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JCLR

Journal of Contemporary Language Research. 2026;5(3): 37-54.

DOI: 10.58803/jclr.v5i3.148

Journal of Contemporary Language Research

Research Article

The Neuroeducation Approach to Language Learning: Exploring Learner Perception

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ARTICLE INFO

Article History:
Received: 09/07/2026
Revised: 20/08/2026
Accepted: 02/09/2026
Published: 30/09/2026

check for updates

Keywords
Neuroeducation
Learner perception
Gamification
Second language acquisition
Implicit learning

ABSTRACT

Introduction: This study investigates learner perceptions of the LIRRA Neuroeducation Program (LIRRA-NP), a neuroeducation-informed program designed to enhance second language (L2) acquisition and reading proficiency in intermediate undergraduate learners. Building upon previous research demonstrating the program's effectiveness, this study explored learner experiences with the program's implementation, content, design, and perceived impact on their language skills.

Methodology: Thirty intermediate-level English learners participated, completing an online questionnaire comprising scaled and open-ended questions. Quantitative data were analyzed using descriptive statistics and two-sided Wilcoxon signed-rank tests comparing five-point item ratings with the numerical scale midpoint, with Holm adjustment for multiple comparisons, while qualitative data were analyzed thematically.

Results: The findings revealed overwhelmingly positive perceptions of the LIRRA-NP, with participants finding it interesting, motivating, relevant, and beneficial. Twenty-six participants (86.7%) gave the highest rating for interest, 26 (86.7%) rated their motivation at 4 or 5, and 29 (96.7%) rated material relevance at 4 or 5. Ratings on the ten analyzed five-point items differed significantly from the numerical midpoint (Holm-adjusted $p <$ .001), with responses concentrated toward the favorable end of the scales. Participants particularly appreciated the program's content, novelty, interactive games, and engaging activities. A few identified areas for improvement and motivational variation due to individual differences.

Conclusion: This study contributes to the optimization of L2 acquisition through neuroeducation-informed practices by providing valuable learner feedback to inform the development of future programs and enhance student-centered learning methods.

1. Introduction

The field of language learning has seen a continuous evolution of teaching approaches, all aiming to maximize students' success. From traditional methods like Grammar-Translation to contemporary approaches like Task-Based Learning, Student-Centered Learning, Self-regulated Learning, and ICT integration, educators have explored various strategies to cater to diverse learner needs and achieve the most effective learning outcomes. In this ongoing pursuit, student reflection and perception of educational programs and teaching strategies have become a cornerstone. Recognizing the significance of these student perspectives allows educators to shape and refine educational approaches, ultimately leading to the development of more effective learning experiences.

1.1. Learner perception of language learning strategies

Adult learners' perceptions of language learning

Cite this paper as: Yusuf NH. The Neuroeducation Approach to Language Learning: Exploring Learner Perception. 2026;5(3): 37-54. DOI: 10.58803/jclr.v5i3.148

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strategies have been investigated in the literature from several perspectives including the use of interactive activities, technology, gamified tasks as well as incorporating motivation in the language learning process. Of note, effective language learning often hinges on creating a stimulating and engaging environment. One approach that fosters this type of environment is the use of interactive activities. To this end, research suggests that adult language learners generally favor interactive activities over non-interactive ones. This preference stems from the benefits interactive activities offer, including increased engagement and interest (Abulhassan & Hamid, 2021; Nugroho & Atmojo, 2022), heightened eagerness for language practice (Sèna, 2022), and boosted motivation (Omar et al., 2020). However, while interactive activities are generally favored, the specific format of interaction, such as group work versus individual work, elicits more varied perspectives from language learners. For example, language learners may have mixed perceptions of group work versus individual work. While group work is sometimes perceived to be a positive experience by EFL and university students, appreciating collaborative tasks (Alali et al., 2020) and improving language-related tasks (Rohmah et al., 2023), other students may prefer individual work for language barrier reasons (Rodrigues, 2023) or for low proficiency-related reasons (Kim & Chin, 2022).

In another line of experience, adult language learners generally demonstrate positive attitudes towards technology and digital tools, finding them more engaging and practical than traditional methods. In this respect, language learners show positive attitudes towards the use of technology and digital platforms compared to traditional methods, appreciating the enhanced engagement and practical application of skills. Research shows that adult learners reported positive attitudes towards the use of technology (Al-Madani, 2021; Yu, 2022), indicating enhanced engagement and an enriched learning experience (Huseinović, 2022; Lamo et al., 2023). This positive perception of technology extends to specific digital tools, such as visual aids, which have also been shown to enhance the learning experience. Research suggests that visual aids foster an enjoyable learning experience and increase adult learners' interest in the learning process (Tweedie & Dressler, 2018). This increased interest and enjoyment translates into tangible learning benefits, as the utilization of visual aids can significantly enhance language learning and improve language skills (Albiladi et al., 2018; Hang & Nhung, 2023).

Beyond the specific activities used in language learning, motivation plays a critical role in shaping learner interest, enhancing the learning experience, and ultimately leading to success. It is worth noting that motivation is factorial in shaping and increasing the learners' interest, and enhancing the learning experience. In this respect, motivation acts as the driving force behind the neurological alteration that supports the learning process and improves attention and memory performance (Osaka et al. 2013). Also, motivational activities are crucial in raising language learning persistence and furthering learning goals among learners (AlQuyadi & Alwass, 2020). Motivation can be stimulated using fun activities (Bon et al., 2022), a rewarding learning environment, and gamified interactive tasks (Yusuf, 2025).

The practical application of motivational strategies is evident in the positive experiences reported by adult learners engaged in gamified language instruction, which is enormously perceived to be engaging. In this regard, adult university students reported high support for gamified language instruction and learning (Charkova, 2022). Similarly, university students perceived gamification to be an effective way of learning (Rodríguez & Argüello, 2023; Trinh et al., 2022), and to be a means for improving participation and interactivity among higher-education students, particularly during the pandemic (Mudure-Iacob et al., 2023). Moreover, adult students are particularly enthusiastic about movement games like scavenger hunts, reporting increased enthusiasm, enjoyment and engagement in L2 acquisition as well as reporting gained benefits in terms of understanding and remembering important L2 acquisition-related terms and concepts (Rosyidi et al. 2023).

1.2. Neuroeducation approaches and programs in language learning

Complementing existing approaches, neuroeducation has emerged as a promising field, prompting researchers to propose various neuroscience-based approaches to optimize language learning. These include approaches emphasizing implicit competence and authentic language engagement (Netten & Germain, 2012), the role of emotions (Lucas-Oliva et al., 2022) through stimulating interest, curiosity, declarative knowledge, multimodal strategies, and dopaminizing tasks, and those prioritizing neurocognitive principles like memory optimization, emotional integration, and decision-making (Yifang, 2011), or approaches informed by neurocognitive underpinnings aiming at addressing procedural memory, right hemisphere function, dopamine release, and memory consolidation (Yusuf, 2025).

Beyond these theoretical approaches, research has also focused on practical neuroeducation programs and frameworks. Among studies investigating such programs (Rogowsky et al., 2013; Valdés-Villalobos & Lazzaro-Salazar, 2023; Yusuf, 2024, 2025), two proposed theoretical models—one for facilitating reading skills (Valdés-Villalobos & Lazzaro-Salazar, 2023) and the LIRRA model for improving L2 acquisition in late learners (Yusuf, 2025)—and two implemented practical programs: a neuroplasticity-

based program for college students' reading and writing (Rogowsky et al., 2013) and a LIRRA-based program for automatizing L2 acquisition and improving reading proficiency in young adults (Yusuf, 2024).

1.3. The LIRRA neuroeducational model and program for language learning

The LIRRA neuroeducational model (Yusuf, 2025) proposes a brain-adaptive language learning environment designed to enhance L2 acquisition in late learners, drawing on principles that attempt to align with first language acquisition. Its practical application, the LIRRA neuroeducation program (LIRRA-NP) (Yusuf, 2024), is informed by five core neurocognitive principles intended to support automatization and improved reading proficiency in young adult L2 learners. First, *exposure to pre-fabricated lexical phrases* is central, with phrases presented repeatedly in varying contexts within learning materials to solidify understanding and engage right hemisphere processing. Second, *implicit learning* is fostered by embedding these phrases in engaging context and gamified tasks, bypassing explicit memorization and hypothesized to engage procedural memory for internalization and long-term storage. Third, *repetitive exposure* is conceptualized to strengthen synaptic connections within the basal ganglia, reinforcing L2 knowledge and promoting automaticity. Fourth, a *rewarding and motivating environment*, using a reward-point system, engaging activities, and gamification, is designed to leverage motivational pathways associated with neuroplasticity by stimulating dopamine release. Fifth, *attention-simulating settings* incorporating novel and relevant input are speculated to foster attentional focus via stimulating neurotransmitters like acetylcholine and noradrenaline, in turn stimulating neuroplasticity and memory formation. Additionally, online and self-paced implementation with unlimited retries provide a supportive learning environment.

In line with the LIRRA model, the LIRRA-NP was generally designed to increase the learners' motivation in order to derive neural change as well as achieve novelty and adapt to their interests. Accordingly, different material and designing features were central to achieving this purpose. The content within LIRRA-NP was central to the program's effectiveness. To this end, this content was meticulously curated from a custom-built corpus that draws upon diverse sources, all carefully chosen to align with the participants' age group's interests where novel and relevant materials are provided. This corpus encompassed a wide range of materials, including jokes, riddles, hypothetical scenarios, moral stories, unusual facts, scientific discoveries, and informative websites covering everyday life topics such as health, success, diet, career advice, along with music, movies, celebrity gossip, and insights into human behavior, personality traits, and even psychological tricks.

The core content was further enhanced by its presentation format. LIRRA-NP employs a variety of engaging and interactive techniques to promote learner engagement. These include online games like word searches, crosswords, word guessing, and story sequencing, alongside group puzzles, memory games, card matching, unscrambling words, and chase mazes. This approach also extends beyond games to incorporate informative animated PowerPoints, visually stimulating flip books, and visually appealing documents. Additionally, the program leverages interactive Google Forms for scenario brain teasers, experience sharing, and riddle-solving, as well as engaging educational videos. In some instances, personality and psychology surveys are also included. Additionally, questions were incorporated into the program to elicit topic discussions. Accordingly, the program's online delivery was key for convenient access and engagement with the interactive tasks it offers.

The LIRRA-NP has shown promising results in automatizing L2 acquisition and significantly improving learners' lexical phrases acquisition and reading proficiency. Recognizing the crucial role of learner feedback in refining and optimizing educational interventions, this study is a follow-up to Yusuf (2024) to examine learner perceptions of the LIRRA-NP, exploring their experiences with the program's implementation and its impact on their learning. Given the limited availability of neuroeducational approaches and programs, there is a corresponding paucity of research on learner perceptions, rendering further investigation in this area essential.

Considering the dearth of applicable neuroeducation programs in L2 acquisition, this research is, according to the researchers' best knowledge, considered the first to evaluate learner perception towards a neuroeducation program for L2 acquisition. This study builds upon the research presented in Yusuf (2024) by evaluating learner perception of the LIRRA-NP program. The primary aim of this study is to gather learner perception and feedback on the LIRRA-NP neuroeducation program, providing valuable insights into its effectiveness and user experience. The significance of this research is to inform the development of future language education programs and approaches. By understanding learner perceptions, these insights will inform researchers and educators on how to best apply or modify similar features in subsequent iterations, guiding the development of effective, student-centered learning methods. By understanding the program's strengths and weaknesses from the learners' perspective, the research aims to ensure not only effective learning environments through the integration of

neuroscientific features but also more engaging environments that cater to learner preferences, ultimately promoting sustained student enthusiasm for language learning.

In light of the above, the research questions of this study are as follows:

RQ1: How do learners perceive their overall experience with the LIRRA-NP program?

RQ2: How do learners perceive the content of the LIRRA-NP program in terms of its relevance and motivation?

RQ3: How do learners perceive the design of the LIRRA-NP materials, in terms of gamification and presentation?

RQ4: How do learners perceive the impact of the LIRRA-NP program on their language acquisition, particularly in terms of lexical phrases acquisition and overall language proficiency?

2. Methodology

2.1. Research design

To investigate learner perceptions of the LIRRA-NP following its application in Yusuf (2024), which aimed at automatizing L2 acquisition and improving reading proficiency in intermediate undergraduates, this study utilized a convergent parallel mixed-methods approach. In this concurrent approach, quantitative and qualitative data were collected simultaneously through a single post-intervention questionnaire. A convergent mixed-methods design was selected to achieve methodological triangulation and elaboration, allowing the strengths of both data types to be combined. Specifically, closed-ended quantitative Likert scales provided broad, quantifiable measures of learner satisfaction, interest, motivation, and perceived language gains. Concurrently, open-ended qualitative prompts elicited rich, narrative reflections that captured the contextual nuances and subjective reasons underlying those numerical ratings. Five-point rating items were additionally summarized using means, standard deviations, medians, and interquartile ranges. Item-level responses were compared with the numerical scale midpoint of 3 using two-sided Wilcoxon signed-rank tests, with Holm adjustment for ten comparisons. The three-category ratings of program components, online-experience response, and excursion-completion times were analyzed descriptively.

2.2. Participants

The participants of this study are the same undergraduates who took part in Yusuf (2024) and completed all of the sessions of the LIRRA-NP. The participants were 30 intermediate-level Egyptian English learners (3 males, 27 females, aged 18-23) enrolled in English departments at two governmental Egyptian universities (second and third-year students). This uneven gender distribution reflects the natural demographic composition of the single, intact undergraduate cohort enrolled in the participating English departments during the original implementation trial (Yusuf, 2024) All participants provided informed consent via an online registration form.

2.3. Instrumentation

An online structured questionnaire was utilized to gather data on participants' perceptions. Following completion of the LIRRA-NP program, the questionnaire was administered to assess learner perceptions with a focus on motivation, satisfaction, and program evaluation. The questionnaire was developed using Google Forms and employed a mixed-methods approach, incorporating both scaled and open-ended questions. In total, the instrument comprised 20 items, structured as 13 quantitative, closed-ended items and 7 qualitative, open-ended reflection prompts.

On the one hand, scaled questions gauged learner satisfaction with various aspects of the program, including interest, motivation, materials, and perceived language gains in terms of proficiency and lexical phrase and vocabulary acquisition. On the other hand, open-ended questions, designed to elicit detailed learner reflections, complemented the quantitative questions and further addressed perceived program impact on proficiency and vocabulary and lexical phrase acquisition.

The 20 questionnaire items were organized into four functional item clusters designed to map directly onto the four research questions:

Cluster 1: Overall Program Experience & Engagement (RQ1): Comprising four quantitative items (Items 1, 2, 5, and 6) assessing overall interest, continuous motivation, material relevance, and program recommendation likelihood, alongside two qualitative prompts (Items 3 and 4) soliciting overarching reflections on user experience and specific likes or dislikes.

Cluster 2: Material Content Relevance, Diversity & Novelty (RQ2): Comprising five quantitative items (Items 7–11) evaluating motivation driven by specific content types (e.g., novelty of information, unbelievable facts, career/success tips, and psychology articles), complemented by one qualitative prompt (Item 12) capturing reflections on content-driven engagement and personal value.

Cluster 3: Instructional Design & Gamification (RQ3): Comprising two quantitative items (Items 13 and 14) measuring perceptions of gamification and specific game-type preferences (e.g., matching games, word puzzles, crosswords), paired with one qualitative prompt (Item 15) gathering feedback on game elements, visual presentation, and structural organization.

Cluster 4: Perceived Language Impact &

Proficiency Gains (RQ4): Comprising two quantitative self-assessment items (Items 16 and 17) rating perceived gains in lexical phrase/vocabulary acquisition and overall L2 proficiency, accompanied by three qualitative prompts (Items 18–20) exploring phrase retention, sentence construction speed/effortlessness, and impact across specific language skill domains.

2.3.1. Validity and reliability

Content and face validity of the instrument were established prior to deployment through expert review. A panel of two academic experts in linguistics and educational methodology evaluated the initial item pool to confirm construct clarity, developmental appropriateness for intermediate L2 undergraduate learners, and non-ambiguity of item wording. Minor refinements to scale anchors and question wording were made based on their feedback.

Participant evaluation was conducted using a 38-item post-program satisfaction questionnaire consisting of two core sections: (a) *Core Program Satisfaction & Perceived Impact* (9 items rated on a 5-point Likert scale, ranging from 1 = *Not at all* to 5 = *Very much*), and (b) *Activity & Content Motivation* (29 items rated on a 3-point ordinal scale: 1 = *Non-motivating*, 2 = *Partially motivating*, 3 = *Very motivating*). To verify internal consistency across the final sample (N = 30), reliability analyses were computed using Cronbach's alpha (α). The Core Satisfaction subscale demonstrated strong internal consistency (α = .81). The Activity Motivation subscale yielded high internal reliability (α = .88). The overall standardized instrument achieved a Cronbach's alpha of α = .90, well above the accepted threshold of .70.

Because the questionnaire was specifically designed as a post-intervention evaluation instrument customized to assess user satisfaction immediately following the empirical implementation of the LIRRA-NP (Yusuf, 2024), formal preliminary pilot testing was not conducted. In contextualized educational intervention studies, post-hoc satisfaction tools tailored to a specific completed experimental program prioritize expert content validation and context authenticity over preliminary pilot testing.

2.4. Procedures and data analysis

Following the implementation of the LIRRA-NP program, participants completed an online questionnaire. Their responses were imported into an Excel spreadsheet for analysis. Quantitative data from closed-ended questions were analyzed using frequencies and percentages; five-point items were additionally described using means, standard deviations, medians, and interquartile ranges. Two-sided one-sample Wilcoxon signed-rank tests compared the ten five-point item distributions with the numerical midpoint of 3, with zero differences omitted and Holm adjustment across ten comparisons. Categorical component ratings, online experience, and completion times were analyzed descriptively. Inferential tests were interpreted as evidence about post-program ratings rather than objective learning gains. Qualitative data from open-ended questions were analyzed using thematic analysis, a systematic process of identifying, analyzing, and reporting themes within the data. This process involved manually coding each response to identify recurring ideas and concepts related to learner experiences and perceptions of the LIRRA-NP, including its impact on proficiency, vocabulary and phrase acquisition, and motivation, as well as aspects they liked or disliked. This combined approach allowed for a comprehensive understanding of learner feedback, providing both quantifiable measures of satisfaction and rich, in-depth insights into their subjective experiences.

The questionnaire responses were collected through Google Forms and subsequently imported into Microsoft Excel for analysis. The quantitative data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations, as appropriate to the nature of the questionnaire items. Regarding the qualitative data, the open-ended responses were analyzed thematically to identify recurring patterns in learners' perceptions and experiences of the LIRRA-NP. The researcher manually examined the responses to each open-ended question and identified meaningful ideas and recurring patterns relevant to the focus of the question. The questionnaire questions provided the initial analytical framework, while the specific themes were developed from the content of the participants' responses. As the responses were examined, relevant portions were assigned to the emerging themes. A single response could contribute to more than one theme when different parts of the response expressed different ideas relevant to different themes. For example, a participant's response could contain one idea concerning the motivational value of the program and another concerning the usefulness of the learning materials; these portions were therefore considered under their respective themes rather than treating the entire response as representing a single category.

As the analysis progressed, responses expressing similar ideas were grouped together to form broader thematic categories. The emerging themes were subsequently reviewed against the participants' responses to ensure that they adequately represented the content of the dataset and remained grounded in the original responses. The researcher also revisited the complete set of responses after the themes had been developed to check the consistency of the thematic categorization and to ensure that relevant responses had not been overlooked. The analysis considered the responses as provided by the participants, including their positive and negative comments, rather than selectively reporting

responses that supported the anticipated findings. The identified themes were then used to organize and interpret the qualitative findings in relation to the research questions. Direct participant quotations were included in the Results section to provide evidence for the identified themes and to maintain a clear connection between the thematic interpretations and the original responses.

3. Results

3.1. Learner Perception of the LIRRA-NP Experience

In answer to the first research question, quantitative analyses utilizing descriptive percentage distributions and frequency counts revealed that learners generally perceived the LIRRA-NP as highly interesting, motivating, beneficial, and unique. All 30 participants rated program interest positively (4 or 5), including 26 (86.7%) who selected 5 (M = 4.87, SD = 0.35; median = 5, Q1–Q3 = 5–5). Motivation was rated positively by 26 participants (86.7%): 11 (36.7%) selected 4 and 15 (50.0%) selected 5 (M = 4.37, SD = 0.72; median = 4.5, Q1–Q3 = 4–5). Material relevance received ratings of 4 or 5 from 29 participants (96.7%), including 19 (63.3%) selecting 5 (M = 4.60, SD = 0.56; median = 5, Q1–Q3 = 4–5). All participants selected 4 or 5 for likelihood of recommendation, with 29 (96.7%) selecting 5 (M = 4.97, SD = 0.18; median = 5, Q1–Q3 = 5–5). All four distributions were above the numerical midpoint of 3 (two-sided Wilcoxon signed-rank tests; Holm-adjusted p < .001 for each; Table 1). (see Figure 1 for a summary of motivation, relevance, interest, and recommendation).

Table 1.
Ratings for Ten Five-point Items

Item	1/2/3/4/5/,n	M (SD)	Median (Q1-Q3)	Rating 4-5	W	Holm-adjusted p
Interest	0 / 0 / 0 / 4 / 26	4.87 (0.35)	5 (5–5)	30/30 (100.0%)	0	<.001
Perceived proficiency	0 / 0 / 4 / 13 / 13	4.30 (0.70)	4 (4–5)	26/30 (86.7%)	0	<.001
Perceived fluency	0 / 1 / 6 / 10 / 13	4.17 (0.87)	4 (4–5)	23/30 (76.7%)	6	<.001
New phrases	0 / 0 / 2 / 5 / 23	4.70 (0.60)	5 (5–5)	28/30 (93.3%)	0	<.001
New vocabulary	0 / 1 / 5 / 12 / 12	4.17 (0.83)	4 (4–5)	24/30 (80.0%)	7	<.001
Motivation	0 / 0 / 4 / 11 / 15	4.37 (0.72)	4.5 (4–5)	26/30 (86.7%)	0	<.001
Relevance	0 / 0 / 1 / 10 / 19	4.60 (0.56)	5 (4–5)	29/30 (96.7%)	0	<.001
Learning log	0 / 1 / 3 / 10 / 16	4.37 (0.81)	5 (4–5)	26/30 (86.7%)	6	<.001
Checkpoint	0 / 0 / 0 / 0 / 30	5.00 (0.00)	5 (5–5)	30/30 (100.0%)	0	<.001
Recommendation	0 / 0 / 0 / 1 / 29	4.97 (0.18)	5 (5–5)	30/30 (100.0%)	0	<.001

Note. All ten Holm-adjusted p-values are < .001. W is the smaller signed-rank sum in the two-sided test, with zero differences excluded. The percentage rated 4–5 is a descriptive measure of endorsement, not a causal effect size. All item-level n = 30. Ratings of 3 represent the numerical midpoint.

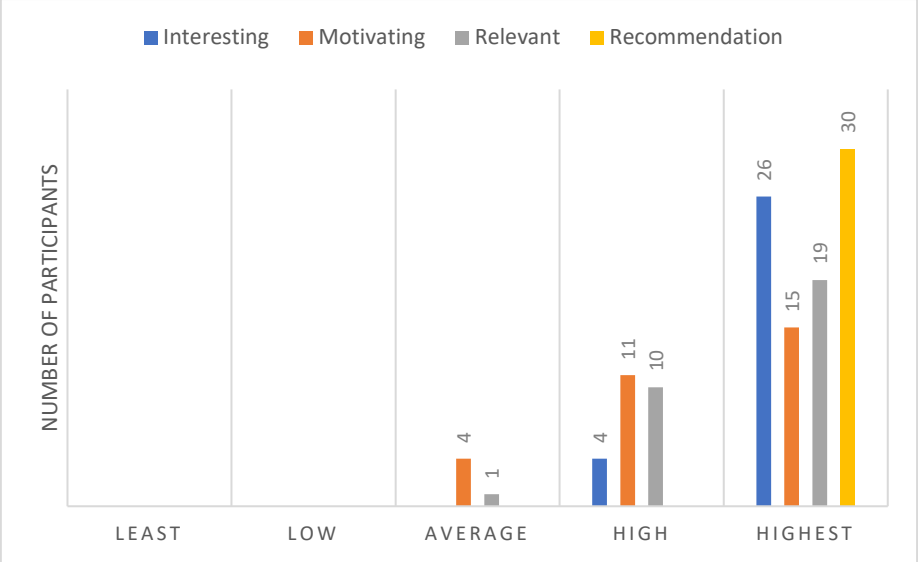


Figure 1.
Learner Perception of the LIRRA-NP Experience



Figure 2.
Learner Perception Description of the LIRRA-NP Experience

The qualitative analyses of the participants' perception of the LIRRA-NP experience also indicated the students' positive attitudes towards the neuroeducation program in terms of motivation and interest as well as positive views of the program as outstanding, non-traditional, feasible, and beneficial. Learners appreciated the program's innovative approach, which departed from traditional classroom settings and incorporated interactive elements. The program also demonstrated significant benefits in enhancing participants' English language proficiency, with many participants expressing interest in repeating the program or joining similar programs. The learners' perceptions can be summarized into the following categories as shown in Figure 2.

3.1.1. Interest and motivation

The participants expressed positive views about the LIRRA-NP. They consistently described their experience with the program as outstanding, motivating, interesting, and unique. The participants' comments included: *"It is really interesting and amazing"; "I perceived it as a fun and exciting experience honestly"; "The whole program was so motivating that I sometimes gave it priority over my academic study and the deadlines :D"; "Really nice and it was an outstanding experience"; "It was a unique experience"; "The program was really like a beautiful journey to know more and more"; "this program is beautiful, the stories and anecdotes were interesting and the games too, the program, frankly, is beautiful".*

The LIRRA-NP received predominantly favorable feedback, although participants also identified minor concerns as detailed at the end of the results. Learners particularly expressed their perception of the program, stating: *"Well there wasn't anything that I disliked"; "Nothing really it was fun",* and several expressing interest in participating again *"I am ready to repeat this experience again because it was very useful and amazing"; "I hope to be part of this type of programs again".* Furthermore, Some students expressed interest in extending the program's focus to other language skills beyond reading.

3.1.2. Innovation and unconventionality

Participants consistently praised the innovative and engaging nature of the LIRRA-NP program. They highlighted its unique approach to language learning, which differed significantly from traditional classroom settings and fostered a more dynamic and enjoyable learning experience. Some of the participants' comments were: *"It was like a game, it always had new things. It is really different from any other ways of learning"; "Not traditional, it had fun and new ideas to avoid boredom and this way made me very interested to do more"; "I loved everything about it. It is about delivering information in a creative way that is not routinely done. It has many ideas that I have not seen before in any course"; "Unlike ordinary English courses, it was effective and interesting".*

3.1.3 Feasibility

Participants reported enjoying the feasibility and usefulness of the online experience, particularly in terms of saving time in comparison to other face-to-face or demanding programs, enabling them to fulfill their tasks at their own pace; this perception was expressed via statements like: *"It saved a lot of time and effort for me"; "It was very interesting and timesaving as well"; "The program was easy and I could do it any time I was available at"; "The online experience was very suitable because it helped me make balance between the program and my college. It saved my time to benefit more from the program"; "This online experience was so beneficial".*

3.1.4 Value

Learners perceived the LIRRA-NP as beneficial to their English language development. Participants reported notable gains in acquiring L2 phrases and vocabulary. They also reported significant improvement in overall proficiency as they stated that the program helped them bypass effortful sentence construction in a way that allowed them to use their L2 more naturally. Their comments included: *"Very beneficial and effective program"; "It is a great program, helped me to learn a lot of things not only phrases and expressions"; "It was very useful and helped me to improve my English"; "It was a new experience for me, to learn more English words and sentences, and to have a new experience".*

3.2. Learner Perception of the LIRRA-NP Content

Answering the second research question, analyses revealed that participants generally perceived the LIRRA-NP content and materials as motivating, although ratings varied across individual components. For topics and new information in readings, 20 participants (66.7%) selected "very motivating" and 10 (33.3%) selected "partially motivating"; none selected "non-motivating." Astonishing/unbelievable facts received 17 (56.7%) "very motivating" and 13 (43.3%) "partially motivating" ratings. Success, career, and life tips received 18 (60.0%) and 12 (40.0%), respectively; psychology tricks received 19 (63.3%) and 11 (36.7%), respectively. However, some other program components received non-motivating ratings, indicating that the motivational appeal of the materials was not uniform across participants or activities (see Figure 3). Overall material relevance was rated 4 or 5 by 29 of 30 respondents (96.7%; median = 5, Q1–Q3 = 4–5), with ratings above the numerical midpoint (Holm-adjusted $p < .001$; Table 1).

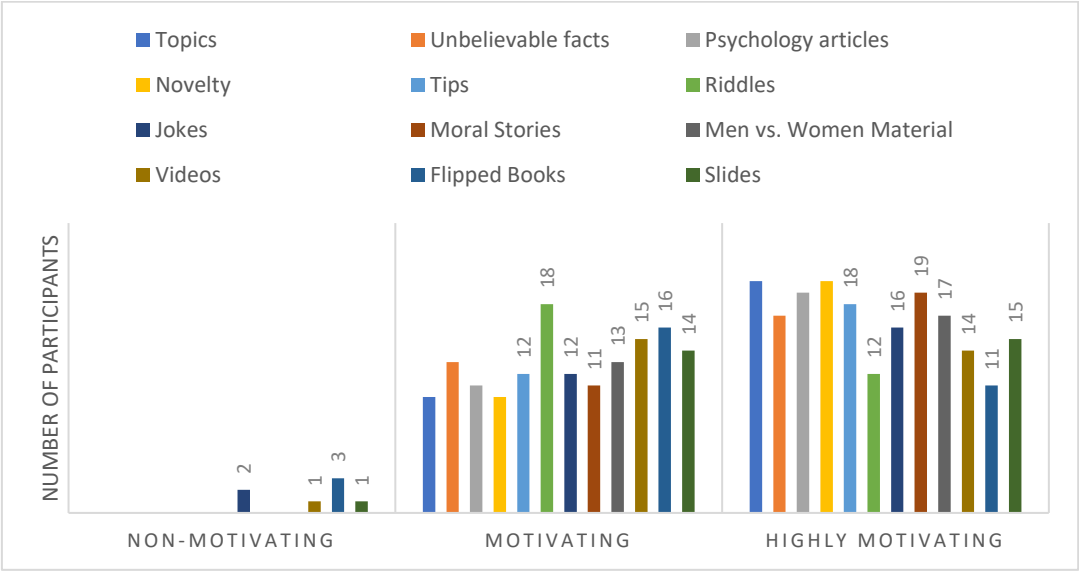


Figure 3.
Learner Perception of the LIRRA-NP Content

The qualitative analyses revealed that in general the participants expressed their satisfaction and interest of the program's materials and content appreciating the motivating and appealing content. Participants particularly valued the novelty of the content, which introduced them to new information and broadened their perspectives on various aspects of life (see Figure 4). This exposure to diverse and engaging content not only enhanced their language skills but also fostered intellectual curiosity and a deeper understanding of the world. To this end, the following themes emerged.

3.2.1. Motivating content

The analyses of participants' responses showed that the content and material of the program were the primary factor for driving their continuous motivation. The LIRRA-NP program effectively leveraged engaging and motivating content to drive participant learning. The inclusion of topics that resonated with participants' interests, such as movies, music, and games, significantly enhanced their motivation and engagement throughout the program. Some of the participants' comments in this respect were: *"The interesting topics were motivating"; "The excursions included topics I love like movies, music, games, so it was very fun to do the excursions"; "I was motivated a lot by the topics. They were amazing and interesting, especially the PowerPoint and the slides"; "The topics themselves motivated me to read more and more to expand my knowledge"; "Excursion's content was really motivating and got me intrigued".*

3.2.2. Diverse Appealing Materials

Alongside the motivating and interesting topics, participants emphasized the importance of the program's diverse thematic content. The variety of topics covered, ranging from science and psychology to fashion and health, kept participants engaged and motivated throughout the program. This was evident in their comments, which entailed: *"It was motivational to have a variety of information in different topics"; "the variety of the articles makes everyone find his/her favorite field. I love science articles, so they were very motivating to me"; "The program was exciting and I was learning new things every time because it was diverse and comprehensive, so it was motivating to me"; "I liked the variety of the topics"; "I liked the psychology articles and the amazing facts and the motivational quotes in those PDFs"; "I liked the topics related to success, fashion, movies and health, besides the stories and flipped books".*

The participants also reported their interest in, other than the topics, the diversity of other materials such as life tips, jokes, riddles, videos and self-assessments/checkpoints among other material. The participants highlighted the following: *"All life tips and moral stories were so interesting."; "Jokes and riddles made me laugh and even when I knew the answers I asked my mom and brother the riddle too"; "I liked that the checkpoints weren't very long , in other words it was precise and concise, and I learned a lot"; "Various methods were used to deliver information, including videos, pictures, stories, games and articles".*

3.2.3. Novelty of content

Another important aspect of the learners' perception of the program's materials is the fact that they were introduced to new information which added to their life experiences. The LIRRA-NP program provided participants with a wealth of new knowledge and broadened their perspectives on a wide range of topics. Participants reported gaining valuable insights from the program materials which enriched their understanding of the world and the different perspectives. This was mentioned in learners' comments as follows: *"There were also topics that would help us in our next life, not only the present"; "Google slides, flipped books and stories, they added a lot of information that I did not know before"; "it adds to my life experiences and opinions"; "I benefited from a lot of information and changed the way I think and look at things"; "My point of view has changed a lot concerning many topics. I feel motivated to start a financial life at an early age ... I can handle many situations better now as I already read about them throughout the program's required excursions"; "I have known a lot of facts and new information in many areas of life by reading the materials of the program"; "It added a lot as there were a plenty of topics discussing various fields"; "It added a lot by using topics I haven't read about before"*

3.3. Learner Perception of the LIRRA-NP Design

Answering the third question, quantitative analyses showed that the appealing design of the program's materials, particularly in the form of games, was considered to be a primary factor for creating a motivating environment, as the majority of participants responded positively to the design of the LIRRA-NP materials, particularly the incorporation of interactive games, which emerged as a prominent motivational feature of the program. Nevertheless, participants' preferences varied across game types, reflecting individual differences in their perceptions of the activities. For example, "very motivating" ratings were given to Leaping Frog Shore games by 19 participants (63.3%), guess-the-words games by 19 (63.3%), guess-the-words-and-phrases games by 18 (60.0%), and matching games by 17 (56.7%). By contrast, memory games received seven "non-motivating" ratings (23.3%), suggesting that particular game formats did not appeal equally to all participants despite the generally favorable reception of gamification. Beyond games, the learning log was rated 4 or 5 by 26 participants (86.7%; median = 5, Q1–Q3 = 4–5), whereas all 30 rated checkpoint benefit as 5 (M = 5.00, SD = 0; Table 1). All 30 respondents answered "Yes" to enjoying the online experience. Figure 5 illustrates game ratings; Table 2 provides the complete component distributions.



Figure 4.
Learner Perception Description of the LIRRA-NP Content

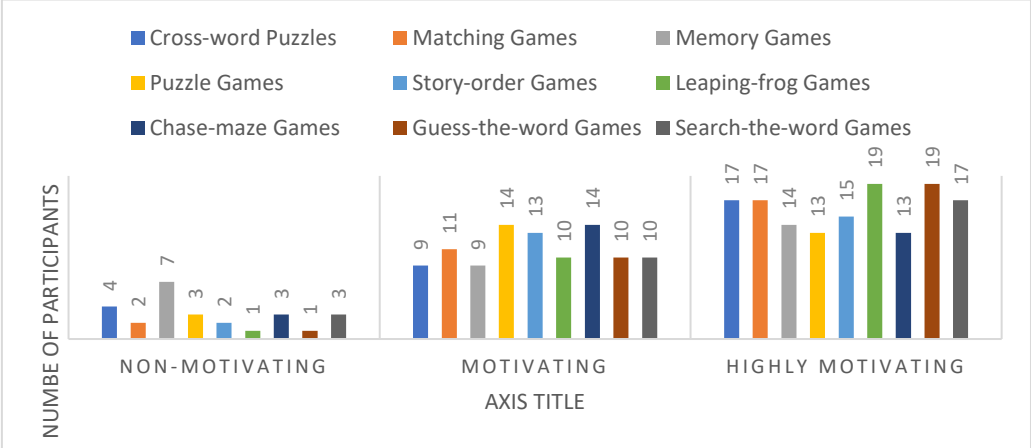


Figure 5.
Learner Perception of the LIRRA-NP Games

Table 2.
Component-level Motivation Ratings

Program component	Non-motivating	Partially motivating	Very motivating
Topics	0 (0.0%)	10 (33.3%)	20 (66.7%)
Psychology tricks	0 (0.0%)	11 (36.7%)	19 (63.3%)
Personality quizzes	0 (0.0%)	13 (43.3%)	17 (56.7%)
Compiled videos	4 (13.3%)	14 (46.7%)	12 (40.0%)
Brightside Videos	1 (3.3%)	15 (50.0%)	14 (46.7%)
Excursion questions	3 (10.0%)	15 (50.0%)	12 (40.0%)
PowerPoints	1 (3.3%)	14 (46.7%)	15 (50.0%)
Flipped books	3 (10.0%)	16 (53.3%)	11 (36.7%)
Cross-word puzzles	4 (13.3%)	9 (30.0%)	17 (56.7%)
Matching games	2 (6.7%)	11 (36.7%)	17 (56.7%)
Memory games	7 (23.3%)	9 (30.0%)	14 (46.7%)
Group puzzles	3 (10.0%)	14 (46.7%)	13 (43.3%)
Story-order games	2 (6.7%)	13 (43.3%)	15 (50.0%)
What would you do situations	1 (3.3%)	16 (53.3%)	13 (43.3%)
Questions & Answers material	3 (10.0%)	11 (36.7%)	16 (53.3%)
Men vs. Women material	0 (0.0%)	13 (43.3%)	17 (56.7%)
Jokes	2 (6.7%)	12 (40.0%)	16 (53.3%)
Riddles	0 (0.0%)	18 (60.0%)	12 (40.0%)
Leaping Frog Shore games	1 (3.3%)	10 (33.3%)	19 (63.3%)
Chase Maze games	3 (10.0%)	14 (46.7%)	13 (43.3%)
Guess the words games	1 (3.3%)	10 (33.3%)	19 (63.3%)
Search the words games	3 (10.0%)	10 (33.3%)	17 (56.7%)
Guess the words & phrases games	1 (3.3%)	11 (36.7%)	18 (60.0%)
New information in readings	0 (0.0%)	10 (33.3%)	20 (66.7%)
The designs of pdfs, PowerPoints, forms, stories, etc.	0 (0.0%)	13 (43.3%)	17 (56.7%)
Moral stories	0 (0.0%)	11 (36.7%)	19 (63.3%)
Astonishing/Unbelievable facts	0 (0.0%)	13 (43.3%)	17 (56.7%)
Movies & games knowledge	0 (0.0%)	11 (36.7%)	19 (63.3%)
Success, career, life tips	0 (0.0%)	12 (40.0%)	18 (60.0%)

Mirroring the findings of the quantitative analyses, the qualitative analyses also emphasized the participants' interests in the program's design where they consistently cited the utilization of games as the most engaging factor followed by the organization and presentation of the program's materials (see Figure 6). Furthermore, participants appreciated the clear structure, professional design, and inclusion of diverse learning activities, fostering an engaging learning environment.

3.3.1. Utilization of games

Games in general were appealing to the participants; they largely attributed their motivation for the LIRRA-NP to the interactive games, which proved to be highly effective in motivating participants and fostering a more enjoyable and effective learning experience. In this regard, participants stated that: *"The games were so fun. The inspiration every excursion gives to me"; "what I liked the most was games, it was super fun"; "The games made a good motivation"; "the games were very helpful to be motivated to continue with the program"; "the interesting games, one of the best ways to motivate me"; "It had so many games that made it a good way to focus more and learn more phrases"; "I liked that we were answering the questions in the form of games".*

On the top of the games' list, the matching games, the puzzles as well as the creative games *'Refresh and Have fun'* were most mentioned. The students showed particular interest in the said games, stating that: *"Matching pictures with text, pairing game and group puzzle are creative ways to receive information. And refresh and have fun games were very entertaining and at the same time aimed at conveying information"; "The interactive materials like puzzles matching and the games"; "The games like, guess the word and word puzzle"; "Games were very motivating to me, especially leaping frog game and matching game"; "the refresh and have fun games were very creative"; "I liked our racing in games".*

3.3.2. Material's organization and presentation

The qualitative analyses also revealed that other than the games, the participants' interest was also raised through other factors including the organization and presentation of the program material, the variety of activities, and the room for discussion through excursion questions. Participants expressed their views stating that: *"I liked how all the questions, games and pdfs were organized amazingly and professionally"; "The organization of the program makes it professional and interesting"; "I liked the design of the materials"; "short sweeeeet comment that pops up after we finish every task".*



Figure 6.
Learner Perception Description of the LIRRA-NP Design

3.4. Learner perception of the LIRRA-NP impact on language acquisition

In answer to the fourth research question, the quantitative analyses of the participants' perception of the impact of the program on their acquisition of the lexical phrases and vocabulary shows the program's significant self-assessment gains. For new English phrases, 28 participants (93.3%) selected 4 or 5, including 23 (76.7%) selecting 5 (M = 4.70, SD = 0.60; median = 5, Q1–Q3 = 5–5). For vocabulary, 24 (80.0%) selected 4 or 5, including 12 (40.0%) selecting 5 (M = 4.17, SD = 0.83; median = 4, Q1–Q3 = 4–5). Perceived proficiency was rated 4 or 5 by 26 participants (86.7%; M = 4.30, SD = 0.70; median = 4, Q1–Q3 = 4–5), while perceived fluency was rated 4 or 5 by 23 (76.7%; M = 4.17, SD = 0.87; median = 4, Q1–Q3 = 4–5). All four distributions were above the numerical midpoint (Holm-adjusted $p < .001$; Table 1; Figure 7 for the relevant ratings).

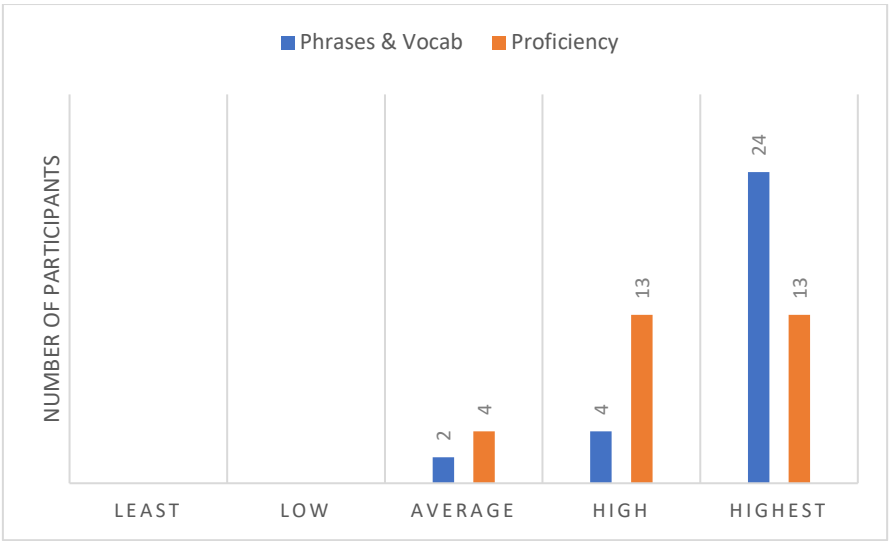


Figure 7.
Learner Perception of the LIRRA-NP Impact on L2

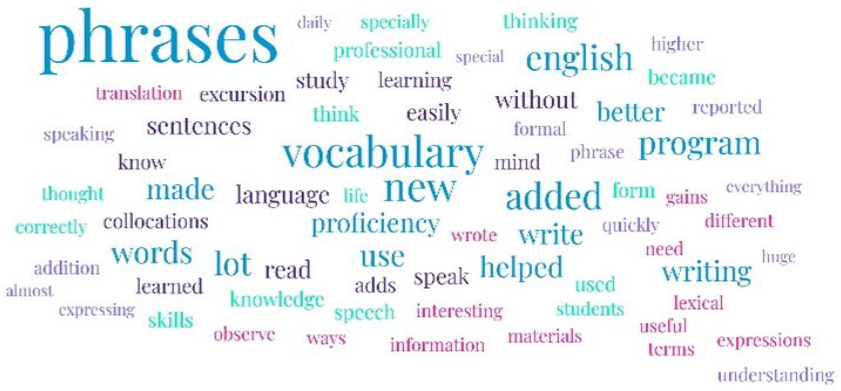


Figure 8.
Learner Perception Description of the LIRRA-NP Impact on L2

The qualitative analyses confirmed the quantitative ones, revealing the participants' self-assessed high gains in the acquisition of both lexical phrases and vocabulary as well as in their improved language proficiency. Furthermore, qualitative analyses revealed the participants' speed-up performance and positive impact on various language skills. Learners noted a shift from effortful sentence construction to more automatic and effortless language production, with phrases and expressions readily coming to mind (see Figure 8).

3.4.1. Impact on the acquisition of lexical phrases and vocabulary

The participants' reflections showed that they were highly satisfied with their acquisition of new phrases and vocabulary via the LIRRA-NP, enriching their overall lexical repertoire. The LIRRA-NP effectively facilitated the acquisition of new phrases as learners reported the following: *"The program added a huge amount of phrases and vocabulary through excursion and games"; "I learned many new phrases and vocabulary. Also, I learned about new collocations and how to use them correctly"; "There were a lot of interesting phrases and new idiomatic expressions introduced in a nice way that I remember with no need to memorize them"; "Collocations, phrases and phrasal verbs used in the program's material and presentations have come in handy in many ways"; "Through the program and in each excursion I wrote down new phrases and vocabulary and saved them. So LIRRA-NP helped me to make my own small dictionary or a reference which I can use when I need it"; "Massively!!! Every single word I wrote in my learning log has been added to my new words glossary".*

3.4.2. Impact on language proficiency

The comments of the learners also showed their self-assessment on proficiency levels to be of significant gains. Many described an enhanced ability to comprehend both spoken and written English, noting a shift from relying on translation to a more automatic language use at a higher level of proficiency than prior to joining the LIRRA-NP. The learners commented on their proficiency gains with statements like: *"I started reading stories and information related*

to life in English, and without needing translation, my eyes began to read English, so I understood better than before any spoken or written speech in English"; "It added a lot to my proficiency by knowing many new words and more phrases about the language"; "It improved my skills because of the usage of vocabulary in different ways. I made so much use of this aspect"; "My language doesn't seem like literal translation"; "I think LIRRA-NP added to my proficiency particularly in the part of forming correct English sentences".

3.4.3. Speed-up and effortless performance

The participants reported on their higher ability to form English sentences in a relatively faster way, especially without effortful thinking compared to their previous proficiency prior to joining the program. They expressed this notion stating: *"Now that I know more phrases I can form more sentences easily"; "The program made it easier for me to produce new phrases and expressions more naturally and without thinking"; "I can form sentences better without thinking too much about them"; "I think the program made the whole phrase come to my mind quickly and easily then I can use it in writing and speaking"; "It helped me speak and made words/phrases come to mind more proficiently"; "It helped me in forming phrases and use them in certain contexts and I think my proficiency level is higher than before".*

3.4.4. Impact on Various Language Skills

In a similar fashion, participants experienced a noticeable enhancement across various aspects of their language skills. The program not only expanded their vocabulary and improved their writing abilities but also contributed to increased fluency and accuracy in both spoken and written English. This was expressed by the learners stating that *"It was a great addition to my language. It made a difference in my writing. I use phrases easily and understand the meaning"; "The LIRRA-NP added new vocab to my language which will help me in my writings and benefit me in my field of study as well"; "It has enabled me to write more professionally"; "It added a lot to the way I write, read and speak"; "I now pay close attention to the mistakes I used to make before the program. In addition to generating speech more rapidly as my range of vocabulary extended by adding the phrases and collocations I've learned throughout the program"; "I became much better in my writing and my choice of words when writing an article or something. Moreover, I became familiar with many terms and thus corrected my understanding of speech more quickly and coherently".*

3.4.5. Less favorable responses

Although the majority of participants reported no dislikes and expressed satisfaction with the LIRRA-NP, a minority identified specific aspects requiring improvement. The most recurrent concern involved the length of certain excursions and the volume of readings, questions, and tasks, with one participant reporting that an excursion sometimes had to be completed over two days. Other participants expressed dissatisfaction with particular activities, including mathematical riddles and group puzzles, while individual comments identified the "Men vs. Women" content and the repeated completion of satisfaction forms as less appealing aspects. Some participants also wished for greater attention to speaking skills, which were outside the program's primary scope. These qualitative responses indicate that, despite the generally favorable reception, participants differed in their preferences and expectations regarding workload, content, and activities. Nevertheless, the majority of participants explicitly stated that they had no dislikes, and several expressed appreciation for the researcher's encouragement and support throughout the program.

4. Discussion

This research was conducted to evaluate learners' perceptions of the LIRRA-NP to gain an understanding of the students' views of neuroeducation programs in terms of likes, dislikes, and impact. In line with the program's dependency on the primary neuroeducational features of *lexical phrases exposure, implicit learning, repetitive exposure, a rewarding and motivating environment, and an attention-simulating setting*, the LIRRA-NP was designed in an engaging and motivational way to capture the participants' interests. This was achieved through material compiled from a variety of sources and developed by the researcher into a variety of interactive games and animated slides, visually appealing documents, and interactive forms. The results revealed that the LIRRA-NP was perceived to be appealing to the interests of the participants on several levels.

Learners perceived the program as motivating, highlighting the importance of a rewarding and motivating learning environment, a key feature of the LIRRA-NP framework. They also cited the novel content as a primary driver of their engagement, aligning with the LIRRA-NP's speculated attention-stimulating setting, which aimed to capture attention by using attentional strategies hypothesized to promote focus and memory consolidation via the release of attentional neurotransmitters . In the realm of language proficiency, self-assessments further indicated that the program enhanced L2 proficiency, expanded knowledge, and accelerated sentence construction. Participants specifically reported improved English writing skills, enabling them to write more efficiently and use appropriate L2 forms with less effort and in less time. These self-reported improvements were corroborated by the measurement assessments, which demonstrated the significant impact of LIRRA-NP on language acquisition and proficiency, providing evidence for the

pedagogical effectiveness of its targeted features (i.e., lexical phrase exposure, implicit learning, and repetitive exposure) (Yusuf, 2024). This general positive reception of the program provides a foundation for examining specific aspects that contributed to its success, including the integration of neuroeducational principles, the use of games, the design of learner-adapted materials, and the online learning environment.

A key element contributing to the positive reception of the LIRRA-NP was its grounding in neuroeducation-informed principles. This study highlights participants' overwhelmingly positive perceptions of the program, which they rated as interesting, motivating, and relevant. In particular, the participants' perception with regard to relevance, novelty and motivating content aligns significantly with the theoretical framework of the LIRRA-NP model, indicating strong support for the instructional utility of these principles in promoting positive learning experiences. Participants expressed high satisfaction and a strong likelihood of recommending the program, aligning with research on the positive impact of neuroeducation on learner attitudes and engagement. The program's motivational aspects align with Mejías et al. (2021), who found that Spanish vocational university students in the NeurAula neuroeducation program reported increased motivation, interest, and awareness of learning strategies. Similarly, Thul's (2019) study on neuroeducation in adult learning demonstrated that such programs enhance understanding of learning practices, foster cognitive growth, and shift perspectives on education. The LIRRA-NP program's unique and appealing online delivery echoes findings from Elvira et al. (2020), which emphasized the importance of playful strategies, social interaction, and collaborative activities in neuroeducation. Emotional engagement and motivation, key strengths of the LIRRA-NP program, were also highlighted by Elvira et al. (2020) as critical to the success of neuroeducational approaches. Overall, the participants' positive feedback aligns with broader research underscoring the effectiveness of neuroeducation programs in boosting learner motivation, engagement, and understanding of learning processes. This positive reception of the neuroeducational framework set the stage for the effective implementation of specific pedagogical strategies, such as the use of games.

This study further highlights the engaging and motivational role of games in the LIRRA-NP program, with participants reporting high enjoyment and motivation across various game types. These findings align with substantial research supporting games as effective pedagogical tools for enhancing language acquisition. For example, Rodríguez & Argüello (2023) found collaborative description games to significantly boost motivation and language competency among EFL university students, while Van Duc et al. (2024) emphasized games' ability to create enjoyable and low-stress learning environments. The interactive nature of games, as noted by Munawarah et al. (2024), fosters vocabulary acquisition and productive skills, echoing the current study's observations. Moreover, research consistently links game-based learning to increased engagement and vocabulary gains (Nasyifa et al., 2024). Tools like Kahoot and Quizizz, highlighted by Yyelland and Duisenova (2024), exemplify how digital games enhance language proficiency and participation. Broader studies, such as Ryu (2013) and Klimova and Kacet (2017), demonstrate gaming's potential to foster collaboration, improve vocabulary, and boost communication through online communities and gameplay. Additionally, the motivational and interactive aspects of game design, such as quests and character interaction, as noted by Kim (2018), and the use of board games for spoken interaction (York, 2020), further validate the current study's findings. Finally, the integration of novel technologies, as highlighted by Wei (2022), underscores the role of game-based approaches in creating personalized, engaging, and retention-enhancing language learning experiences. The engagement fostered by these games was further enhanced by the careful design of the learning materials.

This study also underscores the critical role of learner-adapted materials in language program success, highlighting the significance of relevance, diversity, and novelty in fostering motivation and engagement. Participants valued age-appropriate, culturally relevant, and authentic materials that connected to their interests and life experiences, emphasizing their role in enhancing learning outcomes. These findings align with research showing that authentic materials tailored to learners' real-world contexts boost motivation and performance by fostering relevance and meaningful connections (Anam et al., 2019; Astuti, 2014; Kanoksilapatham, 2018). Culturally and contextually relevant materials have also been linked to improved vocabulary acquisition, voluntary reading, and language proficiency (Haryati et al., 2023; Lasekan, 2016). The diversity and novelty of materials in the LIRRA-NP program, including varied genres, multimedia resources, and self-assessments, emerged as key motivators. Novel content and engaging contexts, supported by Brutman (2024), were shown to stimulate cognitive processes and enhance the learning experience. This aligns with studies demonstrating that diverse, stimulating content improves specific language skills such as vocabulary acquisition (Lee & Pulido, 2016). The findings further resonate with research on content-based language instruction (CLIL), which fosters intrinsic motivation and language acquisition by integrating complex topics with authentic language use (Daraini et al.,

2021). Collectively, the evidence underscores the importance of engaging, learner-centered materials in creating motivating and effective language learning environments. All of these elements were effectively delivered within an online learning environment.

The present study revealed a strong positive perception of the online learning experience among participants. They expressed satisfaction with the online format, citing benefits such as time-saving, flexibility, and overall usefulness. This positive reception aligns with previous research highlighting the advantages of online and blended learning approaches (Kiviniemi, 2014). Studies have shown that combining online and traditional methods can lead to improved student performance, suggesting that the online component itself can be highly effective. Furthermore, the findings resonate with research on learner autonomy and self-regulation in online environments. The participants' emphasis on time-saving and flexibility suggests that the online format facilitated self-paced learning, which is consistent with the findings of Lin et al. (2017), who linked effective online learning strategies to positive outcomes like higher grades and satisfaction. This increased autonomy, allowing learners to manage their studies according to their own schedules, has been shown to enhance motivation and engagement (Zheng, 2024). The perceived benefits of time and cost savings observed in this study are also consistent with Albogami's (2022) findings on EFL learners' perceptions of online learning, indicating that these practical advantages are a common factor contributing to the positive perception of online learning. The overall positive feedback also suggests that the online environment was successful in maintaining learner motivation, which aligns with Marlina's (2023) research on the potential of online platforms to boost motivation. While the current study did not specifically investigate interactive elements, previous research suggests that such elements contribute to learner satisfaction and a sense of competence in online learning environments (Zheng, 2024). In sum, the positive perceptions of online learning observed in this study are consistent with existing research emphasizing the benefits of online and blended learning in terms of performance, autonomy, motivation, and practical advantages.

Despite these positive perceptions, some participants considered certain excursions lengthy and the volume of readings, questions, and tasks demanding. Individual comments also identified dissatisfaction with particular content and the repeated completion of satisfaction forms. Thus, while the diversity of materials was generally appreciated, the findings indicate a potential trade-off between providing varied learning experiences and maintaining a manageable workload. Also, the concern about speaking may reflect a mismatch between some participants' expectations and the reading-centered design. These findings suggest reviewing excursion length, making tasks more modular, reconsidering potentially stereotypical content, and clarifying the program's targeted skills. The single-researcher thematic analysis and small sample further limit the interpretation and transferability of the findings.

This study offers several practical implications for language education. Positive learner perceptions suggest that incorporating LIRRA-NP's neuroeducation-informed principles can benefit L2 learning. To this end, educators should consider integrating these principles and using engaging, varied materials like games, multimedia, and authentic content to create motivating learning experiences. Moreover, integrating online format is prompted given the positive reception of the online format, particularly when providing flexibility and promoting learner autonomy. Learner-centered approaches, actively soliciting and incorporating feedback, are crucial for optimizing interventions. Finally, this study emphasizes the necessity of developing and evaluating neuroeducation-based language learning programs to effectively translate neuroscience insights into improved L2 learning practices. Yet, caution is due when generalizing the results as a notable methodological limitation of this study is the highly skewed gender distribution (27 females and 3 males), which was an inherent outcome of utilizing an intact departmental cohort from the primary intervention (Yusuf, 2024). While these findings offer rich insights into the perceptions of this participant group, the heavy female representation limits the generalizability of the results to broader, gender-balanced L2 learner populations. Because male and female learners may exhibit differing motivational profiles or preferences for specific gamification elements and instructional designs, future research should replicate the LIRRA-NP evaluation with balanced gender samples to assess potential gender-based interaction effects.

Future research should expand upon the findings of this study in several key areas. Further investigation into how learner variables such as learning styles, prior language learning experience, and motivation levels interact with the program could inform personalized learning approaches. While this study primarily focused on learner perception of a neuroeducation-informed program cored in reading comprehension, future research should investigate learner perception in neuroeducation program on a wider range of language skills, including speaking, listening, and writing. Replication of the study with diverse learner populations (varying age groups, language backgrounds, proficiency levels) would enhance the generalizability of the findings. More in-depth qualitative methods, such as interviews or focus groups, could explore learner experiences with specific program elements in greater detail. Finally, given some participants' concerns about session

length, future research could investigate the optimal session duration for maximizing learning outcomes and engagement.

5. Conclusion

This study provides valuable insights into learner perceptions of the LIRRA-NP, a neuroeducation program informed by neurocognitive principles and designed to improve L2 acquisition and proficiency. The overwhelmingly positive feedback from participants underscores the program's success in creating an engaging, motivating, and relevant learning experience. Participants particularly valued the program's content, novelty, interactive design and the integration of diverse learning activities. The alignment of these positive perceptions with the LIRRA-NP's core neuroeducational principles suggests the practical feasibility and effective translation of theory into practice. The study highlights the importance of incorporating learner feedback to refine and optimize educational interventions, ensuring both effectiveness and learner satisfaction. The results suggest that the LIRRA-NP offers a promising approach to designing engaging L2 learning experiences, particularly in the context of promoting L2 acquisition and enhancing overall language proficiency. These findings contribute to the ongoing development of neuroeducation-informed programs in language learning by providing empirical evidence of learner satisfaction and perceived efficacy of the neuroeducation program, offering specific guidance for future language learning programs.

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