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PRE-SERVICE TEACHER'S PERCEPTIONS OF DISAINARY FOR LEARNING ENGLISH SCIENTIFIC VOCABULARY: A QUALITATIVE STUDY

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ABSTRACT

The globalization of science has reinforced English as the dominant language of scientific communication, requiring pre-service science teachers to acquire sufficient mastery of English scientific terminology for academic and professional success. However, many pre-service teachers in Indonesia face persistent challenges, including limited vocabulary, low confidence, and insufficient access to effective learning media. To address these issues, digital tools such as Disainary, a multimodal web-based dictionary designed for scientific terms, have been introduced as innovative learning resources. This study aims to explore pre-service science teachers' perceptions and experiences of using Disainary in vocabulary learning. Employing a descriptive qualitative design, data were collected through semi-structured interviews and classroom observations with 30 participants across several universities in Indonesia. This used purposive sampling technique to employ the participants. The findings indicate three major themes: (1) vocabulary acquisition through repetition and multimodality, (2) increased motivation and engagement, and (3) challenges and limitations. Participants highlighted that Disainary facilitated repeated encounters with scientific terms through definitions, contextual examples, and pronunciation features, which enhanced comprehension and retention. Moreover, the tool's accessibility and scientific contextualization motivated learners to engage with vocabulary more actively. Despite these benefits, participants emphasized the need for expanded lexical coverage, additional exercises, and the visual elements to optimize learning. The study concludes that Disainary holds strong potential as a digital learning tool to bridge the gap between English vocabulary acquisition and science literacy in teacher education. Implications suggest that integrating multimodal digital tools can not only enhance pre-service teachers' language proficiency but also prepare them for effective knowledge transmission in globalized science classrooms.

Keywords: Digital Learning Tools; Disainary; Pre-service Science Teachers; Scientific Vocabulary

INTRODUCTION

English has become the primary medium for scientific communication, positioning it as an essential tool in education, research, and professional practice. The advances in

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information technology have further accelerated the spread of scientific information, making access to English-language materials indispensable. For students and professionals alike, particularly those in science-related disciplines, proficiency in English is no longer optional but rather a prerequisite for active engagement in the global academic community. The people who pursue education as their major are expected not only to acquire scientific knowledge but also to disseminate it. Thus, the pre-service teachers cannot afford to ignore the mastery of English scientific terms. Indeed, mastery of English scientific terms is inseparable from their professional responsibility as knowledge transmitters, making vocabulary competence a foundational component of their pedagogical preparedness (Andayani, 2022).

This issue becomes evident when considering the scale of education students in Indonesia. Data from PDDIKTI indicate that more than two million students are enrolled in education programs nationwide. These pre-service teachers have the responsibility to master English for their own academic development and to equip their future students with the linguistic tools needed. Despite this pressing need, however, pre-service science students in Indonesia remain insufficiently proficient in English. Their struggles are compounded by the fact that most scientific resources, academic journals, and even informal references to science concepts in daily life are presented in English. Thus, the pre-teacher science students have no choice but to improve their proficiency in English to be able to learn academic content (Lee & Cory A. Buxton, 2013).

Pre-service teachers face multi-dimensional challenges, particularly in the linguistic aspect. Previous research has identified issues such as limited vocabulary mastery, low confidence in speaking, difficulties in understanding scientific meanings, and the inadequate use of learning media (Rohmani, 2025). These challenges are critical, given that vocabulary underpins both the structural and conceptual foundations of science literacy. Foundation studies such as Shaw et al. (2014) and Gardner & Davies (2014) establish the theoretical importance of academic vocabulary in constructing scientific meaning and enabling academic communication. Building on this foundation, more recent studies demonstrate that science literacy supported by strong vocabulary knowledge enhances learners' contextual understanding and higher-order thinking skills (Oktaviani & Faizah, 2024). Weaknesses in vocabulary, therefore, hinder not only language competence but also broader scientific understanding. This challenge is further intensified by the rapid development of scientific terminology across disciplines such as biology, chemistry, physics, and technology, which often leads to misconceptions and increased cognitive load for pre-service science teachers.

Referring to Aina et al. (2013), the science students perform less compared to the technical education students in English proficiency. Otherwise, the study reveals that English proficiency is correlated with academic performance in both study programs. This correlation underscores the importance of strengthening English skills, particularly vocabulary, for pre-service science teachers whose academic and professional futures depend on it. In seeking solutions, scholars have argued for multimodal approaches to science literacy. Townsend et al. (2018) believe that the development of science literacy is optimally supported through multimodal approaches, whereby language, visual and

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auditory media, writing, and digital tools collectively facilitate the communication, comprehension, and demonstration of scientific knowledge. For instance, Kay (2011) demonstrated that multimodal web-based learning tools, such as computer simulations integrating visual, auditory, and written modes, can enhance teachers' technology integration, foster student engagement, and support differentiated learning in science classrooms.

Several studies illustrate both the promise and the limitations of such approaches. Idayani et al. (2025) attempt to address the problem in pronouncing English words for science students, especially in science. They implement the "English Pronunciation IPA" application to solve the issue. They reveal that language interference and phonology knowledge were the main factors that affected students' pronunciation. While Idayani et al. (2025) successfully addressing pronunciation issues, their approach does not engage with vocabulary comprehension or contextual usage, which are essential for science literacy. Hindrasti & Amelia (2018) demonstrate that biology pre-teachers could elevate their science literacy by using an English module. Yet, their intervention was limited to biology and did not extend to other crucial domains such as chemistry, physics, and technology. Taken together, these studies demonstrate that although digital and multimodal interventions can support specific aspects of language learning, they remain fragmented, narrowly focused, and discipline-bound, offering limited support for comprehensive scientific vocabulary development among pre-service science teachers.

The persistence of vocabulary-related challenges in science education demands more innovative solutions. As Septiani et al. (2025) emphasized, scientific terms often differ significantly from everyday language, making their mastery indispensable. However, traditional methods of vocabulary learning remain insufficient for meeting the needs of 21st-century science students. In the era of globalization, where science transcends national boundaries and linguistic barriers, a clear correlation exists between mastering English scientific terms and achieving success in science education (Cohen, 2012). Vocabulary research in EAP helps identify the specialized words and multi-word units learners need and use in writing, highlighting how technical vocabulary is often discipline-specific, rarely encountered outside its field, yet essential for both specialists and non-specialists to communicate effectively (Coxhead, 2018).

It is globally recognized that vocabulary plays a central role in science literacy, as it forms the conceptual foundation necessary for understanding scientific phenomena. This is further supported by empirical findings. Studies of Semartini, Ariyanti, and Rahmawati (2023) and Giawa and Panjaitan (2021) found a significant correlation between students' mastery of scientific vocabulary and their science reading comprehension (Ariyanti et al., 2023; Giawa & Panjaitan, 2021). Their study indicates that students with a stronger command of science-related vocabulary demonstrate higher levels of comprehension when engaging with scientific texts. For pre-service science teachers, mastering English scientific terms is essential not only for accessing research literature but also to effectively communicate in a scientific global context and for teaching in bilingual or international contexts. It also reinforces the argument that vocabulary mastery is a key predictor of success in science learning.

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Despite its importance, vocabulary learning in science remains constrained by well-documented challenges. However, many students in non-English-speaking countries struggle with scientific terminology due to limited exposure, complex morphology, and domain-specific usage. Moreover, repetition has been identified as a central factor in vocabulary acquisition (Nation & Richards, 2017). However, the density of unknown words in a text, the number of unfamiliar terms, and the overall frequency of words in the language all indirectly shape the learning process. These factors can overwhelm learners, reduce motivation, and increase cognitive load, making vocabulary learning particularly challenging in scientific contexts. The integration of Disainary facilitates systematic and repeated encounters with scientific terms through multimodal input. Moreover, by mediating the challenges posed by unknown word density, number of unfamiliar terms, and overall word frequency, Disainary enhances learners' capacity to manage cognitive load while sustaining motivation in vocabulary learning.

What is already known is that English scientific vocabulary is critical for science literacy and academic success. Despite extensive research on scientific vocabulary and multimodal learning, little attention has been given to an integrated, discipline-spanning digital vocabulary tool designed specifically for pre-service science teachers. To address this gap, the present study explores Disainary, a web-based digital dictionary tailored to English scientific terms. It examines how pre-service science teachers perceive and experience its use as a learning tool to face the vocabulary challenge. Unlike previous studies that focus on isolated language skills or single science disciplines, this study examines pre-service science teachers' experiences with a multimodal digital dictionary designed to support scientific vocabulary learning across multiple science fields.

It is in this context that digital learning tools such as Disainary present significant potential. Disainary is a digital dictionary, web-based, specifically designed to provide clear definitions, contextualized examples, and visual representations of English scientific terms. It is accompanied by the pronunciation audio to help users learn the correct way to pronounce it. Not only that, Disainary also gives examples on how to use the sentence in a scientific context. Unlike conventional dictionaries, it integrates multimodal features aligned with contemporary learning theories. By providing systematic and repeated encounters with scientific vocabulary, Disainary enhances the retention of terms while supporting learners' capacity to infer meaning and manage the challenges posed by unknown word density. Moreover, by combining textual and auditory input, it sustains learner motivation and reduces the cognitive barriers typically associated with vocabulary learning.

Thus, the integration of Disainary into pre-service teacher education offers a promising response to the enduring vocabulary gap. It not only addresses learners' immediate challenges with English scientific terms but also equips them with the linguistic tools necessary for their future roles as science educators. As English continues to dominate the global landscape of science, pre-service teachers must acquire the capacity to navigate and teach scientific knowledge in English with confidence and accuracy. Given these considerations, the present study aims to explore how pre-service science teachers perceive and experience the use of Disainary in learning English scientific terms.

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Specifically, this research seeks to answer the question of how pre-service science teachers view and experience using Disainary as a learning tool.

METHODS

This research employs a descriptive method as its foundation and adopts a qualitative approach in its methodology. The primary objective of this method is to obtain the meaning, perceptions, experiences, and opinions of the participants who serve as data sources, to provide an accurate description of the phenomenon under study. Specifically, this study seeks to systematically describe how pre-service science teachers perceive and experience the use of Disainary as a digital learning tool for mastering English scientific terminology.

Following Bogdan and Taylor's definition in Moleong (2019), a qualitative research generates descriptive data in the form of written or spoken words and observable behavior. This design is particularly suitable for exploring participants' lived experiences, which cannot be captured through quantitative measures alone. In this context, the focus is on obtaining rich, contextualized insights into the challenges faced by pre-service science teachers in vocabulary acquisition and how Disainary mediates these challenges.

The participants consisted of thirty pre-service science teachers enrolled in teacher education programs at several universities in Indonesia. They were selected using purposive sampling, with the criteria that participants had a science education background and had prior experience using Disainary in their learning activities. Participation was voluntary, and all participants provided informed consent before data collection, with assurances of confidentiality and anonymity.

Data collection involves semi-structured interviews and classroom observations. The interviews were conducted individually, lasting approximately 30-45 minutes per participant, and focused on their experiences, perceptions, and challenges in using Disainary for learning English scientific terms. Classroom observations were carried out over two instructional sessions to document how Disainary was utilized in authentic learning contexts, including patterns of interaction and engagement with the tool.

In line with Moleong (2019), data analysis is conducted continuously throughout the research process. The analysis followed thematic analysis procedures, beginning with open coding to identify meaningful units of data, followed by categorization to group similar codes, and theme development to capture recurring patterns related to vocabulary learning and digital tool use. The emerging themes were then interpreted to provide a systemic and comprehensive understanding of the phenomenon. The qualitative approach enables the study to examine not only the functional use of Disainary but also its pedagogical implications for science teacher education.

RESULTS

Vocabulary Acquisition through Repetition and Multimodality

The present study aims to explore how pre-service science teachers perceive and experience the use of Disainary in learning English scientific terms. Specifically, this

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research seeks to answer the question of how pre-service science teachers view and experience vocabulary acquisition through repetition and multimodality of using Disainary as a learning tool. Table 1 below shows the results of pre-service science teachers' views and experiences of repetition and multimodal vocabulary learning.

Table 1. Vocabulary Acquisition through Repetition and Multimodality

Frequency	Repetition and Multimodality
25 PST	Repetition supports memory
23 PST	Multimodality through textual and contextual features
25 PST	Increase vocabulary retention
27 PST	Preferred digital tool

The research findings reveal that pre-service science teachers viewed repetition as a central factor in vocabulary acquisition when using Disainary. Most participants reported that repeated exposure to scientific terms through frequent dictionary consultation strengthened memory and improved recall. The participant PST 8 stated that, "I didn't try to memorize the words, but because I kept checking the same terms, they stayed in my memory." This sustained interaction enabled learners to become more familiar with technical terminology, reduced hesitation in use, and contributed to noticeable improvement in science vocabulary over time.

In addition, participants highlighted the role of textual and contextual multimodality in supporting comprehension and engagement. The combination of definitions, pronunciation support, and example sentences helped learners understand how terms functioned in scientific contexts, even in the absence of visual or audiovisual features. As mentioned by PST 15, "The example sentences really helped me understand how the word is used in science, not just the meaning." The majority of respondents also expressed a clear preference for Disainary over traditional dictionaries, describing the digital format as easier and more enjoyable to use, which encouraged more frequent vocabulary practice and sustained engagement.

However, a notable contradiction emerged regarding multimodality. While many participants valued the existing textual and auditory elements, others perceived multimodality as incomplete due to the absence of visual or audiovisual components. Some learners felt that abstract scientific concepts would be easier to understand if images or diagrams were included. This indicates differing learner needs. While repetition and textual multimodality were sufficient for some, others required richer visual support to deepen comprehension.

Classroom observation showed that pre-service science teachers frequently used Disainary as part of their learning activities, resulting in repeated exposure to scientific vocabulary. Students were observed consulting the dictionary multiple times during reading, discussions, and task completion, which facilitated memory reinforcement and improved recall. Although the tool lacks visual and audiovisual features, learners actively engaged with its textual multimodal elements, such as definitions, pronunciation support,

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and example sentences, to clarify meaning and usage. The observations also revealed improved vocabulary application, as students confidently and accurately used previously consulted terms in oral and written tasks. Furthermore, the ease of access and efficiency of the digital format encouraged autonomous and sustained use, indicating that Disainary supported both vocabulary retention and learner engagement in classroom contexts.

Motivation and engagement

This study examines teachers' perceptions and experiences of the use of Disainary in learning English scientific terms. Specifically, this research seeks to answer the question of how pre-service science teachers (PST) view and experience the use of a Disainary to support motivation and engagement. Table 2 below shows the result of pre-service science teachers' views on the use of Disainary to support their motivation and engagement.

Table 2. Motivation and Engagement of Disainary

Frequency	Motivation and Engagement
26 PST	Increased learning motivation
25 PST	Autonomy in learning
25 PST	Behavioral engagement
22 PST	Emotional engagement

The findings indicate that the use of Disainary contributed positively to both motivation and engagement among pre-service science teachers. A substantial proportion of participants reported increased learning motivation, noting that the digital dictionary reduced the effort required to search for unfamiliar scientific terms. As noted by PST 2, "When I meet difficult terms, I don't feel stressed anymore because I can directly check them." This ease of access made vocabulary learning feel more manageable and less frustrating, particularly when engaging with complex scientific texts. In addition, many participants emphasized the role of Disainary in fostering learner autonomy. By allowing immediate clarification of meanings without dependence on lecturers or peers, the tool supported independent learning practices and encouraged students to take greater responsibility for their vocabulary development.

In terms of engagement, the data reveal strong evidence of both behavioral and emotional involvement. Frequent and repeated use of Disainary during reading activities, classroom discussions, and task completion reflects active behavioral engagement with learning processes. Participants also reported emotional benefits, including increased confidence and reduced anxiety when encountering unfamiliar scientific terminology. This emotional engagement appeared to support sustained participation and willingness to use new vocabulary in academic contexts.

Classroom observations support the interview findings by showing that pre-service science teachers frequently and independently used Disainary during reading, discussions, and task completion, reflecting strong behavioral engagement and learner autonomy. The quick access to vocabulary meanings appeared to reduce frustration and hesitation,

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allowing students to remain focused on learning activities. Observations also indicated increased confidence, as students used scientific terms more readily in classroom interactions, suggesting that Disainary contributed positively to motivation and engagement. The content of Disainary is shown in figure 1 below.

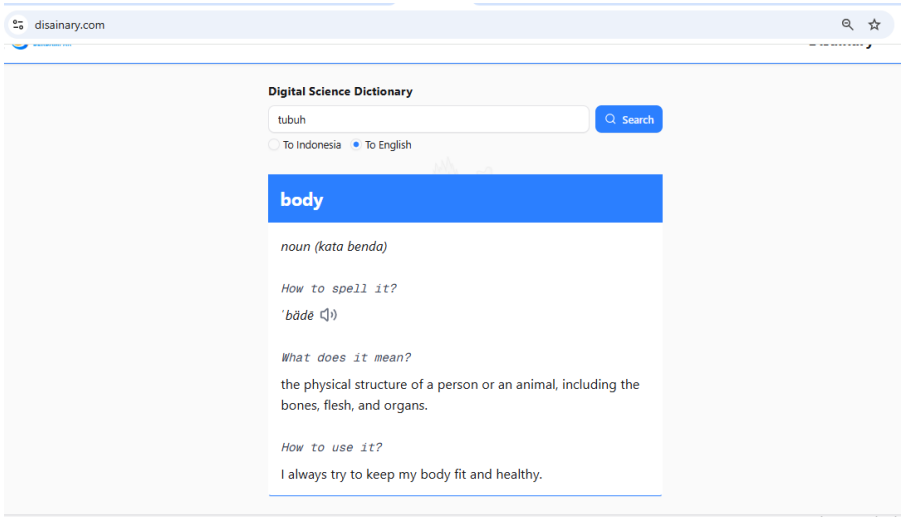

Figure 1. Disainary

Challenges and limitations

Despite the positive responses, participants also identified certain limitations. The result of pre-service science students (PST) views on challenges and limitations of Disainary are presented in Table 3 below.

Table 3. Challenges and limitations of Disainary

Frequency	Challenges and Limitations
26 PST	Limited multimodal features
18 PST	Technical constraints
20 PST	Limited vocabularies

The data above reveal several challenges and limitations in the use of Disainary as reported by pre-service science teachers. A large proportion of participants indicated that the absence of multimodal features, such as images, videos, and diagrams, limited their ability to visualize and fully comprehend abstract scientific concepts. It is proven by the comment from PST 22, “For science terms, sometimes I need pictures to really understand the concept.” Technical constraints were also identified as a notable concern, with some participants reporting that unstable internet connectivity and slow system responses occasionally disrupted learning activities. In addition, a number of pre-service teachers noted limitations in vocabulary coverage, explaining that certain scientific terms were not

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available in the dictionary, which reduced its usefulness during content-intensive learning tasks.

These perceptions were supported by classroom observations, which showed that students sometimes paused their activities when terms were unavailable or when access was interrupted by technical issues, and that learners often sought additional resources to compensate for the lack of visual support. Overall, both interview and observation data indicate that while Disainary is beneficial as a reference tool, its effectiveness is constrained by limited multimodal support, technical reliability, and incomplete vocabulary coverage.

DISCUSSION

The findings indicate that the use of Disainary enhances pre-service science teachers' vocabulary acquisition through repetition and multimodality, increases motivation and engagement, and encounters challenges and limitations. The participants consistently reported that Disainary provided multiple exposures to scientific terms, which significantly enhanced their retention. The availability of definitions and contextual examples supported deeper understanding. Moreover, the tool gives access to the participants to hear the correct pronunciation of each word. PST 5 expresses her feeling after using Disainary, "After reading the example sentences of the words, I find it easier to remember the complex science terms such as convergent and divergent". This proves that the multimodal features of Disainary address the challenge of limited exposure to specialized vocabulary in traditional classrooms. It is also aligned with the research result of Hansen (2024), which emphasizes that multimodal approaches enhance learners' word retention and engagement.

The majority of participants asserted that Disainary motivates them to learn scientific English. Panagiotidis & Arvanitis (2023) support this, that motivation can increase if there is a combination of technology in the learning process. When used in English language study, technology-based media will provide many advantages (Sidarta et al., 2025). Technology makes classes more engaging and can improve language skills, including reading, writing, speaking, and listening (Othman, 2025). This e-dictionary helps them to find the unfamiliar words of science as well as their context. It is different from other tools that cannot provide the scientific context that they need. Several participants also highlight how convenient it is. "It is really easy to use. I don't need to make an account and just get what I need in seconds.", said PST 19. Their excitement while using this tool reflects on how they smile when finding the terms and discussing them with friends.

Despite the positive responses, participants also identified certain limitations. A few participants face unstable internet connectivity. Others suggested that the tool could be more helpful for individual learning if it added exercises. They need to test their own understanding after learn the scientific terms. PST 17 enlightened us that Disainary should be improved from time to time. "I cannot find the unfamiliar words such as autotroph and abyssal in this e-dictionary. Maybe it can be updated.", he said. Thus, the coverage of terms should be expanded to include more advanced scientific vocabulary. Some of the participants echoed the same voice, which is asking for adding the pictures as a

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visualization to make it more attractive. It is similar to the findings of Duong et al. (2021) study, that the participants tend to link the word with a visual image.

The findings of this study reinforce the pivotal role of vocabulary in science literacy, aligning with previous studies that highlight how insufficient vocabulary hampers comprehension and academic performance (Townsend et al., 2018). The participants' positive experiences with Disainary demonstrate that digital tools designed with multimodal features can substantially aid in overcoming vocabulary-related challenges. The repeated exposure to scientific terms provided by Disainary echoes Nation & Richards (2017) assertion that repetition is central to vocabulary acquisition. Unlike conventional resources, Disainary allows learners to encounter the same term across various modalities—auditory and textual—which supports both short-term retention and long-term mastery. This is consistent with multimodal learning theories, which argue that combining modes of input enhances comprehension and motivation (Kay, 2011; Townsend et al., 2018). Adding visuals to the platform, as requested by participants, could maximize the modalities carried.

The increasing motivation in learning English to support their science competence is the fact that their limitation needs to be facilitated. As mentioned by Havwini et al. (2024), the lack of vocabulary leads to a lack of confidence, and this tool could overcome it. The findings suggest that when learners are actively involved in meaning-making through digital media, they are more likely to sustain their learning efforts despite difficulties with specialized terminology. However, the challenges raised by participants highlight the importance of the exercise section. Limited internet access and gaps in lexical coverage indicate that while Disainary is effective, its scalability requires technical and pedagogical adjustments. This echoes previous findings by Idayani et al. (2025), who emphasized that technological solutions must be adapted to local educational infrastructures to maximize their impact. Added to this, the study of (Sabiteka et al., 2025)highlights that an effective technology adoption model must consider local needs and infrastructure limitations so that educational technology can be implemented sustainably and in accordance with the specific conditions of each educational environment.

In terms of pedagogical implications, the findings indicate that Disainary shuld be integrated into pre-service science teacher education as a structured digital resource to support the learning of English scientific vocabulary. By enabling repeated and contextualized exposure to scientific terms, Disainary can be embedded in reading, discussion, and task-based activities to strengthen vocabulary retention while fostering learner autonomy and digital literacy. This is particularly relevant in bilingual and internationalized science education contexts, where future teachers are expected to access and mediate global scientific knowledge (Cohen, 2012; Coxhead, 2018).

At the same time, teacher education programs need to consider the limitations identified in this study by supporting the development of richer multimodal features, practice-based exercises, expanded lexical coverage, and more reliable technical access. Due to the limitations captured, the research on this issue is helpful to know the current needs of the pre-service teachers. It is in line with the belief of Maryna & Yaroslav (2024) that the urgency of research in this field arises from the understanding that the

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advancement of lexical skills is closely linked to addressing other pressing challenges in foreign language instruction. A similar view also suggests that vocabulary mastery is the foundation for the development of subsequent language skills, such as reading comprehension and other productive abilities in L2, and it also indicates that a comprehensive understanding of vocabulary learning mechanisms is still limited and requires further research (Janjić et al., 2026).

CONCLUSION

This study examined pre-service science teachers' perceptions and experiences of using Disainary as a digital tool for learning English scientific vocabulary. The findings demonstrate that Disainary contributes positively to vocabulary acquisition through repeated and contextualized exposure. It also enhances learner motivation and engagement, and supports autonomous learning. By integrating textual and auditory multimodal features, Disainary helps bridge the gap between language learning and scientific knowledge acquisition, particularly in contexts where exposure to English scientific terminology is limited. These findings extend existing research on multimodal vocabulary learning by providing empirical evidence from pre-service science teacher education. As widely known that its context has received relatively limited attention.

In terms of practical and policy implications, the study suggests that teacher education programs should consider integrating discipline-specific digital dictionaries such as Disainary into English for Academic Purposes and content-based science instruction. Such integration can support both linguistic competence and digital literacy. It is increasingly essential for future science teachers in bilingual and globalized educational settings. At the institutional level, policies that encourage the use of pedagogically grounded digital tools and provide adequate technological infrastructure can enhance the effectiveness and sustainability of technology-enhanced learning.

Despite these contributions, this study has limitations that point to directions for future research. Further studies could employ mixed-methods or experimental designs to examine the impact of Disainary on measurable learning outcomes, such as vocabulary gains and reading comprehension. Future research may also explore the integration of additional multimodal features, including visual representations and practice-based exercises, as well as investigate the tool's applicability across different science disciplines and educational contexts. Addressing these areas would contribute to a deeper understanding of how digital vocabulary tools can be optimized to support science education and teacher preparation.

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