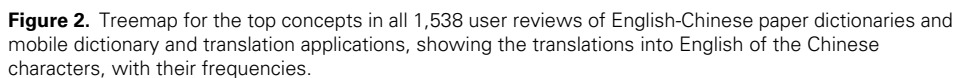


Figure 1. Treemap for the top concepts in all 1,538 user reviews of English-Chinese paper dictionaries and mobile dictionary and translation applications, showing the original Chinese characters, with their frequencies.

Paid applications also differed significantly from paper dictionaries in both behavioural dimensions, showing a lower proportion of lookup mentions ($z = -2.972$, $p = 0.003$) and a higher proportion of memorisation mentions ($z = 2.335$, $p = 0.020$). These findings highlight a shift in usage patterns when moving from static, traditional reference tools to more dynamic, digital platforms. The more personalised, interactive, and goal-oriented features of paid



applications—such as spaced repetition systems, progress tracking, or tailored word lists—may account for this shift, encouraging users to engage with the tool not just for understanding a single word, but for building broader lexical competence over time.

Although word memorisation appears less frequently than word lookup in the overall dataset (50 vs. 87 mentions respectively), this does not diminish its significance. In fact, the higher prevalence of word memorisation in paid reference applications indicates that users are

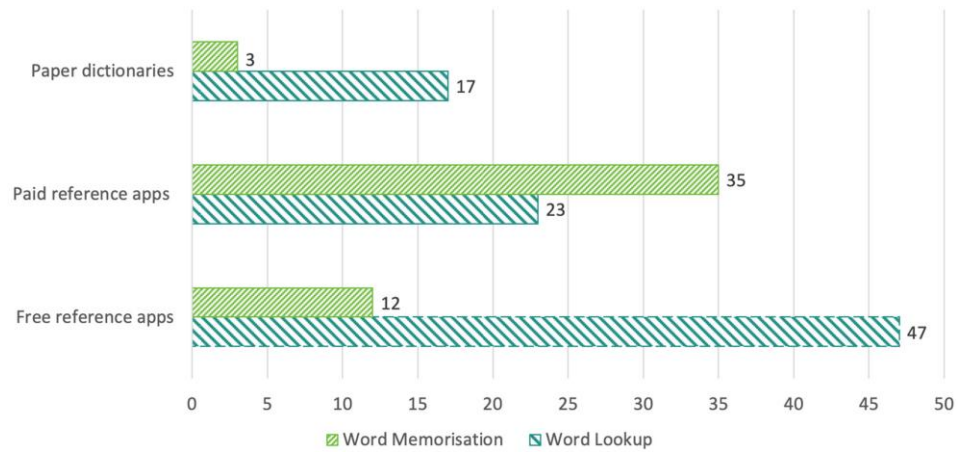


Figure 3. Comparison between word lookup and word memorisation in user reviews of English-Chinese paper dictionaries and mobile dictionary and translation applications.

willing to invest financially in tools that support memorisation functionalities. This highlights the potential value of incorporating memorisation features into future lexicographic tools.

3.2 Receptive needs vs. Productive needs

We also categorised dictionary users’ needs into receptive and productive types. Receptive needs refer to language comprehension activities. This category was further divided into meaning comprehension and translation reference. Meaning comprehension pertains to users consulting dictionaries to understand the meanings of words or phrases. Relevant keywords include “释义” (definition), “意思” (meaning), “含义” (connotation), “解释” (explanation), “定义” (definition), “语义” (semantics), “语境” (context), “上下文” (discourse context) and “阅读” (reading). Translation reference involves users seeking the translation of words or phrases into their native language. Keywords linked to this subcategory include “翻译” (translation), “中文” (Chinese), “对照” (comparison), “对译” (translation equivalent), “译文” (translated text), “对应” (correspondence) and “母语” (native language).

Productive needs refer to language output activities. Within this category, we further distinguished between expression support and form confirmation. Expression support refers to cases where users consult dictionaries to improve their ability to express themselves in writing or speaking. Keywords related to this category include “用法” (usage), “使用” (use), “搭配” (collocation), “例” (example), “造句” (sentence-making), “同义词” (synonym), “近义词” (near-synonym), “写作” (writing), “表达” (expression), “地道” (idiomatic) and “自然” (natural). Form confirmation refers to users’ attention to linguistic forms, such as spelling, pronunciation, and grammatical features, for the purpose of ensuring language accuracy. Keywords associated with this category include “拼写” (spelling), “发音” (pronunciation), “词性” (part of speech), “词形” (word form), “变形” (inflection), “词根” (root), “单复数” (singular/plural forms), “语法” (grammar), “读音” (pronunciation), “音标” (phonetic symbols) and “时态” (tense).

A comparison across free applications, paid applications and paper dictionaries revealed distinct patterns in user needs and vocabulary-engagement behaviours; see Figure 4. At the first classification level (receptive needs vs. productive needs), the distributions differed significantly across platforms (χ^2 test, $p = 5.40 \times 10^{-5}$), indicating substantial variation in the relative prevalence of receptive and productive needs among free applications, paid applications and paper dictionaries. To further identify the source of these differences, a residual

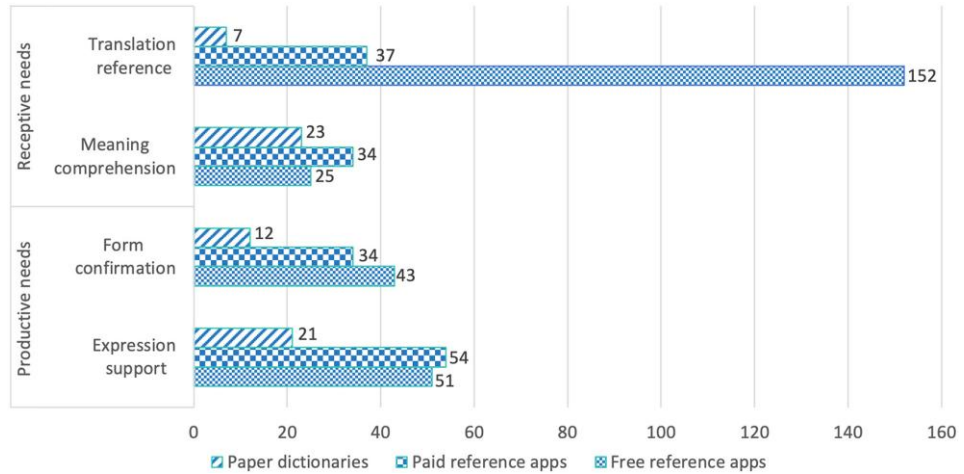


Figure 4. Comparison between receptive needs and productive needs in user reviews of English-Chinese paper dictionaries and mobile dictionary and translation applications.

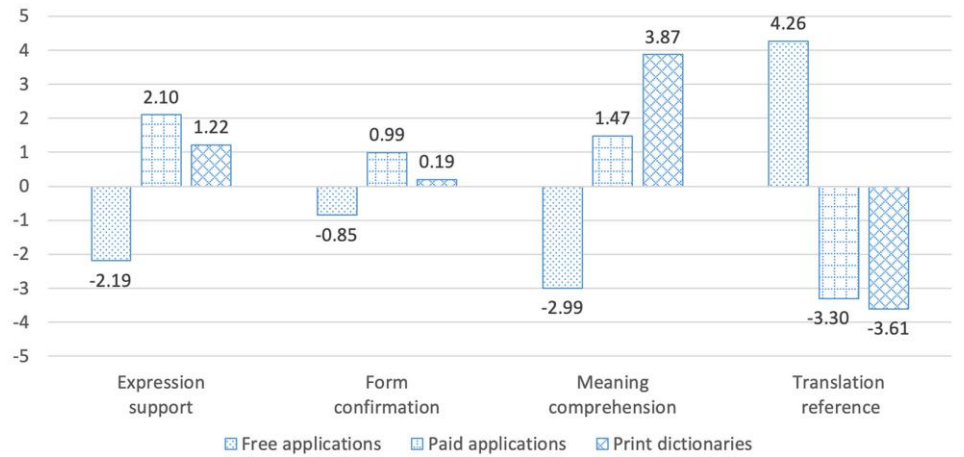


Figure 5. Residual analysis of receptive needs and productive needs in user reviews of English-Chinese paper dictionaries and mobile dictionary and translation applications.

analysis was conducted to determine which categories deviated most strongly from the expected values. At the second classification level (four subcategories), the distribution of needs differed markedly across reference types (χ^2 test, $p = 2.76 \times 10^{-15}$), with the largest deviations observed in translation reference, meaning comprehension, and expression support.

A residual analysis of a chi-square test of independence (standardised Pearson residuals, Z) reveals clear, platform-specific functional profiles; see Figure 5. By convention, $|Z| \approx 2$ indicates meaningful deviation from the expected frequency under independence, with larger magnitudes signalling stronger effects. Against this benchmark, translation reference is markedly over-represented in free digital applications ($Z = +4.26$) and under-represented in both paid apps ($Z = -3.30$) and print tools ($Z = -3.61$). Meaning comprehension shows the opposite tendency: it is disproportionately associated with print dictionaries ($Z = +3.87$) and under-represented in free apps ($Z = -2.99$). Within productive functions, expression support is modestly over-represented in paid apps ($Z = +2.10$) and modestly under-

represented in free apps ($Z = -2.19$), while form confirmation does not deviate meaningfully across platforms ($|Z| \leq 0.99$).

These deviations are theoretically coherent when considered alongside the affordances and use contexts of each platform. Free applications prioritise minimal time-to-answer (e.g., copy-paste, screenshot OCR, pop-up lookups), which lowers interaction costs and channels users toward rapid, translation-first decoding. The strong positive residual for translation reference ($Z = +4.26$), combined with negative residuals for meaning comprehension ($Z = -2.99$) and expression support ($Z = -2.19$), is consistent with solve-it-now needs that arise under immediate communicative pressure (e.g., messaging, browsing, errands). In such contexts, deeper semantic interpretation and iterative formulation help are comparatively less salient, yielding their observed under-representation.

Paid applications exhibit a complementary profile that reflects learning-oriented, productive engagement. Subscriptions are typically justified by premium features—curated collocations, rich example banks, usage notes, and writing aids—that scaffold language production beyond literal decoding. Accordingly, expression support is over-represented ($Z = +2.10$) and translation reference under-represented ($Z = -3.30$) in paid ecosystems. The data thus indicate that users with study or writing goals preferentially select paid tools that provide feedback loops for formulation (e.g., phrasing, tone, collocational fit), aligning with the design investment these platforms make in guidance-centric user experiences.

Print dictionaries retain a distinct niche centred on in-depth semantic interpretation. Their strong positive deviation for meaning comprehension ($Z = +3.87$) and strong negative deviation for translation reference ($Z = -3.61$) reflected the uninterrupted reading they would expect. Rather than servicing quick queries, print reference encourages slow, reflective consultation—appealing to users who prioritise accuracy, nuance, and trust in lexical description over immediacy.

Taken together, the pattern seen in [Figure 5](#) suggests that receptive functions remain dominant across the ecosystem, with free digital applications specialising in rapid decoding and print dictionaries offering semantic depth. Equally important is the non-trivial and proportionally significant presence of productive needs—most evident in paid applications—which reflects shifting user expectations. Contemporary reference tools are now judged not only on their ability to provide immediate answers, but also on their capacity to foster long-term expressive accuracy. For future development, particularly on AI-enhanced platforms, this calls for integrative designs that seamlessly combine decoding and encoding. Such platforms should preserve low-friction translation pipelines for just-in-time comprehension, embed context-aware usage guidance and collocation support to assist the transition into writing, and enable access to fine-grained semantic interpretation when precision is required. Ultimately, success will depend on creating adaptive workflows that fluidly accommodate both receptive and productive needs within a unified, user-centred architecture.

4. Analysis of the questionnaire responses

The questionnaire responses complement the user reviews by providing structured and detailed insights into users' engagement with reference tools, particularly regarding usage preferences, opinions about tool performance, and expectations for further development. See Addendum C for this questionnaire in Chinese, to which English translations have been added. The raw data of the questionnaire analysis, together with the various values expressed as percentages, bar charts, radar graphs, stacked line charts and word clouds, may be found in Addendum D.

The 16 questions from the questionnaire are referred to as Q1 to Q16 in the discussion which follows. This discussion proceeds sequentially from Q1 to Q16, except for a few questions that are 'skipped' at first and are then treated further down in order to bind the material thematically.

4.1 Demographic profile of the questionnaire participants

Q1: Among the 60 respondents, 43 (72%) were female and 17 (28%) were male. The significant predominance of female participants suggests that female users were more engaged in this study, which may reflect differential engagement or willingness to participate rather than underlying population-level usage patterns. **Q2:** Most of the participants were young adults, particularly those aged between 26 and 35 years old, who accounted for 40 (68%) of the respondents. Participants aged between 18 and 25 years old accounted for 15 (25%) of the respondents, while only 5 (8%) respondents were above 36 years old. This indicates that the survey primarily reached a young, active user base.

Q3: In terms of occupational status, most respondents were students ($n = 49$, 82%), followed by working professionals ($n = 9$, 15%). **Q4:** The educational background of the participants was generally high, with 37 (62%) PhD candidates, 9 (15%) undergraduates, and 5 (8%) Master's students. Additionally, the sample included 1 (2%) Master's graduate, 4 (7%) PhD holders, and 4 (7%) postdoctoral researchers. This indicates that the survey primarily engaged a highly educated population, with doctoral students forming the largest subgroup.

Q5: The participants' academic backgrounds were diverse: 27 (45%) were from Science and Technology disciplines, 15 (25%) from the Humanities, and 10 (17%) from the Social Sciences. A smaller number came from the Medical Sciences ($n = 4$, 7%), the Arts ($n = 2$, 3%), and other disciplines ($n = 2$, 3%). The distribution indicates that Chinese students in the surveyed overseas contexts are primarily from Science and Technology backgrounds.

Q6: Regarding English language proficiency, 28 (47%) participants had taken the International English Language Testing System (IELTS) exam, 22 (37%) had passed the College English Test Band 6 (CET-6) and 16 (27%) had passed the College English Test Band 4 (CET-4). CET-4 and CET-6 are national standardised English proficiency tests administered by the Ministry of Education of China, primarily designed to assess the listening, reading, and writing—and for the high scorers also speaking—competence of Chinese university students. A smaller number of respondents had taken the Test of English as a Foreign Language (TOEFL, $n = 4$, 7%) and the Pearson Test of English (PTE, $n = 1$, 2%). Additionally, 18 (30%) participants had not taken any standardised English proficiency tests but reported having frequent exposure to English in academic or everyday contexts. These findings suggest that most of the survey participants possessed solid English proficiency or were actively engaged in further improving their language skills.

4.2 Functional needs and usage context

Q8: According to the respondents the improvement digital and AI tools need most is 'usage' (e.g., examples and collocations), with a comprehensive score of 4.35, as seen in [Figure 6](#).

Note that the comprehensive score was automatically computed by the survey platform (Wenjuanxing) based on all respondents' rankings. Specifically, each option received a weighted average score calculated as

$$\left(\sum \text{frequency} \times \text{weight} \right) / \text{number of respondents.}$$

where the weight corresponded to the ranking position (e.g., in a list of n items, the top-ranked option receives n points, the second $n - 1$, and so on). Higher scores therefore indicate higher overall preference among respondents.

This finding aligns well with the argument made by [Hanks \(2002\)](#) where he critiques the traditional emphasis on semantic inventories and argues for a usage-based, syntagmatic approach to lexicographic design. Hanks emphasises that the meaning of a word is best revealed through its patterns of use in context, not through abstract, isolated definitions. No wonder, then, that the claim has been made that the forefather of GenAI in lexicography was none other than Patrick Hanks ([de Schryver, 2023b](#), p. 381; [2026b](#)). The questionnaire responses

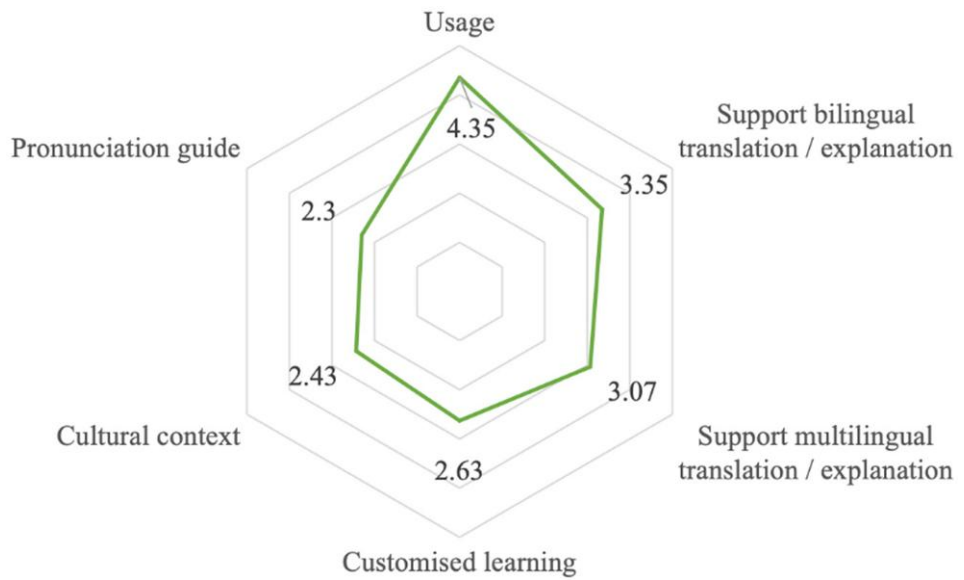


Figure 6. Type of improvements digital and AI tools need most, according to the Chinese questionnaire participants.

suggest that users intuitively value this approach, seeking tools that offer contextualised insights rather than static explanations. It reinforces Hanks’s wish that future lexicographic tools must prioritise examples and collocations in authentic contexts to support meaningful language learning and application. In addition to usage information, the second most important function valued by respondents was bilingual translation or explanation (with a score of 3.35), followed by multilingual translation or explanation (score of 3.07). The preference for bilingual tools may be attributed to the dominance of English in academic discourse and the respondents’ linguistic background—most being Chinese-speaking PhD students working or studying in international contexts. Additionally, the importance of multilingual support likely stems from the sociolinguistic context of a country like Belgium, where Dutch, French, and German are all official languages. In daily life, particularly for international students residing in cities like Ghent, access to multilingual explanations is crucial for navigating public services, housing, and community life.

Q9: Regarding preferred query methods, the respondents indicated that lookup typically involves *copying and pasting text* into translation or reference tools, with a very limited use of voice input; see [Figure 7](#).

Q10: In terms of contexts of use, the Chinese participants reported using English language tools more frequently in academia than in everyday life; compare [Figures 8](#) and [9](#). Across both academic and everyday scenarios, text reading and writing consistently emerged as the most frequent activities for which participants relied on language tools, while listening was reported as the least supported by such tools. The dominance of academic reading and academic writing as primary usage contexts is not unexpected, as the majority of respondents were Chinese students studying abroad, whose language needs are strongly driven by academic requirements. This finding echoes [Li and Tarp’s \(2024\)](#) observation that Chinese learners of English tend to rely heavily on written language tools in academic environments.

Q11: In terms of specific purposes, about half of the participants reported using these tools daily to access definitions and to obtain translations, and to assist with their writing tasks; see [Figure 10](#).

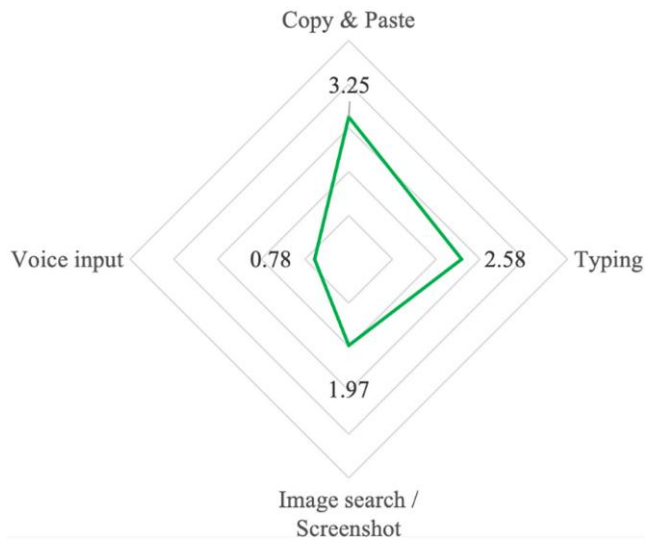


Figure 7. Preferred methods to search for words, according to the Chinese questionnaire participants.

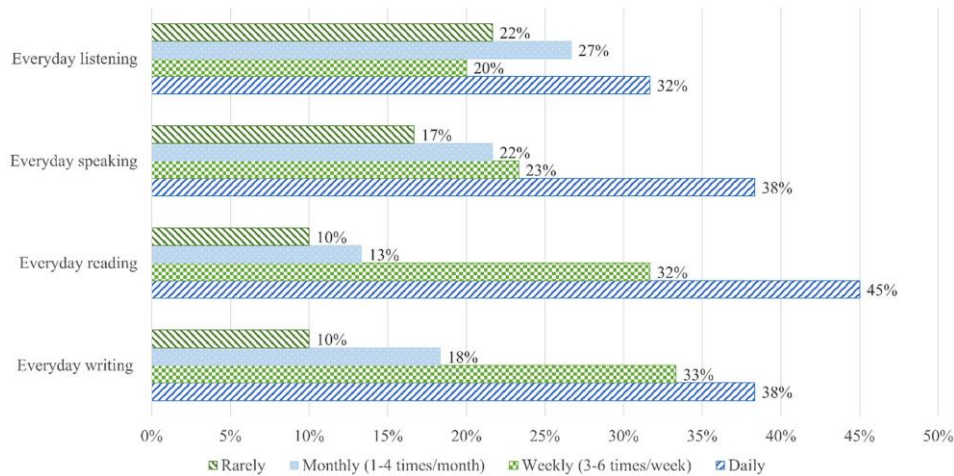


Figure 8. Frequencies of the types of activities with language tools in everyday contexts, according to the Chinese questionnaire participants.

These stated purposes are highly consistent with the dominant usage contexts identified earlier, particularly academic reading and academic writing. The frequent use of language tools for comprehension and composition reflects the participants’ strong academic needs and further underscores the central role these tools play in supporting their studies in a foreign language environment.

4.3 Tool preferences

Q7: The questionnaire results reveal that the participants demonstrated diverse preferences in selecting English reference tools; see [Figure 11](#). Similar to the findings of [Buendía-Castro \(2025, p. 110\)](#), machine-translation platforms (73%) and digital dictionaries (57%) are very

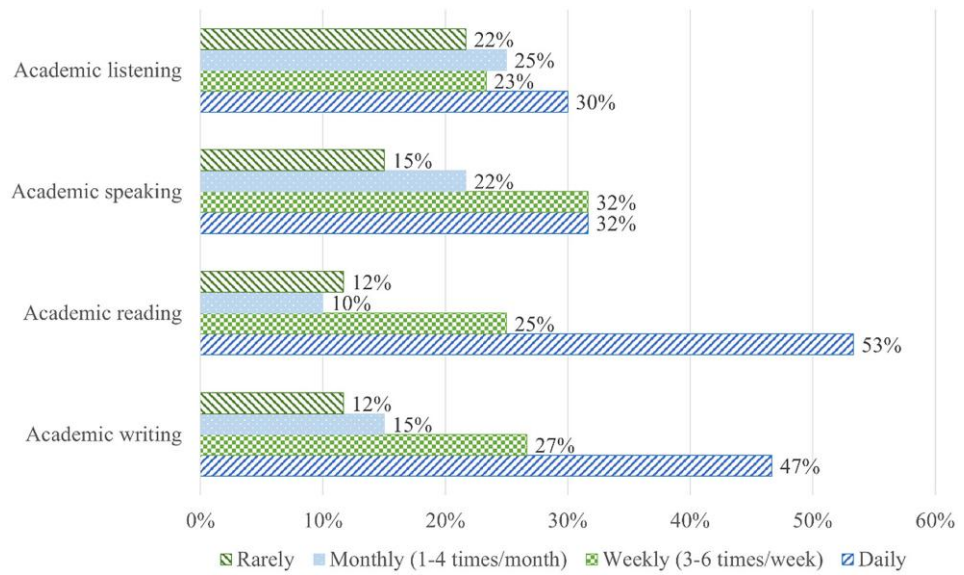


Figure 9. Frequencies of the types of activities with language tools in academic contexts, according to the Chinese questionnaire participants.

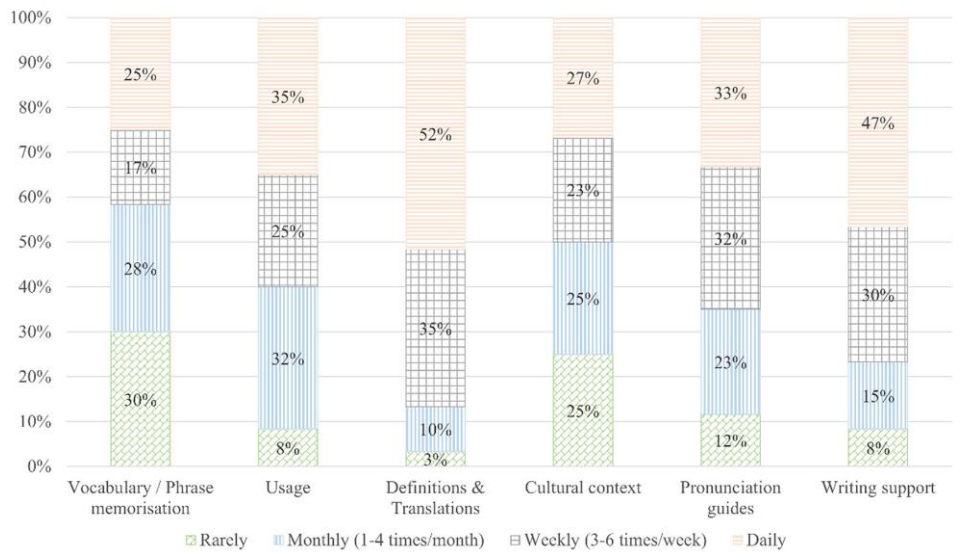


Figure 10. The link between the primary purposes of using language tools and their frequency, according to the Chinese questionnaire participants.

popular, while paper dictionaries are the least in demand (8%). This suggests that machine translation, which typically offers quick access and convenient translation services, is highly favoured by Chinese users. As to digital dictionaries, covered under the mobile apps, these applications offer portability and user-friendly interfaces, making them popular among student users who indeed frequently rely on mobile devices for language support. Also, but in

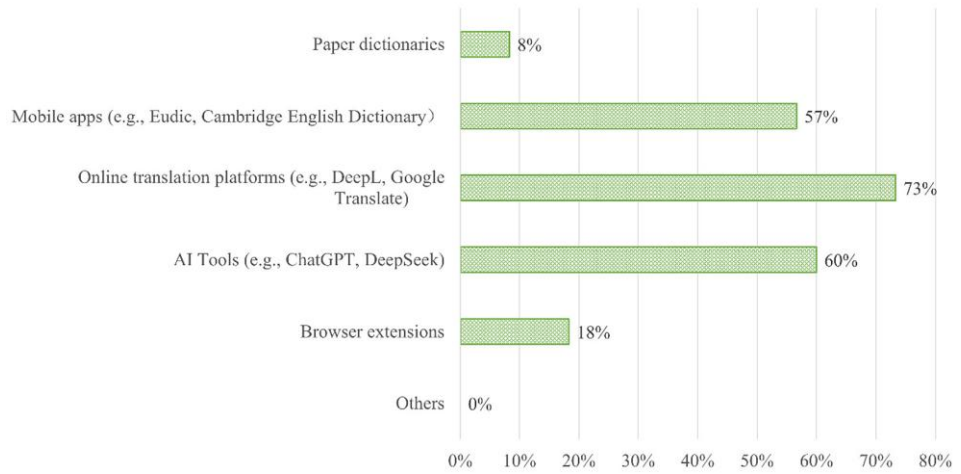


Figure 11. Language-tool preferences, according to the Chinese questionnaire participants.

contrast to Buendía-Castro (2025), the present study found that GenAI-powered tools, such as the LLMs ChatGPT and DeepSeek, are already the second-most sought-after reference tools (60%). This indicates the growing acceptance and integration of AI-based resources among Chinese overseas students, particularly in the context of the rapidly advancing era of GenAI technologies. The fact that traditional paper dictionaries were the least favoured confirms the decreasing reliance on paper dictionaries in contemporary language-learning contexts (Lew & de Schryver, 2014).

Q14(1): Further insights were obtained from the first part of the first open-ended responses, where participants were asked to list the paper dictionaries they currently use. A total of 38 respondents (out of 60, so 63%) explicitly stated that they no longer used paper dictionaries. Among those who still used them, Oxford was mentioned the most (9 users), followed by Longman (3 users) and Collins (2 users)—see the word cloud in Addendum D, where 牛津 is “Oxford”, and 词典 is “dictionary”. This further illustrates the diminishing role of paper dictionaries among the surveyed population.

Q14(2): The second part of the first open-ended responses further revealed the specific machine-translation and mobile-dictionary apps most frequently used by the participants. The Youdao (有道) Dictionary (词典) was by far the most frequently mentioned tool—in the centre and in big in the word cloud included in Addendum D. This is followed by Google Translate, DeepL and Eudic—in the word cloud as 欧陆 “European continent”, a typo for 欧路 “Eudic” (an error that seems particularly common among students studying in Europe, as the characters share the same pinyin input). Interestingly, classic dictionary brands such as Merriam-Webster, Collins and Cambridge were rarely mentioned in their app versions, each being cited only once by the respondents. This finding suggests that Chinese users studying abroad tend to favour multi-functional apps like Youdao and Eudic, which integrate multiple dictionaries, offer simplified word entries, and provide instant translations in an all-in-one interface. In contrast, traditional dictionaries, even in their digital forms, appear less appealing to these users, possibly due to their lack of integrated functions, or less user-friendly designs compared to popular Chinese-developed apps. The significant preference for Youdao and similar platforms indicates that accessibility, integrated resources, and ease of use may outweigh brand recognition when it comes to the language needs of the participants. This stresses the importance of practical convenience and localised user experience in the adoption of language tools among Chinese overseas students.

Q16: Participants were also invited to share their views on the ‘irreplaceable value’ of paper dictionaries, if they believed such value applied. That question was the only optional one,

and was specifically aimed at respondents who perceived that paper dictionaries might still hold some unique advantages. Those who believed paper dictionaries to be entirely replaceable were unlikely to provide an answer. Consequently, only 20 out of the 60 participants offered responses. Six of those 20 respondents explicitly expressed that they do not consider paper dictionaries to be irreplaceable. This suggests that, overall, at least 46 (77%) participants in the survey either considered paper dictionaries to be fully replaceable or did not find the topic relevant enough to even comment on it, reinforcing the observed marginal role of paper dictionaries in the current language-tool landscape. A mere 6 participants (a tenth) noted that paper dictionaries might only be irreplaceable in extreme circumstances, such as situations without internet access or electricity. Long gone are the days when [de Schryver \(2003](#), pp. 152-153) managed to still list a number of arguments in a section titled ‘The Unbeatable Paper Dictionary’ in favour of paper dictionaries.

4.4 Perceptions of AI

Q12: Regarding the use of AI tools, the majority of respondents reported a preference for using ChatGPT; see [Figure 12](#). Notably, DeepSeek ranked second, significantly outperforming other AI tools in terms of usage frequency. This result suggests that, while ChatGPT remains dominant in the current AI-assisted language-learning system, emerging tools such as DeepSeek are rapidly gaining traction, potentially due to their integration of LLMs with tailored functionalities for Chinese-speaking users. As noted by [Poo \(2025\)](#), DeepSeek is a highly efficient reasoning model that rivals top LLMs like ChatGPT. This may explain why DeepSeek has become a competitive alternative within a relatively short period of time, particularly for users who value affordability and technological openness. In addition to DeepSeek, other China-developed AI tools such as Doubao and Kimi were also frequently mentioned by participants—see the relevant word cloud in Addendum D, Q12*, where 豆包 is “Doubao”. The increasing visibility of these domestic AI tools indicates a growing diversification in user preferences and highlights the potential of China-developed AI products to meet the specific language and cultural needs of Chinese-speaking learners. This trend

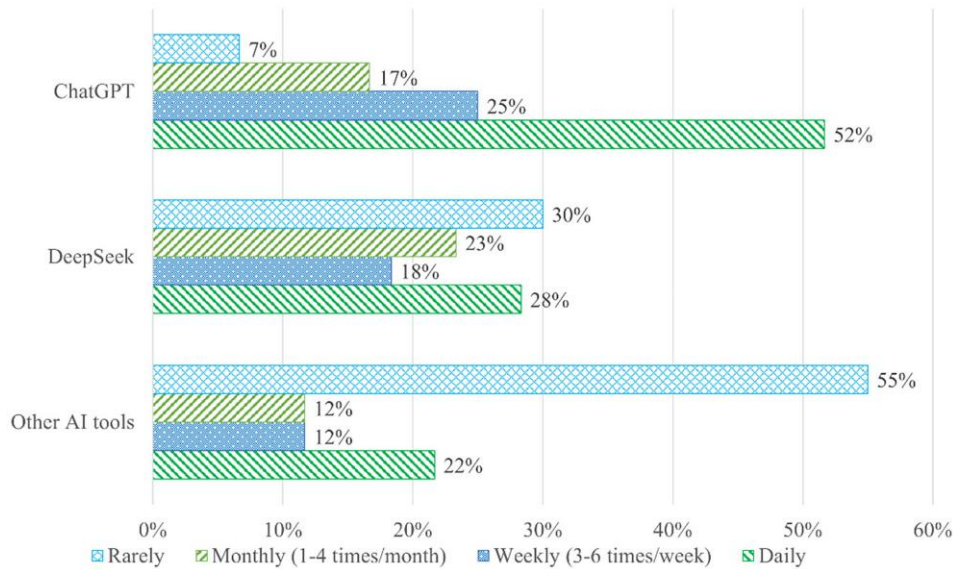


Figure 12. Usage frequencies of ChatGPT, DeepSeek and other AI tools, according to the Chinese questionnaire participants.

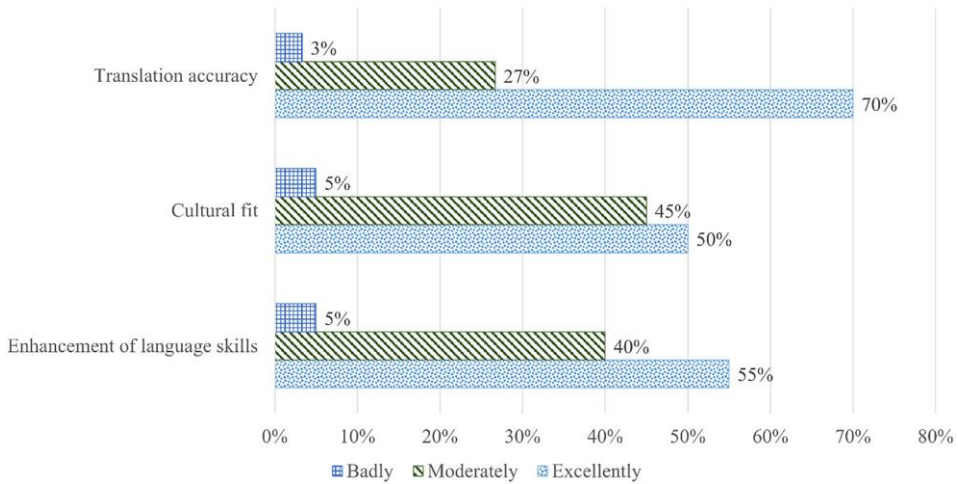


Figure 13. Performance of GenAI-tools on translation accuracy, cultural adaptability and language-proficiency enhancement, according to the Chinese questionnaire participants.

suggests that while global platforms like ChatGPT continue to lead, localised AI solutions are rapidly establishing their presence and may play an increasingly important role in language learning. This is supported by recent empirical evidence showing that the Chinese AI chatbot Kimi outperformed a bilingual dictionary app in vocabulary comprehension, collocation production, and retention among Chinese EFL learners (Chen, 2025).

Q13: As for users' perceptions of current AI-tool performance, most respondents expressed general satisfaction with the capabilities of AI systems. Among the three assessed aspects, translation accuracy, cultural adaptability and language-proficiency enhancement, participants were most inclined to acknowledge the strong performance of AI tools in terms of translation accuracy; see Figure 13. This indicates that AI systems are increasingly capable of providing reliable bilingual output, particularly in high-resource language pairs such as English and Chinese. Apart from accurate translation, a considerable number of users additionally recognised the benefits of AI tools in supporting language learning, suggesting that these language tools are valued not only as reference tools but also as effective aids for improving language proficiency.

However, perceptions of *cultural adaptability* were more divided. Exactly 50% of the respondents rated AI's performance in this area as good, while 45% considered it average, and 5% rated it as poor. This relatively lower level of satisfaction suggests that many users perceive current AI tools to be less capable of handling sociocultural nuances, pragmatic meanings, and contextually sensitive language use, indeed big issues in Chinese lexicography (Li & Xia, 2020). Such limitations may be attributed to the insufficient integration of culturally-grounded corpora or the lack of advanced contextual modelling in current AI systems, which are still predominantly optimised for lexical and syntactic accuracy rather than cultural depth and appropriateness. The outcome here is actually comparable to one of the outcomes of Q11 (Figure 10), in terms of the preference or not for 'cultural context' (e.g., idioms, encyclopaedic information) in modern language tools. The cultural context is the one and only aspect for which the attention given to it is simultaneously 'rare', 'monthly', 'weekly' and 'daily'—each of them ends up at a quarter. It is our conviction, however, that Chinese dictionary users have not yet discovered the true power of DeepSeek in this regard, as is for instance hinted at in Han & de Schryver (2025).

Q15: When asked about areas in need of improvement in either digital dictionaries or AI tools, the most frequently mentioned suggestion was the inclusion of more specialised

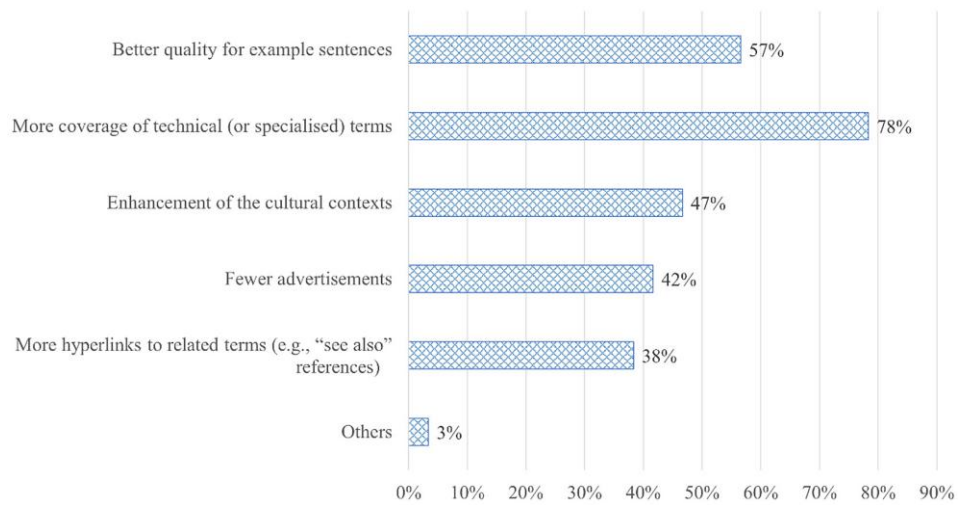


Figure 14. Areas which need improvement in current digital dictionaries and AI tools, according to the Chinese questionnaire participants.

terminology for academic or professional domains; see [Figure 14](#). This finding aligns with the earlier observations from Q10 ([Figures 8 and 9](#)) and Q11 ([Figure 10](#)), where participants reported using language tools predominantly for academic reading and writing, as well as discipline-specific tasks. This further supports the conclusion that users’ primary needs go beyond general language comprehension, emphasising the demand for precise, domain-specific lexical support in areas such as scientific writing, business communication, and legal translation. Recent empirical evidence indeed shows that incomplete or inaccurate entries in e-dictionaries may lead to sentence misinterpretation among advanced users ([Wang et al., 2025](#)).

The second-most-cited issue was the quality of example sentences, which echoes the results from Q8 ([Figure 6](#)), where participants overwhelmingly prioritised usage information, especially examples and collocations, as the most important function of digital reference tools to be improved upon. This continued emphasis on high-quality, authentic, and pedagogically valuable examples suggests that users not only seek accurate definitions and translations, see Q11 ([Figure 10](#)), but also require practical and context-rich usage scenarios to fully support their language learning and application.

The third area of concern was the limited availability of cultural background explanations, which closely corresponds with the findings from Q13 ([Figure 13](#)), where cultural adaptability received relatively lower satisfaction ratings compared to translation accuracy and language learning support. This consistent pattern indicates that users expect digital lexical resources and AI tools to move beyond linguistic accuracy and begin offering deeper semantic insights and intercultural interpretability.

5. Further elaborations on the results

Our investigation into Chinese user perspectives on language service technologies and reference works consisted of two components: an analysis of user reviews of English-Chinese language tools, and an analysis of a user questionnaire regarding Chinese-English dictionary and AI-tool usage.

The study of 1,538 **user reviews** primarily focused on users’ word-related behaviours, specifically word lookup and word memorisation, as well as the receptive and productive needs reflected in their comments. In free reference tools, word lookup was mentioned more

frequently than word memorisation, whereas the opposite trend was observed in paid reference tools. Moreover, receptive needs were more frequently emphasised than productive needs in free reference tools, while paper dictionaries showed a relatively balanced distribution in this regard. The prominence of productive needs in the group of paid reference tools suggests that when users invest, it is in tools that can support active language production, indicating a serious demand for such features.

The 60 participants providing the **questionnaire responses** were from relatively high educational backgrounds and their expectations for language tools naturally surpassed simple meaning retrieval. The respondents expressly emphasised the need for specialised academic support, especially in reading and writing contexts. In addition to understanding word meanings, users also express a strong desire to learn how to correctly use the language in practice.

Regarding **lookup methods** (Q9), respondents demonstrated a clear preference for copying and pasting text, which emerged as the most frequently used approach. This method is widely favoured for its convenience and efficiency, especially when interacting with digital content where text can be easily selected and transferred into translation or dictionary tools. Typing was the second-most-common method, presumably when copy-paste is not possible. The third-preferred method was image-based recognition, such as taking photos or screenshots for text extraction and translation, which is particularly useful when the text is non-editable, visually complex or simply in an unreadable script for the user. As pointed out in the concluding section of the *Cambridge Handbook of the Dictionary* (Finegan & Adams, 2024), in a chapter titled ‘The Future of Dictionaries’ (written in 2021 in memory of the passing of Sue Atkins, but only published three years later):

‘Whereas travel to exotic places used to be truly challenging, including in linguistic terms, future dictionaries and the language tools in which they will be embedded will contribute to the illusion that the world’s rich diversity is gone, and in so doing will hasten its actual homogenization. An Ethiopian who wishes to order a dish in China where the menu is in Mandarin only? No problem, point your smartphone to the Chinese characters, and hear them pronounced in Amharic. Then speak and order in Amharic and have your smartphone do the talking for you in Mandarin. A Japanese who wants to make sense of an email sent in Greek? No problem, simply dump the contents into Google Translate. Then compose an answer in Japanese and do the reverse: the answer arrives in Athens in perfect Greek.’

— de Schryver (2024a, p. 663)

Rather surprisingly, voice input was the least-used method among the participants, possibly due to concerns about accuracy, situational appropriateness, or the impracticality of using voice commands in certain environments. These findings suggest that users prioritise speed, precision, and ease of integration with digital workflows, while newer modalities like voice input may still face usability and acceptability challenges.

While the **majority of users already transitioned to digital tools** (Q16), a small number of participants continued to value paper dictionaries in specific or exceptional contexts, and their perspectives should not be overlooked. These users emphasised several distinct advantages of paper dictionaries. Some viewed them as more authoritative and reliable, with one participant noting that they typically offer more comprehensive annotations, classic fixed expressions, and illustrative examples. Others highlighted their archival and historical value, pointing out that paper dictionaries can serve as essential linguistic records for tracing language changes over time; for instance: modifications in pinyin pronunciation that can only be verified through older editions. Practical considerations were also mentioned: for certain smaller or less-resourced languages, electronic versions may not exist at all. Additionally, a few respondents appreciated the ability to annotate entries directly, on paper, which they felt better supported individual learning habits. Two participants stressed the continuing necessity of paper dictionaries in exam settings, where digital tools are not permitted. Finally, one

user suggested that for younger learners, the use of paper dictionaries may help foster concentration and reduce the distractions often associated with digital devices.

These findings suggest that while **the mainstream use of paper dictionaries is clearly declining**, certain functional, educational, and even archival advantages are valued by some users. This presents an important consideration for lexicographers in future dictionary development. There appear to be two possible directions: one is to actively integrate the perceived irreplaceable qualities of paper dictionaries, such as their role in information preservation and their historical-documentary value, into the design of future lexicographic resources; the other is to leave these advantages exclusive to paper dictionaries, allowing them to retain a unique position alongside digital tools. What is certain, however, is that to remain relevant and competitive in the digital era, future lexicographical tools must go beyond superficial digitisation and instead embrace modern technologies to deliver well-designed, high-quality, and user-focused online resources (Leuckert, 2024). Researchers also point out that if dictionaries as lexically-oriented reference tools are to compete with general search engines, then they should embrace modern technologies by offering truly digital tools for the benefit of the present and future users (Kosem et al., 2019). Notably, the perceived advantages of paper dictionaries in the domain of small languages may gradually diminish in the future. Recent work by de Schryver (2025a) has demonstrated that, with the use of customised GPT models, even an oral language like Lusoga—no doubt forever a low-resource language—is beginning to show potential for successful lexicographic processing by GenAI.

Overall, the **recurring concerns** across multiple questions (see especially Q15) highlight the strong user expectations for (1) more specialised, (2) authentic, and (3) culturally-informed language support—in both digital-dictionary applications and AI tools. The first concern, on terminology, brings to mind the colleagues associated with the Center for Lexicography at Aarhus University, and their theory of lexicographic functions, who have argued that future dictionaries must significantly improve their coverage of Language for Specific Purposes (LSP) terminology. For over three decades, they have emphasised that dictionaries should move beyond traditional linguistic descriptions to become functional utility products that address the specific needs of users in extra-lexicographical situations (Bergenholtz & Tarp, 2003). With GenAI chatbots, we may very well finally be closing in on this goal now (Fuentes-Olivera, 2025). Going forward, and assuming that all future lexicographic products will be driven by GenAI, the second concern brings to mind one of the COBUILD revolutions, namely the insistence on corpus-based examples over hand-crafted ones (Fox, 1987). Luckily, examples generated by GenAI are closer to ‘authentic’ examples than hand-crafted pedagogical ones (de Schryver, 2023b). As to the third concern, Huang (2020) is one of several scholars who has pointed out the problems with treating cultural words in Chinese foreign dictionaries. That this may indeed be solved by GenAI, more in particular DeepSeek, is covered in de Schryver & Han (forthcoming).

6. The future of Chinese lexicography in the era of GenAI ... *may lead to DeepSeek*

Nowadays, learners actively select from paper dictionaries, free applications, paid language services, and AI-supported tools based on factors such as accessibility, cost, reliability, and individual learning objectives. In the current digital age, users no longer expect reference tools to function merely as static platforms. Instead, they increasingly seek dynamic, multi-functional environments that integrate linguistic precision, contextual richness, and a user-adaptive design—expectations that especially GenAI-powered tools are uniquely positioned to meet. While technological progress continues to accelerate, an understanding of how users interact with diverse reference tools in real-world settings remains incomplete.

Several limitations of the present study should be acknowledged. First, although user reviews and questionnaire responses offer valuable insights into users’ perceptions and self-reported behaviours, the information provided is often insufficiently comprehensive, and

the questionnaire sample size is relatively small, which together restrict deeper inference about users' underlying motivations and consultation processes. Future research could therefore employ larger samples and complement survey data with in-depth interviews. Second, as the study relies primarily on self-reported data from Chinese users, these findings may not fully reflect their actual tool use in real-time contexts. Future research could use behavioural methods, such as eye-tracking or screen-recording, to capture more detailed and ecologically valid usage patterns. Third and final, while this study maps current user perceptions and stated user behaviours, the practical effectiveness of emerging AI systems such as DeepSeek for the compilation of reference works, as knowledge bases themselves, or even as professional language tutors in their own right, remains to be empirically evaluated.

That said, it is worth noting that DeepSeek has already emerged as the second most frequently used GenAI tool after ChatGPT for the Chinese respondents. With its open-source accessibility, free availability, and its development within the Chinese context, DeepSeek actually holds considerable potential to become the number one lexicographer, especially for Chinese-speaking users.

Supplementary material and data availability

- Addendum A - User Reviews
- Addendum B - User Reviews Analysis
- Addendum C - Questionnaire
- Addendum D - Questionnaire Analysis
- Python code
 - all available from the Open Science Framework (OSF) at <https://osf.io/bqpxr/files/osfstorage>
(Note that in case there is a problem with OSF's ability to generate a preview of a file, all material remains available for download at OSF.)

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- Data curation: WH
- Formal analysis: WH
- Funding acquisition: WH & G-MdS
- Investigation: WH & G-MdS
- Methodology: WH & G-MdS
- Project administration: G-MdS
- Resources: WH & G-MdS
- Software: WH
- Supervision: G-MdS
- Validation: WH & G-MdS
- Visualisation: WH
- Writing - original draft: WH
- Writing - review & editing: G-MdS

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