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Construction and validation of a multilingual diagnostic instrument for neuromyths and their origins

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Abstract: This study presents the development of a comprehensive neuromyth identification tool designed to be valid, reliable, and multilingual, including French, English, Turkish, Greek, Kazakh, Arabic, Malay, and Chinese. By incorporating languages from diverse geographic regions, the tool aims to increase the accessibility and relevance of neuromyth research, allowing for more comprehensive and generalizable findings. The primary research question guiding this study was: "What structural properties should a valid and reliable instrument have to effectively identify teachers' primary neuromyth beliefs and the origins of these beliefs?" A mixed-methods approach was used, integrating both quantitative and qualitative methods to ensure the robustness of the instrument. The development process unfolded in four key stages: (1) a thorough literature review to identify existing neuromyths and relevant survey instruments, (2) the design of the initial questionnaire, (3) pilot testing to evaluate and refine the instrument, and (4) language adaptation to ensure cultural and linguistic appropriateness in the target languages. The resulting neuromyth identification tool has been rigorously tested for its structural properties, such as validity and reliability, across different linguistic and cultural contexts.

1. INTRODUCTION

The brain's intricate and often mystifying properties have long made it a subject of fascination and commercial exploitation (Dekker *et al.*, 2012; Ferrero *et al.*, 2016). Beliefs about how the brain functions that are commonly held but not based on facts are called neuromyths. These neuromyths can arise from misunderstandings, misinterpretations, or oversimplifications of neuroscientific findings (OECD, 2002). These misconceptions have been spread through informal sources such as films, documentaries, advertisements, and social media platforms (Carter *et al.*, 2020; Howard-Jones, 2014; Ruhaak & Cook, 2018). However, studies have shown that formal education systems, especially teacher training programs, professional

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development activities, and school curricula, perpetuate these myths by incorporating them into teaching methods (Tardif *et al.*, 2015; Vig *et al.*, 2023; Zhang *et al.*, 2019).

As defined by the Organisation for Economic Co-operation and Development (OECD, 2002), neuromyths stem from the misunderstanding, misinterpretation, or misapplication of neuroscientific findings regarding the cognitive and affective characteristics of learning. A common example is the concept of learning styles, which posits that individuals have distinct preferences, such as visual, auditory, or kinesthetic learning. Although this idea is based on the observation that different types of information are processed in specialized regions of the brain, it has not been scientifically validated by neuroscience research (Tardif *et al.*, 2015; Zhang *et al.*, 2019). Such misconceptions are reinforced through popular media, commercial "brain-based" programs, and even formal teacher education curricula, thereby becoming entrenched in educational settings (Vig *et al.*, 2023; Zhang *et al.*, 2019). Consequently, without a critical evaluation of these claims against neuroscientific evidence, teachers may inadvertently integrate them into their instructional practices.

In addition to learning styles, other widely held neuromyths include the theory of multiple intelligences, the notion of left- and right-brain dominance, the belief in effective multitasking, and the claim that humans use only 10% of their brains. The persistence of these myths highlights the importance of accurately interpreting scientific evidence and recognizing the brain's complex, holistic role in learning. The prevalence of these neuromyths in education has significantly influenced our understanding of learning, often with negative consequences. Misconceptions about brain training, learning styles, nutrition, and medication have led to inappropriate practices that threaten learning, achievement and overall well-being of students. Despite evidence to the contrary, such practices appear to persist largely in educational settings (Ching *et al.*, 2020). Research has shown that socio-cognitive biases are strong predictors of neuromyth beliefs, suggesting that modifying thought schema is essential to dispel these myths (van Elk, 2019).

Neuromyths spread rapidly through both formal and informal educational environments, facilitated by the misinterpretation of neuroscience research, exploitation by those unfamiliar with the field, and the appeal of sensationalist narratives in popular media. Teachers play a critical role in both perpetuating and dispelling neuromyths (Dekker *et al.*, 2012). During both pre-service and in-service training, teachers engage in formal and informal learning activities to support their professional development. In this process, certain practices that emerge as innovative approaches are often adopted without undergoing rigorous scientific scrutiny, inadvertently leading to the creation of new neuromyths or the reinforcement of existing ones (Ching *et al.*, 2020; Dekker *et al.*, 2012; Tardif *et al.*, 2015; Zhang *et al.*, 2019). The study conducted by Ching *et al.* (2020) highlights the central role of educators in perpetuating neuromyths. Therefore, it is essential that teachers evaluate information from various disciplines with constructive skepticism and actively seek scientific validation.

Although studies in literature identify common neuromyths, they offer minimal insight into their origins and dissemination. Additionally, research indicates that the data collection instruments used to identify neuromyths have certain scientific methodology weaknesses. These weaknesses include insufficient reporting of the instruments' structural characteristics, inadequate evidence of adaptation to linguistic and cultural contexts, and uncertainties in sample selection. Neuromyths significantly impact the learning process. Therefore, it is important to determine the neuromyth beliefs and learning sources of educational stakeholders, particularly teachers and pre-service teachers, regarding advances in neuroscience. This can be achieved by using well-designed instruments developed in accordance with rigorous scientific methods.

In recent years, researchers have conducted multiple studies to determine the prevalence of neuromyths among teachers. These research projects have employed various measurement instruments. A review of this research reveals that data are most often collected using true/false or Likert-type questionnaires. One widely used instrument is the neuromyth questionnaire developed by Dekker *et al.* (2012), which has been adapted and used in many countries. It typically consists of items related to neuromyths and mental functions with true/false or "don't know" response options and contains between 12 and 35 items. The tool used in the study of Dekker *et al.* (2012) is based on the OECD's 2002 report on neuromyths and the myths identified therein.

Researchers have generally used these measurement instruments in translation without linguistic and cultural adaptation. However, only a few studies have adapted them for specific contexts. For instance, Schmitt *et al.* (2023) expanded the study of Dekker *et al.* (2012) and Macdonald *et al.* (2017) based on a 23-item scale by adding nine new giftedness-related items. They presented the questionnaire in English, French, and German to accommodate Luxembourg's multilingual structure and tested the translations for cultural validity. Another distinctive approach among these studies is the scenario-based instrument developed by Tovazzi *et al.* (2020) titled the Neuroscience Against Neuromyths Questionnaire (NNQ). Unlike traditional neuromyth questionnaires, this tool provides a more practical and contextualized approach, evaluating how teachers would respond to real classroom scenarios.

Structurally, it is observed that the reliability of the items in most of these instruments has been evaluated using Cronbach's alpha coefficients. Although valid and reliable data collection instruments are essential for accurately analyzing research data, the literature lacks validity and reliability analyses during the development of these instruments. Consequently, there is insufficient information on item analysis, pilot testing, and other development processes. Table 1 presents a sample based on several neuromyth studies conducted in recent years, with the most recent study serving as the starting point.

As shown in Table 1, most studies have used instruments derived from one or two primary sources. Linguistic adaptations to target languages are rarely undertaken, and the structural characteristics of the instruments are rarely verified or reported. Overall, the tools used to assess neuromyths exhibit significant methodological variation. While most rely on the traditional true–false test format, some studies have incorporated scenario-based items, multiple-choice questions, or Likert-type scales to enrich their assessments. Within the literature, instruments explicitly designed to gather data on the origins of neuromyths remain particularly scarce. The overwhelming focus of existing research has been on the identification of neuromyths themselves, with insufficient attention devoted to systematically investigating their sources.

An effective diagnosis of neuromyths and their origins requires a precise conceptualization of the myths, a scientific plan for linguistic and cultural adaptation processes, and a thorough report on the validity and reliability of the instruments. Such methodological rigor would facilitate more accurate identification and support the development of targeted intervention programs, thereby enhancing the capacity to distinguish between scientific evidence and popular misconceptions within educational contexts. To address these gaps, this study aims to create a neuromyth identification tool that is valid, reliable, and multilingual encompassing French, English, Turkish, Greek, Kazakh, Arabic, Malay, and Chinese languages. By including languages spoken across a broad geographic area, this tool is expected to enhance the usability and applicability of the surveys, facilitating more comprehensive and generalizable research findings.

Thus, the research question guiding this study is: "What structural properties could a valid and reliable instrument possess to identify teachers' primary neuromyth beliefs and the origins of these beliefs?" As previously discussed, the lack of such comprehensive instruments in the existing literature emphasizes the novelty and uniqueness of this research. Therefore, the objective of this study is to conduct the development of a questionnaire that facilitates critical reflection on the aforementioned properties.

Table 1. *Comparative review of neuromyth identification tools.*

Source	Instrument Description	Adapted / Based On	Language/Cultural Adaptation	Validity / Reliability Reported
Sazaka *et al.*, 2024	5-item neuromyth identification tool	Tardif *et al.* (2015)	Not reported	Not reported
Deibl *et al.*, 2023	46-item neuromyth identification tool	Dekker *et al.* (2012); Krammer *et al.* (2019, 2020)	Not reported	Not reported
Vig *et al.*, 2023	23-item neuromyth identification tool	Dekker *et al.* (2012)	Not reported	Not reported
Deans *et al.*, 2022	5-item neuromyth identification tool	Dekker *et al.* (2012)	Not reported	Not reported
Jeyavel *et al.*, 2022	7-item neuromyth identification tool	Not reported	Not reported	Not reported
Ruiz-Martin *et al.*, 2022	32-item neuromyth identification tool	Dekker *et al.* (2012)	Not reported	Not reported
Simoes *et al.*, 2022	30-item neuromyth identification tool	Not reported	Not reported	Not reported
Bisessar, 2021	30-item neuromyth identification tool	OECD (2002)	Not reported	Not reported
Craig *et al.*, 2021	30-item neuromyth identification tool	Dekker *et al.* (2012)	Not reported	Not reported
Carter *et al.*, 2020	32-item neuromyth identification tool	Dekker *et al.* (2012)	Not reported	Not reported
Ching *et al.*, 2020	17-item neuromyth identification tool	Dekker *et al.* (2012),	Translation & back-translation	Not reported
McMahon *et al.*, 2019	32-item neuromyth belief questionnaire	Dekker *et al.* (2012)	Not reported	Not reported
Zhang *et al.*, 2019	40-item neuromyth identification tool	Dekker *et al.* (2012), Howard-Jones *et al.* (2009),	Translation & back-translation	Not reported
Ruhaak&Cook, 2018	25-item neuromyth identification tool	Dekker *et al.* (2012), Howard-Jones *et al.* (2009), OECD (2002)	Not reported	Not reported
Ferrero *et al.*, 2016	32-item neuromyth identification tool	Dekker *et al.* (2012), Howard-Jones *et al.* (2009), OECD (2002)	Not reported	Not reported
Tardif *et al.*, 2015	3-item neuromyth data collection tool	Not reported	Not reported	Not reported
Dekker *et al.*, 2012	32-item neuromyth identification tool	Howard-Jones *et al.* (2009), OECD (2002)	Not reported	Not reported

2. METHOD

This research employed a mixed-methods approach, combining both quantitative and qualitative methodologies to develop a valid and reliable instrument for identifying teachers' neuromyth beliefs and their sources. The development of the questionnaire involved four stages: literature review, design, pilot testing, and language adaptation. During the literature review phase, a comprehensive review of existing studies and thematic analysis were conducted to create an initial pool of questionnaire items and to validate the content of these items. Subsequently, in the design phase, the items were carefully crafted in terms of both content and presentation, setting the stage for the pilot phase. The pilot study served as a preliminary test to evaluate the characteristics of the questionnaire items. Finally, in the language adaptation phase, the questionnaire was translated to accommodate the linguistic diversity of the target audience, and its structural integrity was analyzed.

2.1. Analysis and Design Phase: Literature Analysis and Creation of Items

The analysis phase of the study was characterized by a comprehensive review and descriptive analysis. The research encompassed a thorough examination of most studies on neuromyths that were present within international databases. This comprehensive review aimed to identify prevalent neuromyths and to evaluate both formal and informal learning resources associated with them.

2.1.1. *Literature review criteria*

The literature review was meticulously structured based on criteria established by the research team. To ensure a comprehensive and systematic search, specific parameters were established for keywords, databases, areas of research, language, and year of publication. Keywords selected for the literature search included "neuromyths", "neuromyth belief" and "neuromyths and learning". The databases selected for review were those containing articles related to "education", "educational sciences", "educational research", "psychology", and "neuroscience", specifically indexed in renowned academic platforms such as Web of Science (WOS), Elsevier, Springer, Sage, Taylor & Francis, Wiley, and Frontiers Media Sa. (SSCI, ESCI-SCI-E). The language of the research was limited to English. Given the nascent nature of the field of neuromyth and the resulting paucity of studies, we chose not to restrict the year of publication. A total of 141 studies were initially identified following the review process. During the planning and review process, three researchers conducted independent searches using the same keywords and obtained a similar number of studies. Five duplicate studies were removed from the review in the selection phase (k = 136). Then, 39 studies that were not written in English or that were not research articles were excluded (k = 97). Based on the subject-area criterion, an additional 35 studies unrelated to the fields of education, neuroscience, or psychology were removed (k = 62). According to these criteria, the remaining studies were reclassified by content. This resulted in 49 articles associated with educational sciences and learning. We then examined the research aims, methodological designs, data collection instruments, and analyses of these selected studies in greater detail in terms of accuracy, clarity, and validity. Finally, the articles were reclassified according to their content, and 37 studies were analyzed (Adıgüzel *et al.*, 2024). The detailed criteria are presented in Table 2.

Table 2. *Literature review criteria*.

Categories	Criteria
Keyword:	"Neuromyths", "Neuromyths belief" "Neuromyths and learning"
Database:	Web of Science (WOS), Elsevier, Springer, Sage, Taylor & Francis, Wiley, Frontiers Media Sa
Field:	"education", "educational sciences", "educational research", "psychology", "neuroscience"
Research type:	Article
Language:	English
Year:	All years

2.1.2. *Evaluation and creation of items*

To develop a comprehensive and up-to-date questionnaire, an extensive evaluation of data collection instruments from relevant studies was conducted. Each item from these studies underwent a rigorous evaluation by researchers and subject matter experts, focusing on similarity, accuracy, clarity, and validity. This process included correlating each item with its respective references and compiling them into a centralized item repository. A panel of six Ph.D.-level experts with international contributions in neuroscience, neuro education and education reviewed the items, excluding those that failed to meet established criteria. Theoretical frameworks from the literature were also considered to inform the development of neuromyth items. Discussions ensured the appropriateness of each statement, considering the target audience's characteristics. This meticulous process ensured the development of a robust and comprehensive questionnaire.

Following the analysis of the neuromyth items, an in-depth review of learning resources was conducted. The resources were categorized as either formal or informal to enable a more comprehensive analysis. Upon completion of these studies, neuromyth items and learning resources were identified and then structured into a questionnaire form.

2.2. Implementation Phase: Pilot Implementation

In the second phase of the study, the draft instrument was piloted, and after the piloting, a general evaluation meeting was held with the participants, and the items in the item repository were evaluated.

2.2.1. *Participants*

The pilot implementation was conducted with teachers employed at a private school. No specific sampling procedure was applied. Instead, participation was based on voluntary consent, and all teachers at the school were invited to participate in the study. Participants were required to be actively employed as teachers at the time of the study. Those who were not engaged in teaching were excluded. A total of 190 teachers participated in the pilot implementation of the developed instrument. Two teachers were excluded for providing blank answers, and five were excluded for failing to respond to most items. Consequently, the analyses were based on the responses of 183 teachers. Participants in the study were predominantly female, with 78% of teachers being women and 22% being men. Among the participating teachers, 42% had five years of experience or less, 27% had six to ten years, 13% had eleven to fifteen years, 7% had sixteen to twenty years, and 11% had twenty-one years or more.

2.2.2. *Pilot implementation process*

During the pilot phase, the draft questionnaire designed to assess cognitive readiness and relevant learning resources was to be administered in a controlled setting. This draft questionnaire was administered to 190 teachers in a single session, with an average completion time of 20 minutes per respondent. Following the session, an analysis of the 39-item instrument was conducted. A follow-up meeting was convened to discuss the results of the analysis and to address any items that participants found overly technical or challenging.

2.2.3. *Analysis of pilot implementation data*

In the present study, several statistical procedures were applied to ensure the validity, reliability, and cultural appropriateness of the measurement instrument. Subsequently, exploratory factor analysis (EFA) was employed to examine the construct validity of the instrument and to verify whether the empirical data supported the theoretically proposed two-factor structure ("Perceptions of the learning process" and "Perceptions of brain and intelligence characteristics"). The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were calculated to determine the suitability of the data for factor analysis. Factor loadings, eigenvalues, and scree plot inspection were used to confirm the dimensional structure. In addition, correlation analyses were performed to explore the relationships between the identified factors and relevant study variables, providing further evidence for the instrument's construct validity. Internal consistency was evaluated using Cronbach's alpha coefficients. All analyses were conducted using SPSS, and a significance level of $\alpha < .05$ was adopted.

2.3. Language Adaptation Phase: French, Turkish, Greek, Kazakh, Arabic, Malay, Chinese

2.3.1. *Language adaptation protocol and briefing*

To ensure the global applicability of the developed questionnaire, a comprehensive selection of countries was identified for the implementation study. To facilitate this, language adaptation criteria were carefully established. Collaborations with scientists and translators from each target country were initiated to ensure accurate adaptation. The experts recruited for this adaptation process were guided by the following key phases:

Preparation Phase: This involved the formation of a dedicated translation team, followed by detailed briefings and specialized training to align the team with the study objectives.

Translation and back-translation phase: The questionnaire underwent a rigorous translation process, followed by back-translation to ensure fidelity to the original content. This phase also included careful comparison, editing, and review by a panel of experts before final implementation.

2.3.2. *Language adaptation process*

In this study, translating the data collection instrument into multiple languages was a critical step. Researchers from each target country were recruited on the basis of predefined criteria, and the English version of the instrument was distributed to them. These researchers played an integral role in the adaptation process, ensuring that the tool was modified according to the established guidelines. Through this collaborative effort, the data collection tool was prepared for global use in eight languages: French, English, Turkish, Greek, Kazakh, Arabic, Malay, and Chinese.

2.4. Validity and Reliability of The Study

Within the scope of the research, ethical and implementation permissions were obtained in accordance with established ethical guidelines. These permissions were subsequently shared with all participating countries, ensuring a unified and compliant approach to the study.

2.4.1. *Validity*

To ensure the validity of the questionnaire, several steps were followed. First, a comprehensive literature review was conducted to inform the development of the questionnaire items. This review was essential for grounding the questionnaire in scientific evidence and incorporating the full scope of knowledge and findings from previous research.

The study's ethical validity was ensured by the voluntary participation of respondents. Additionally, the research received ethics committee approval, which was disseminated to administrators in each participating country, further affirming the study's adherence to ethical standards and guidelines.

The formulation of the questionnaire items and their translation into different languages were informed by expert consultation. Each item was supported by a literature review, thereby strengthening the content validity of the instrument. In addition, the inclusion of a wide range of learning resources, both formal and informal, ensured a comprehensive representation of participants' learning environments within the survey.

2.4.2. *Reliability*

A series of strategies was used to increase the reliability of the study. Initial pilot testing of the questionnaire was used to clarify any ambiguous items. To achieve consistent results across different country groups, maximum sampling variation and objective sample selection were used. The language adaptation phase involved careful translation and back-translation of the questionnaire items to ensure linguistic accuracy and comprehensibility. The inclusion of both correct and incorrect items, along with the strategic use of the term "perception" rather than "neuromyth" was designed to minimize researcher-induced bias. To complement the neuromyth items, learning resources were developed through an extensive literature review and expert consultation, and the questionnaire was formally structured to reflect these inputs. The internal consistency of the questionnaires across languages was verified using the split-half method. In addition, inter-language correlation coefficients were calculated using data from a new application.

During the language adaptation process, responses collected through the online survey platform were analyzed. To prevent participants from searching for correct answers online, a 30-second time limit was imposed for each item. These measures collectively enhanced the questionnaire's reliability, improving both its internal consistency and temporal stability.

3. RESULTS

3.1. Analysis and Design Phase: Literature Analysis and Development of Items

During the analysis and design phase of the study, a comprehensive, multifaceted questionnaire was developed to identify teachers' misconceptions about neuromyths and their associated learning resources in relation to the learning process and intelligence characteristics in eight languages. This development was preceded by a systematic review of the existing literature on neuromyths, which yielded an initial 50-item instrument that aligned with the research methodology's requirements.

Draft items were reviewed by a panel of six experts, each with at least a master's degree in neuroscience or education. Their collective insights resulted in a refined questionnaire that was narrowed down to 39 items selected for their relevance, informational accuracy, and alignment with the research objectives and phrasing style.

To authenticate the data collection tool and facilitate nuanced data analysis, the questionnaire was divided into two dimensions: "Perceptions of the learning process" and "Perceptions of brain and intelligence characteristics". The format of the questionnaire was formalized to allow for detailed examination. Response categories such as "correct", "incorrect" and "I can't answer because" were introduced for each neuromyth statement. Additional response options, "I don't have enough information to answer", "There are important uncertainties about this issue", "I've never heard of it" were included to clarify the reasons for unanswered items and to minimize data attrition.

A distinctive feature of the questionnaire is the inclusion of categories for both formal and informal sources that shape neuromyth beliefs. To thoroughly investigate the origins of these beliefs, 12 different sources were identified and incorporated into the data collection instrument, as shown in Figure 1.

Sources / Statements	Formal learning resources			Informal learning resources								NC
	S1. Undergraduate/graduate education	S2. Professional development programs	S7. Academic publications	S3. Professional experience	S4. Social media	S5. Websites	S6. Colleagues or friends	S8. Other publications	S9 The movies	S10. Television programs	S11. Advertisements	S12. Self-intuitions

Figure 1. *Neuromyth learning resources questionnaire.*

As seen in Figure 1, formal learning resources were grouped under three sources, and informal learning resources were grouped under eight sources because they were more diverse. Within this structure, "self-intuition" was structured outside of the formal and informal sources. This origin, which was included at the suggestion of experts in the field, was included in the categories as an independent learning resource formed by professional experience and affective learning characteristics.

To determine the neuromyths and learning resources, each neuromyth item was defined based on various references within a comprehensive literature review. Examples of these references are provided in Table 3.

Table 3. *Scientific references of neuromyths items.*

Items	References	Items	References
IT1	Dekker *et al.*, 2012	IT17	Schmitt *et al.*, 2023
IT4	Tokuhama-Espinosa, 2018	IT19	van Dijk *et al.*, 2020
IT9	Schmitt *et al.*, 023	IT20	Dekker *et al.*, 2012
IT10	De Bruyckere, 2015	IT21	De Bruyckere, 2015
IT11	De Bruyckere, 2015	IT23	De Bruyckere, 2015
IT13	Papadatou-Pastou *et al.*, 2018	IT25	Dekker *et al.*, 2012
IT14	Tokuhama-Espinosa, 2018	IT26	Betts *et al.*, 2019
IT15	Howard-Jones *et al.*, 2009	IT28	Dekker *et al.*, 2012
IT16	Dekker *et al.*, 2012		

The data shown in Table 3 are also shown in Figure 2 with network analysis through the Gephi 0.10.1 program. This representation allows an understanding of the invocation of each item in the studies from which they were inspired.

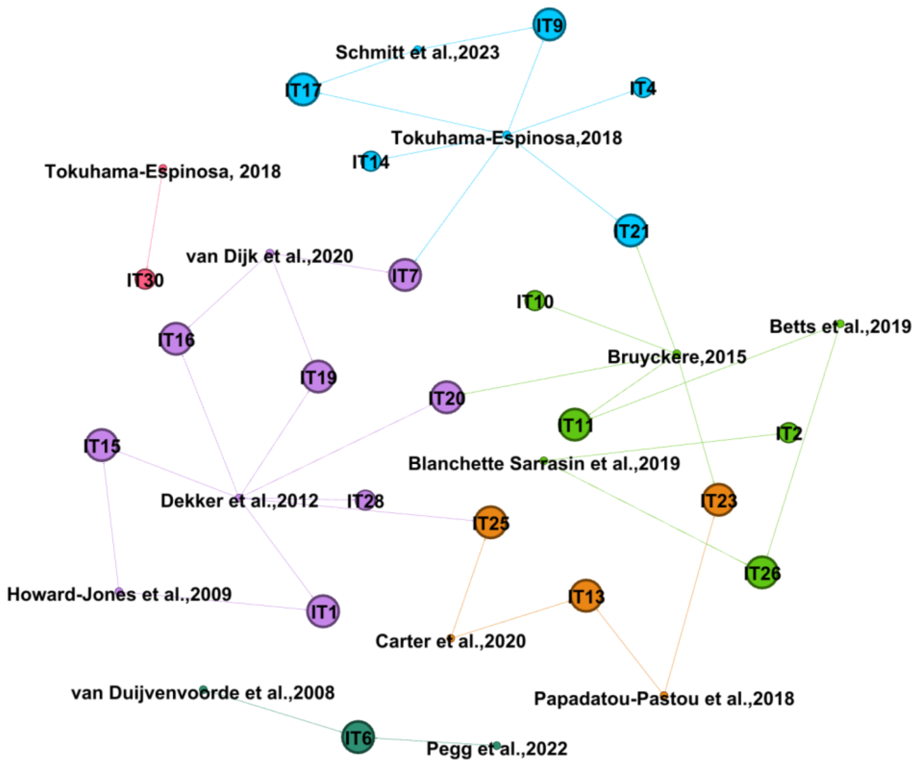

Figure 2. *Neuromyths network analysis.*

3.2. Implementation Phase: Pilot Implementation

The questionnaire was structured around two dimensions that were theoretically predetermined: "Perceptions of the learning process" (ST1–ST19) and "Perceptions of brain and intelligence characteristics" (ST20–ST39). The items and the theoretical framework were designed from the outset according to this two-factor structure. A factor analysis was subsequently conducted to validate that the neuromyth items were appropriately categorized under these dimensions. Prior to conducting the Exploratory Factor Analysis (EFA) to examine the construct validity of the instrument, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were performed to assess the suitability of the data for factor analysis. The KMO value was 0.70, indicating an acceptable level of sampling adequacy. Bartlett's test of sphericity yielded a statistically significant result ($\chi^2(741) = 1754.95$, $p < .001$), confirming that the correlation matrix was factorable. The EFA was conducted using the Principal Component Analysis extraction method in SPSS. To enhance interpretability and achieve a simpler factor structure, the Equamax orthogonal rotation method was applied. Prior to conducting the factor analysis, the dataset was examined for both univariate and multivariate outliers. Initially, all item responses were screened for completeness and consistency. Furthermore, an examination of the inter-item correlation matrix was conducted on the dataset. All correlations between variables were below .90, indicating that multicollinearity was not a concern. The results of the analysis confirmed the hypothesized two-factor structure of the instrument (1) Perceptions of the Learning Process and (2) Perceptions of Brain and Intelligence Characteristics as theoretically proposed. This plot is illustrated in Figure 3.

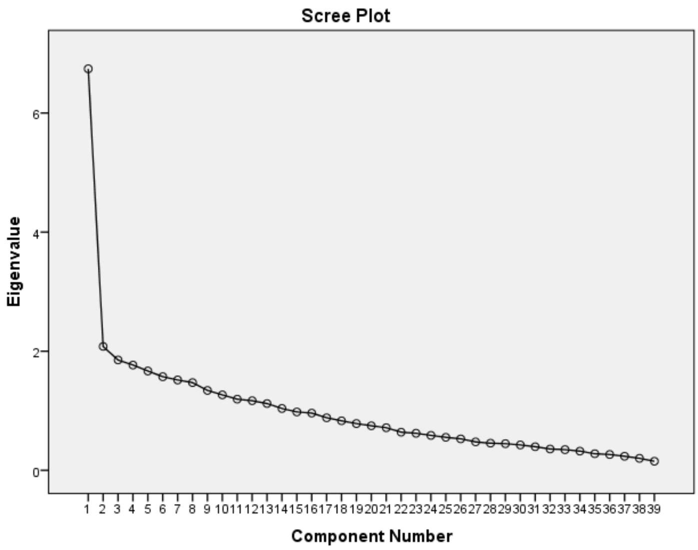

Figure 3. *Scree plot graph.*

Following the initial exploratory factor analysis (EFA), the structure of the instrument was confirmed to align with the theoretically proposed two-factor model. To refine the scale, item factor loadings were examined in detail after applying the Equamax rotation method. Items exhibiting cross-loadings above .30 on both factors or loadings below the acceptable threshold of .40 were identified as problematic (Tabachnick & Fidell, 2013). Based on these statistical criteria, nine items (Items 2, 4, 8, 16, 25, 30, 31, 32, and 39) were systematically removed from the instrument in an iterative process. After each item removal, the factor analysis was rerun to ensure that the two-factor structure remained stable and that the overall model fit improved. This process resulted in a final 30-item instrument with clear and distinct loadings on the two dimensions (Perceptions of the Learning Process and Perceptions of Brain and Intelligence Characteristics), free from cross-loading items and demonstrating improved internal consistency. The rotated factor loadings of the retained items are presented in Table 4.

Table 4. *Rotated component matrix.*

	Component			Component			Component	
Items	1	2	Items	1	2	Items	1	2
IT35	.646	.162	IT28	.449		IT20	.213	.587
IT22	.624		IT17	.406	.109	IT13		.556
IT38	.587	.107	IT14	.370		IT12	.251	.496
IT36	.555	.180	IT19	.353	.205	IT18		.396
IT33	.553		IT23	.331		IT10	.154	.378
IT7	.549		IT29	.328	.316	IT27	.105	.301
IT24	.531	.188	IT21	.324	.265	IT15	.237	.290
IT37	.527	.165	IT26	.307	.248	IT5		.230
IT6	.459		IT11	.185	.645	IT3		.220
IT34	.451	.189	IT9	.260	.632	IT1	-.111	.147

The analyses revealed that the empirical factor structure largely aligned with the anticipated two dimensions. Specifically, items IT6, IT7, IT14, IT17, and IT19 loaded on the "Perceptions of Brain and Intelligence Characteristics" factor, and items ST20 and ST27 loaded on the "Perceptions of the Learning Process" factor. However, several items (IT1, IT3, IT5, IT10, IT15, IT18, and IT27) had factor loadings below the recommended threshold of .40, indicating an insufficient association with their respective constructs (Hair *et al.*, 2019). Iterative examinations of the rotated component matrix also identified nine items (2, 4, 8, 16, 25, 30, 31, 32, and 39) with low loadings or substantial cross-loadings (≥ .30 on both factors). These items were removed to improve factorial clarity. After systematically eliminating these items and rerunning the EFA after each removal, a final 30-item instrument emerged, demonstrating a clear two-factor solution free from cross-loading items. The initial 39-item scale had a Cronbach's alpha coefficient of .88, indicating high internal consistency. This remained strong ($\alpha = .85$) for the refined 30-item version. The final questionnaire included 21 false and nine true items, and the reduced set of items showed improved interpretability and construct validity.

After all revisions were made, the final data collection instrument included 30 items. Twenty-one of these items were formulated to be incorrect (IT1, IT2, IT4, IT6, IT7, IT9, IT10, IT11, IT13, IT14, IT15, IT16, IT17, IT19, IT20, IT21, IT23, IT25, IT26, IT28, IT30), and nine were formulated to be correct (IT3, IT5, IT8, IT12, IT18, IT22, IT24, IT27, IT29). To minimize response bias and maintain measurement validity, the correct and incorrect items were intermixed throughout the questionnaire rather than being grouped by type, as illustrated in Table 5. In addition, the complete version of the neuromyth diagnostic instrument is presented in the Appendices in eight languages: Appendix 1 (English), Appendix 2 (Turkish), Appendix 3 (Arabic), Appendix 4 (Chinese), Appendix 5 (French), Appendix 6 (Greek), Appendix 7 (Kazakh), and Appendix 8 (Malay).

Table 5. *Neuromyth items.*

No	Items	Correct/ Incorrect
M1	Individuals learn better when they receive information in alignment with in their dominant learning styles (examples: visual, auditory, kinesthetic etc.)	Incorrect
M2	The dominant intelligence profile of learners (examples: mathematical, verbal, spatial) must be considered in teaching	Incorrect
M3	In the learning process, the mind associates new information with previous knowledge	Correct
M4	Different parts of the brain operate independently during the learning process	Incorrect

Table 5. *Continues.*

M5	Learning occurs through changes in synaptic connections between neurons in the brain	Correct
M6	Learning is a purely cognitive skill, not emotional	Incorrect
M7	Learning takes place independent from individuals' learning backgrounds	Incorrect
M8	Some mental processes (experience, learning) repeated over a long period of time can change the structure and function of some areas of the brain	Correct
M9	Individuals can learn new information even while in a state of sleep	Incorrect
M10	Humans are good multitaskers	Incorrect
M11	The fact that some people are more "right-brained" and others are more "left-brained", helps explain the differences in how we learn	Incorrect
M12	Individuals learn better when course content is presented in short sessions or modules	Correct
M13	There are specific periods in childhood after which certain things can no longer be learned	Incorrect
M14	Memorization has no impact on the learning process	Incorrect
M15	Environments that provide a larger amount of stimuli improve the brains of pre-school children	Incorrect
M16	Mental capacity is hereditary and cannot be changed by the environment or experience	Incorrect
M17	Listening to classical music improves mental capacity	Incorrect
M18	When a part of the brain is damaged, other parts can take over its function	Correct
M19	Short periods of coordination exercises can improve brain function (for example, touching your right ankle with your left hand and vice versa)	Incorrect
M20	We use only 10% of our brain	Incorrect
M21	Individuals with larger brains are smarter	Incorrect
M22	The brain continues to generate new connections throughout an individual's life	Correct
M23	Male and female brains are designed for different types of skills	Incorrect
M24	The brain remains active 24 hours a day	Correct
M25	Supplements such as Omega-3 and Omega-6 have a positive effect on academic achievement	Incorrect
M26	Brain development is complete by the time children reach the end of puberty	Incorrect
M27	The normal development of the human brain involves the birth and death of brain cells	Correct
M28	The brain shuts down during sleep	Incorrect
M29	On average, males have bigger brains than females	Correct
M30	Humans are born with all the neurons they will have in their lifetime	Incorrect

3.3. Language Adaptation: French, Turkish, Greek, Kazakh, Arabic, Malay, Chinese

To facilitate the translation of the data collection tool into multiple languages, the researchers shared the English version with partner countries and requested translations into their respective languages. During the translation process, an adaptation protocol was also prepared and sent with the measurement tool. The following steps were followed in the process of language adaptation of the measurement tool.

3.3.1. *Organization phase*

Establishing the Translation Team: The first step in the multinational research project was to develop a measurement tool. Teams were assembled from each participating country that were proficient in the target languages. An English version of the Neuromyth Questionnaire was distributed via e-mail, which led to the creation of specialized translation teams composed of experts in both the subject matter and the respective languages. These teams were then responsible for adapting the data collection tool to their cultural and linguistic contexts.

Information and Training: The translation teams were informed about the purpose and content of the questionnaire and about neuromyths. The translation process highlighted the crucial importance of linguistic nuance and cultural relevance. In addition, teams were instructed to pay close attention to terminology used in educational and neuroscientific disciplines in order to maintain the integrity of the questionnaire across languages.

3.3.2. *Translation and back translation process*

Translation: Two independent linguists translated the original questionnaire into the respective target languages.

Back translation: A different pair of independent linguists then back-translated these versions into the original language.

Comparison and editing: The original questionnaire and the back-translated versions were meticulously compared. Discrepancies were addressed, leading to refinements in both the translated and back-translated texts.

3.3.3. *Expert panel and pretest*

Expert panel: Translated versions of the questionnaire were e-mailed to the researchers. The translations were subject to rigorous review process, involving both expert language specialists and advanced computational tools, to detect and correct any errors or deficiencies. As a result, the research data collection instrument was accurately refined and made available in Turkish, Greek, Kazakh, Arabic, Malay, Chinese, English, and French.

Pilot Application: Once the data collection instrument was finalized in eight languages, it was integrated into the online survey platform "Interceptum". The survey links were subsequently distributed to the participating countries, where teachers were recruited to facilitate the collection of empirical data. Following data collection, a subset of 50 participants per language was extracted to form a new, representative dataset. This data set was used to calculate the internal consistency coefficient of the instrument by assessing the correlation between its two halves. The calculated consistency coefficients for each language are shown in Table 6.

Table 6. *Internal consistency coefficients.*

Correlation	Language	French ($f = 50$)	Turkish ($f = 50$)	English ($f = 50$)	Greek ($f = 50$)	Kazakh ($f = 50$)	Malay ($f = 50$)	Arabic ($f = 50$)	Chinese ($f = 50$)
Spearman-Brown Coefficient	Equal Length	.74	.89	.93	.81	.91	.82	.85	.78
	Unequal Length	.74	.89	.93	.81	.91	.82	.85	.78
Guttman Split Half Coefficient		.74	.78	.92	.75	.89	.74	.75	.68

3.3.4. *Validity and reliability analyses*

To evaluate the psychometric quality of the instrument across all language versions, both reliability and validity analyses were conducted on the pilot data. The reliability assessment focused on internal consistency, while the validity evaluation emphasized cross-linguistic construct equivalence.

Internal consistency was examined using the Spearman–Brown split-half coefficient, Guttman split-half coefficient, and Cronbach's alpha for reliability. For all eight language versions (French, Turkish, English, Greek, Kazakh, Malay, Arabic, and Chinese), the coefficients exceeded the commonly accepted threshold of .70 (Nunnally & Bernstein, 1994). Specifically, the Spearman–Brown coefficients ranged from .74 to .93 and the Guttman split-half coefficients ranged from .68 to .92 (see Table 6). These results indicate that the items within each language version consistently measure the intended constructs, demonstrating satisfactory to excellent internal consistency. The English version exhibited the highest internal consistency (α = .93), while all other languages remained well above the acceptable range.

Construct validity across languages was assessed through interlanguage correlation analyses using Spearman's rho. High and statistically significant correlations were found between all language pairs (r = .98-.99, p < .001; see Table 7). These extremely high coefficients provide strong evidence that the instrument consistently measures the same underlying construct across diverse linguistic and cultural contexts. The findings suggest that the translation, back-translation, and expert panel review processes ensured semantic and conceptual equivalence among the different language versions. This cross-linguistic consistency confirms that the adapted versions maintain the factorial structure and interpretive meaning of the original instrument. In summary, the multilingual adaptations of the neuromyth identification tool demonstrated high internal consistency and provided substantial evidence of cross-linguistic construct validity. These results confirm the tool's methodological robustness and support its use in rigorous, comparative studies of neuromyth beliefs in different linguistic and cultural contexts.

Table 7. *Correlation coefficients.*

Language		French (f = 50)	Turkish (f = 50)	English (f = 50)	Greek (f = 50)	Kazakh (f = 50)	Malay (f = 50)	Arabic (f = 50)	Chinese (f = 50)
French	Correlation Coefficient	1.000	.991**	.989**	.990**	.980**	.987**	.989**	.983**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
Turkish	Correlation Coefficient	.991**	1.000	.990**	.988**	.981**	.988**	.990**	.984**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
English	Correlation Coefficient	.989**	.990**	1.000	.991**	.986**	.989**	.992**	.993**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
Greek	Correlation Coefficient	.990**	.988**	.991**	1.000	.987**	.990**	.989**	.989**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
Kazakh	Correlation Coefficient	.980**	.981**	.986**	.987**	1.000	.987**	.985**	.989**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
Malay	Correlation Coefficient	.987**	.988**	.989**	.990**	.987**	1.000	.990**	.991**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
Arabic	Correlation Coefficient	.989**	.990**	.992**	.989**	.985**	.990**	1.000	.988**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
Chinese	Correlation Coefficient	.983**	.984**	.993**	.989**	.989**	.991**	.988**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	

** Correlation is significant at the .01 level (2-tailed).

4. CONCLUSION

This study developed and validated a multilingual neuromyth identification tool to measure the prevalence and origins of neuromyth beliefs among teachers. Psychometric analyses revealed that the final 30-item scale exhibited strong internal consistency, a consistent two-factor structure, and substantial cross-linguistic construct validity across eight language versions. These findings have important methodological, theoretical, and practical implications.

The exploratory factor analysis (EFA) confirmed the theoretically anticipated two-factor structure, "Perceptions of the Learning Process" and "Perceptions of Brain and Intelligence Characteristics" with items exhibiting clear and distinct loadings. Through an iterative process, problematic items with factor loadings below .40 or cross-loadings of at least .30 were systematically removed, resulting in a 30-item instrument. This rigorous approach to eliminating items ensured factorial clarity and internal consistency (Cronbach's $\alpha = .85$). The high factor loadings of the retained items (most exceeding .50) indicate strong alignment with the intended constructs. Items that were removed from the scale often represented items that were subject to differences in cultural interpretation or conceptual ambiguity during the translation process.

The present instrument offers several methodological innovations compared to widely used neuromyth questionnaires, such as the Dekker *et al.* (2012) scale and the Neuroscience Against Neuromyths Questionnaire (Tovazzi *et al.*, 2020). First, it was designed from the beginning to be multilingual and culturally adaptable. It encompasses eight languages that represent diverse geographic and educational contexts. Second, the scale incorporates a balanced mix of true and false items to reduce acquiescence bias and provide a more accurate assessment of knowledge. Third, the tool uniquely incorporates an assessment of the sources from which participants acquire knowledge about brain function, addressing a notable gap in literature.

This study addresses a critical gap in the neuromyth literature by developing and validating a multilingual instrument with strong psychometric properties. Previous research has largely relied on monolingual instruments with limited cross-cultural testing and has often neglected rigorous adaptation procedures. This new tool allows for reliable cross-cultural comparisons of neuromyth beliefs, thus broadening the scope of educational neuroscience research.

The findings of this study have significant implications for teacher education, curriculum development, and educational policy. The high prevalence of misconceptions regarding certain items emphasizes the urgent necessity of implementing focused professional development programs to enhance teachers' neuroscience literacy. The validated instrument developed in this study can serve as a reliable diagnostic tool in pre-service and in-service teacher education. It enables educators and policymakers to identify and address the most persistent neuromyths through evidence-based interventions. The two-factor structure, which captures misconceptions about learning processes and brain/intelligence characteristics, suggests that teacher training curricula should integrate neuroscience content that directly addresses these misconceptions.

Beyond teacher education, the instrument's multilingual design and robust psychometric properties allow for valid cross-national comparisons of neuromyth prevalence in diverse cultural and linguistic contexts. Such comparative data can guide policymakers in developing context-specific strategies while contributing to a global framework for addressing misconceptions in education. Additionally, including items that assess knowledge sources provides a unique opportunity to investigate how formal and informal information channels influence the persistence of neuromyths. This offers both theoretical insight and practical guidance for designing more effective educational interventions.

4.1. Limitations

Despite its methodological thoroughness and multilingual scope, this study has several restrictions that should be recognized. First, although rigorous translation and back-translation procedures were employed to ensure linguistic accuracy, the complexity of the neuroscience concepts may have introduced subtle differences in meaning across languages that could affect respondents' interpretations. Second, the language adaptation process was conducted with relatively small groups of participants in each target language. Expanding this stage to include larger, more diverse samples would strengthen the validity of cross-linguistic comparisons. Second, adapting the instrument into eight languages represents a significant improvement over existing tool. However, adapting it to additional languages and cultural contexts would increase its global applicability and ensure that it captures a broader range of educational settings. Third, while the pilot and validation samples were diverse, they were limited in size. In some cases, they were drawn from convenience samples within specific educational institutions. This may restrict the generalizability of the findings, so future studies should test the instrument on larger, more representative populations.

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Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors. **Ethics Committee Number**: Ethics Committee of Anadolu University, 04.12.2023-649986.

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APPENDICES

Note on Item Classification. The final version of the neuromyth diagnostic instrument comprises 30 items. Of these, 21 are incorrect items representing neuromyths (ST1, ST2, ST4, ST6, ST7, ST9, ST10, ST11, ST13, ST14, ST15, ST16, ST17, ST19, ST20, ST21, ST23, ST25, ST26, ST28, ST30), while 9 are correct items (ST3, ST5, ST8, ST12, ST18, ST22, ST24, ST27, ST29).

Appendix 1. *Neuromyths items learning process and intelligence characteristics: English version.*

No	Items	Correct	Incorrect	For each item, please indicate which sources influenced your answers *(You can check more than one answer)*											
				1. Undergraduate/graduate education	2. Professional development programs	3. My professional experience	4. Social media (Twitter (X), Instagram,	5. Websites	6. My colleagues or friends	7. Academic publications	8. Other publications such as books,	9 The movies	10. Television programs	11. Advertisements	12. My intuitions
M1	Individuals learn better when they receive information in alignment with in their dominant learning styles (examples: visual, auditory, kinesthetic etc.)			1	2	3	4	5	6	7	8	9	10	11	12
M2	The dominant intelligence profile of learners (examples: mathematical, verbal, spatial) must be considered in teaching			1	2	3	4	5	6	7	8	9	10	11	12
M3	In the learning process, the mind associates new information with previous knowledge			1	2	3	4	5	6	7	8	9	10	11	12
M4	Different parts of the brain operate independently during the learning process			1	2	3	4	5	6	7	8	9	10	11	12
M5	Learning occurs through changes in synaptic connections between neurons in the brain			1	2	3	4	5	6	7	8	9	10	11	12
M6	Learning is a purely cognitive skill, not emotional			1	2	3	4	5	6	7	8	9	10	11	12
M7	Learning takes place independent from individuals' learning backgrounds			1	2	3	4	5	6	7	8	9	10	11	12
M8	Some mental processes (experience, learning) repeated over a long period of time can change the structure and function of some areas of the brain			1	2	3	4	5	6	7	8	9	10	11	12
M9	Individuals can learn new information even while in a state of sleep			1	2	3	4	5	6	7	8	9	10	11	12
M10	Humans are good multitaskers			1	2	3	4	5	6	7	8	9	10	11	12
M11	The fact that some people are more "right-brained" and others are more "left-brained", helps explain the differences in how we learn			1	2	3	4	5	6	7	8	9	10	11	12
M12	Individuals learn better when course content is presented in short sessions or modules			1	2	3	4	5	6	7	8	9	10	11	12
M13	There are specific periods in childhood after which certain things can no longer be learned			1	2	3	4	5	6	7	8	9	10	11	12
M14	Memorization has no impact on the learning process			1	2	3	4	5	6	7	8	9	10	11	12
M15	Environments that provide a larger amount of stimuli improve the brains of pre-school children			1	2	3	4	5	6	7	8	9	10	11	12
M16	Mental capacity is hereditary and cannot be changed by the environment or experience			1	2	3	4	5	6	7	8	9	10	11	12
M17	Listening to classical music improves mental capacity			1	2	3	4	5	6	7	8	9	10	11	12
M18	When a part of the brain is damaged, other parts can take over its function			1	2	3	4	5	6	7	8	9	10	11	12
M19	Short periods of coordination exercises can improve brain function (for example, touching your right ankle with your left hand and vice versa)			1	2	3	4	5	6	7	8	9	10	11	12
M20	We use only 10% of our brain			1	2	3	4	5	6	7	8	9	10	11	12
M21	Individuals with larger brains are smarter			1	2	3	4	5	6	7	8	9	10	11	12
M22	The brain continues to generate new connections throughout an individual's life			1	2	3	4	5	6	7	8	9	10	11	12
M23	Male and female brains are designed for different types of skills			1	2	3	4	5	6	7	8	9	10	11	12
M24	The brain remains active 24 hours a day			1	2	3	4	5	6	7	8	9	10	11	12
M25	Supplements such as Omega-3 and Omega-6 have a positive effect on academic achievement			1	2	3	4	5	6	7	8	9	10	11	12
M26	Brain development is complete by the time children reach the end of puberty			1	2	3	4	5	6	7	8	9	10	11	12
M27	The normal development of the human brain involves the birth and death of brain cells			1	2	3	4	5	6	7	8	9	10	11	12
M28	The brain shuts down during sleep			1	2	3	4	5	6	7	8	9	10	11	12
M29	On average, males have bigger brains than females			1	2	3	4	5	6	7	8	9	10	11	12
M30	Humans are born with all the neurons they will have in their lifetime			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 2. *Neuromyths items learning process and intelligence characteristics: Turkish version.*

No	Maddeler	Doğru	Yanlış	Lütfen her bir madde için, yanıtlarınızı verirken hangi kaynaklardan etkilendiğinizi belirtiniz (Birden fazla yanıtı işaretleyebilirsiniz)											
				1. Lisans/lisansüstü eğitimlerden	2. Mesleki gelişim programlarından	3. Mesleki deneyimlerimden	4. Sosyal medya uygulamalarından (Twitter	5. Diğer internet sitelerinden	6. Meslektaşlarımdan veya arkadaşlarımdan	7. Akademik yayınlardan	8. Kitaplar, dergiler, popüler yayınlar gibi	9 Filmlerden	10. Televizyon programlarından	11. Reklamlardan	12. Mantıklı bulduğum için
M1	Öğrenciler, öğrenme stillerine uygun ortamlarda daha etkili öğrenirler (görsel, işitsel, kinestetik vb.)			1	2	3	4	5	6	7	8	9	10	11	12
M2	Öğretim sürecinde, öğrencilerin baskın olan zekâ türleri (matematiksel, sözel, uzamsal vb.) dikkate alınmalıdır			1	2	3	4	5	6	7	8	9	10	11	12
M3	Öğrenme sürecinde zihin yeni bilgilerle önceki bilgileri ilişkilendirir			1	2	3	4	5	6	7	8	9	10	11	12
M4	Öğrenme sürecinde beynin bölümleri birbirinden ayrı çalışır			1	2	3	4	5	6	7	8	9	10	11	12
M5	Öğrenme, beyindeki nöronlar arasındaki sinaptik bağlantılarda meydana gelen değişiklikler yoluyla gerçekleşir			1	2	3	4	5	6	7	8	9	10	11	12
M6	Öğrenme süreci duygusal değil, tamamıyla bilişsel bir özelliktir			1	2	3	4	5	6	7	8	9	10	11	12
M7	Öğrenme, bireylerin öğrenme geçmişlerinden bağımsız olarak gerçekleşir			1	2	3	4	5	6	7	8	9	10	11	12
M8	Uzun süreli tekrarlanan bazı zihinsel süreçler (deneyim, öğrenme vb.), beynin bazı bölgelerinin yapısını ve işlevini değiştirebilir			1	2	3	4	5	6	7	8	9	10	11	12
M9	Bireyler uykudayken yeni bilgiler öğrenebilir			1	2	3	4	5	6	7	8	9	10	11	12
M10	İnsanlar çoklu görevlerde başarılıdır			1	2	3	4	5	6	7	8	9	10	11	12
M11	Bazı insanların "sağ beyinli", bazılarının ise "sol beyinli" olması öğrenme özelliklerimizdeki farklılıkları açıklamaya yardımcı olur			1	2	3	4	5	6	7	8	9	10	11	12
M12	Bireyler, ders içeriği kısa oturumlar veya modüller halinde sunulduğunda daha iyi öğrenirler			1	2	3	4	5	6	7	8	9	10	11	12
M13	Çocuklukta belirli dönemlerden sonra bazı şeyler artık öğrenilemez			1	2	3	4	5	6	7	8	9	10	11	12
M14	Ezberlemenin öğrenme süreci üzerinde etkisi yoktur			1	2	3	4	5	6	7	8	9	10	11	12
M15	Zengin uyarıcı ortamlar okul öncesi dönemde çocukların beyinlerini daha iyi geliştirir			1	2	3	4	5	6	7	8	9	10	11	12
M16	Zihinsel kapasite kalıtsaldır ve çevresel faktörler veya öğrenme deneyimleri ile sonradan değiştirilemez			1	2	3	4	5	6	7	8	9	10	11	12
M17	Klasik müzik dinlemek zihinsel kapasiteyi geliştirir			1	2	3	4	5	6	7	8	9	10	11	12
M18	Beyin bölgesinin bir bölümü hasar gördüğünde beynin diğer bölgeleri bu işlevi üstlenebilir			1	2	3	4	5	6	7	8	9	10	11	12
M19	Kısa süreli koordinasyon egzersizleri beyin fonksiyonlarını geliştirebilir (örneğin, sol el ile sağ ayak bileğine dokunmak veya tam tersi)			1	2	3	4	5	6	7	8	9	10	11	12
M20	Beynimizin sadece %10'unu kullanırız			1	2	3	4	5	6	7	8	9	10	11	12
M21	Beyni büyük olan insanlar daha zeki olurlar			1	2	3	4	5	6	7	8	9	10	11	12
M22	Beyinde yeni bağlantıların üretimi yaşam boyu devam eder			1	2	3	4	5	6	7	8	9	10	11	12
M23	Erkek ve kadın beyinleri farklı türde beceriler için tasarlanmıştır			1	2	3	4	5	6	7	8	9	10	11	12
M24	Beynimiz günde 24 saat çalışmayı sürdürür			1	2	3	4	5	6	7	8	9	10	11	12
M25	Omega-3 ve Omega-6 gibi takviyelerin akademik başarı üzerinde olumlu etkisi vardır			1	2	3	4	5	6	7	8	9	10	11	12
M26	Bir kişi ergenliğe ulaştığında beyin gelişimini tamamlanmış olur			1	2	3	4	5	6	7	8	9	10	11	12
M27	İnsan beyninin normal gelişimi, beyin hücrelerinin doğumunu ve ölümünü içerir			1	2	3	4	5	6	7	8	9	10	11	12
M28	Uyuduğumuzda beynimiz çalışmayı durdurur			1	2	3	4	5	6	7	8	9	10	11	12
M29	Ortalama olarak, erkeklerin beyinleri kadınlardan daha büyüktür			1	2	3	4	5	6	7	8	9	10	11	12
M30	İnsanlar yaşamları süresince sahip olacakları tüm nöronlarla doğarlar			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 3. *Neuromyths items learning process and intelligence characteristics: Arabic version.*

الرقم	البنود	صحيح	غير صحيح	لكل بند يرجى كتابة المصر الذي آثر على اجاباتكم											
				1. التعليم الذي اتلقاه بالجامعة	2. برامج التطوير المهني	3. خبرتي المهنية	4. وسائل التواصل الاجتماعي	5. مواقع الكترونية	6. من الزملاء	7. من النشرات العلمية	8. منشورات أخرى – كتب مجلات	9. من الأفلام	10. من برامج التليفزيون	11. من الإعلانات	12. يبدو لي منطقياً
M1	يتعلم الطلاب بشكل أفضل عندما يتلقون المعلومات بأسلوب التعلم المفضل لديهم)على سبيل المثال، السمعي أو البصري أو الحركي(			1	2	3	4	5	6	7	8	9	10	11	12
M2	يجب أن يؤخذ في الاعتبار ملف الذكاء السائد للمتعلمين)على سبيل المثال، الذكاء المنطقي الرياضي، اللفظي، المكاني (في التدريس			1	2	3	4	5	6	7	8	9	10	11	12
M3	في عملية التعلم، يربط الدماغ المعلومات الجديدة بالمعرفة السابقة			1	2	3	4	5	6	7	8	9	10	11	12
M4	تعمل أجزاء مختلفة من الدماغ بشكل منفصل عن بعضها البعض أثناء عملية التعلم			1	2	3	4	5	6	7	8	9	10	11	12
M5	يحدث التعلم من خلال التغيرات في الاتصالات المتشابكة بين الخلايا العصبية في الدماغ			1	2	3	4	5	6	7	8	9	10	11	12
M6	التعلم مهارة معرفية بحتة وليست مهارة عاطفية			1	2	3	4	5	6	7	8	9	10	11	12
M7	يتم التعلم بشكل مستقل عن مسارات تعلم الأفراد			1	2	3	4	5	6	7	8	9	10	11	12
M8	يمكن لبعض العمليات العقلية)الخبرة والتعلم (المتكررة على مدى فترة طويلة أن تعدل بنية وعمل مناطق معينة من الدماغ			1	2	3	4	5	6	7	8	9	10	11	12
M9	يمكن للإنسان أن يتعلم معلومات جديدة أثناء النوم			1	2	3	4	5	6	7	8	9	10	11	12
M10	إن العقل البشري متوافق بشكل خاص مع المهام المتعددة			1	2	3	4	5	6	7	8	9	10	11	12
M11	بعض الناس يستخدمون دماغهم الأيمن والبعض الآخر يميلون إلى دماغهم الأيسر، مما يساعد في تفسير الاختلافات في الطريقة التي نتعلم بها.			1	2	3	4	5	6	7	8	9	10	11	12
M12	يتعلم الأفراد بشكل أفضل عندما يتم تقديم محتوى الدورة التدريبية في جلسات أو وحدات قصيرة			1	2	3	4	5	6	7	8	9	10	11	12
M13	هناك فترات محددة من الطفولة لا يمكن بعدها تعلم أشياء معينة			1	2	3	4	5	6	7	8	9	10	11	12
M14	الحفظ ليس له أي تأثير على عملية التعلم			1	2	3	4	5	6	7	8	9	10	11	12
M15	البيئات التي توفر قدرًا أكبر من المحفزات تعمل على تحسين وظائف المخ لدى الأطفال في مرحلة ما قبل المدرسة			1	2	3	4	5	6	7	8	9	10	11	12
M16	القدرات العقلية وراثية ولا يمكن تغييرها بالبيئة أو الخبرة.			1	2	3	4	5	6	7	8	9	10	11	12
M17	الاستماع إلى الموسيقى الكلاسيكية يساعد على تحسين القدرات العقلية			1	2	3	4	5	6	7	8	9	10	11	12
M18	عندما تتضرر منطقة واحدة من الدماغ، يمكن لمناطق أخرى أن تتولى وظيفتها			1	2	3	4	5	6	7	8	9	10	11	12
M19	يمكن لجلسات قصيرة من تمارين التنسيق أن تحسن وظائف المخ على سبيل المثال، لمس الكاحل الأيمن باليد اليسرى والعكس) (صحيح			1	2	3	4	5	6	7	8	9	10	11	12
M20	نحن نستخدم حوالي 10 %فقط من قدرات دماغنا			1	2	3	4	5	6	7	8	9	10	11	12
M21	الأشخاص الذين لديهم أدمغة أكبر هم أكثر ذكاءً			1	2	3	4	5	6	7	8	9	10	11	12
M22	يستمر إنتاج اتصالات جديدة في الدماغ طوال الحياة			1	2	3	4	5	6	7	8	9	10	11	12
M23	تم تصميم أدمغة الذكور والإناث لأنواع مختلفة من المهارات			1	2	3	4	5	6	7	8	9	10	11	12
M24	الدماغ ينشط 24 ساعة في اليوم			1	2	3	4	5	6	7	8	9	10	11	12
M25	المكملات الغذائية مثل أوميغا 3 وأوميغا 6 لها تأثير إيجابي على الأداء المعرفي			1	2	3	4	5	6	7	8	9	10	11	12
M26	يكتمل نمو الدماغ عندما يصل الأفراد إلى نهاية سن البلوغ			1	2	3	4	5	6	7	8	9	10	11	12
M27	التطور الطبيعي للدماغ البشري ينطوي على ولادة وموت خلايا الدماغ			1	2	3	4	5	6	7	8	9	10	11	12
M28	عندما ننام، الدماغ لا يعمل			1	2	3	4	5	6	7	8	9	10	11	12
M29	في المتوسط، أدمغة الرجال أكبر من أدمغة النساء			1	2	3	4	5	6	7	8	9	10	11	12
M30	يولد البشر بكل الخلايا العصبية التي سيمتلكونها طوال حياتهم			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 4. *Neuromyths items learning process and intelligence characteristics: Chinese version.*

編號	題目	正確	不正確	根據每個題項，請勾選出您的回答受到了下列哪些因素的影響（可複選）：											
				1. 大學/研究所教育	2. 專業發展課程(如繼續教育課程或其它增	3. 個人專業經驗	4. 社群媒體(Twitter (X), Instagram,	5. 網路資訊	6. 同事或親友	7. 學術刊物	8. 其他刊物如書籍、期刊、雜誌	9. 電影	10. 電視節目	11. 廣告	12. 對我來說很合理
M1	當人們以其擅長或優勢的學習方法（如視覺、聽覺、動作學習）獲得資訊時，能夠學習得更好。			1	2	3	4	5	6	7	8	9	10	11	12
M2	個人的優勢智力（如：數學、語言、空間智力）必須納入教學時的考量。			1	2	3	4	5	6	7	8	9	10	11	12
M3	在學習歷程中，個人的心智運作會連結新資訊與既有知識。			1	2	3	4	5	6	7	8	9	10	11	12
M4	大腦的各個部分在學習歷程中彼此獨立工作。			1	2	3	4	5	6	7	8	9	10	11	12
M5	學習是透過大腦神經元之間的神經突觸連結變化發生的。			1	2	3	4	5	6	7	8	9	10	11	12
M6	學習是一種純粹的認知技能，而不是情緒技能			1	2	3	4	5	6	7	8	9	10	11	12
M7	學習的發生與個人的學習背景無關。			1	2	3	4	5	6	7	8	9	10	11	12
M8	一些長時間、重複的心智運作（如經驗、學習歷程）能夠改變某些大腦的結構與功能。			1	2	3	4	5	6	7	8	9	10	11	12
M9	人類能夠在睡著的情況下學習新知。			1	2	3	4	5	6	7	8	9	10	11	12
M10	人類是良好的多工處理者。			1	2	3	4	5	6	7	8	9	10	11	12
M11	有些人有更多的右腦特質，有些人有更多的左腦特質；這樣的分類方式有助於我們解釋人們在學習方式上的差異。			1	2	3	4	5	6	7	8	9	10	11	12
M12	當學習內容以簡短的單元方式呈現時，人們能夠學習得更好。			1	2	3	4	5	6	7	8	9	10	11	12
M13	童年時期存在特定的學習階段，若錯過就無法再學習。			1	2	3	4	5	6	7	8	9	10	11	12
M14	記憶對學習歷程沒有影響。			1	2	3	4	5	6	7	8	9	10	11	12
M15	提供大量刺激的環境能夠改善學齡前兒童大腦的功能。			1	2	3	4	5	6	7	8	9	10	11	12
M16	心智能力是遺傳的，無法透過環境或學習經驗改變。			1	2	3	4	5	6	7	8	9	10	11	12
M17	聽古典樂能夠改善心智能力。			1	2	3	4	5	6	7	8	9	10	11	12
M18	當大腦某個區域受損時，大腦其他部分可以接管它的功能。			1	2	3	4	5	6	7	8	9	10	11	12
M19	短期的協調性運動能夠改善大腦的功能。			1	2	3	4	5	6	7	8	9	10	11	12
M20	我們只使用了10%的大腦。			1	2	3	4	5	6	7	8	9	10	11	12
M21	大腦體積越大的人越聰明。			1	2	3	4	5	6	7	8	9	10	11	12
M22	大腦產生新的神經連結的現象會在整個生命歷程中持續進行。			1	2	3	4	5	6	7	8	9	10	11	12
M23	男性和女性的大腦是為了不同類型技能而設計			1	2	3	4	5	6	7	8	9	10	11	12
M24	大腦在一天24小時都保持活動的狀態。			1	2	3	4	5	6	7	8	9	10	11	12
M25	營養補充品如：omega-3和omega-6對學業成就有正向效果。			1	2	3	4	5	6	7	8	9	10	11	12
M26	大腦在青春期結束時就已發展完成。			1	2	3	4	5	6	7	8	9	10	11	12
M27	正常的大腦發展涉及腦細胞的誕生與死亡。			1	2	3	4	5	6	7	8	9	10	11	12
M28	當我們睡覺時，大腦會停止運作。			1	2	3	4	5	6	7	8	9	10	11	12
M29	平均而言，男性比女性擁有較大的大腦。			1	2	3	4	5	6	7	8	9	10	11	12
M30	人們在出生時就擁有他／她一生中所需的所有大腦神經元。			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 5. *Neuromyths items learning process and intelligence characteristics: French version.*

No	Items	Correct	Incorrect	Pour chaque item, veuillez indiquer les sources qui ont influencé vos réponses (*Vous pouvez cocher plus d'une réponse*).											
				1. D'enseignements reçus à l'université	2. De programmes de développement professionnel	3. De mon expérience professionnelle	4. De médias sociaux (Twitter (X), Instagram, LinkedIn, YouTube, etc.)	5. De sites web	6. De mes collègues	7. De publications scientifiques	8. D'autres publications telles que des livres, des revues, des magazines populaires	9. De films	10. D'émissions de télévision	11. De publicités	12. Cela me paraît logique
M1	Les élèves apprennent mieux lorsqu'ils reçoivent l'information dans leur style d'apprentissage préféré (p. ex., auditif, visuel ou kinesthésique)			1	2	3	4	5	6	7	8	9	10	11	12
M2	Le profil d'intelligence prédominant des apprenants (p. ex., logico-mathématique, verbale, spatiale) doit être pris en compte dans l'enseignement			1	2	3	4	5	6	7	8	9	10	11	12
M3	Dans le processus d'apprentissage, le cerveau associe les nouvelles informations aux connaissances antérieures			1	2	3	4	5	6	7	8	9	10	11	12
M4	Les différentes parties du cerveau fonctionnent séparément les unes des autres au cours du processus d'apprentissage			1	2	3	4	5	6	7	8	9	10	11	12
M5	L'apprentissage se produit par des changements dans les connexions synaptiques entre les neurones du cerveau			1	2	3	4	5	6	7	8	9	10	11	12
M6	L'apprentissage est une compétence purement cognitive et non émotionnelle			1	2	3	4	5	6	7	8	9	10	11	12
M7	L'apprentissage se fait indépendamment des parcours d'apprentissage des individus			1	2	3	4	5	6	7	8	9	10	11	12
M8	Certains processus mentaux (expérience, apprentissage) répétés sur une longue période peuvent modifier la structure et le fonctionnement de certaines zones du cerveau			1	2	3	4	5	6	7	8	9	10	11	12
M9	Les personnes peuvent apprendre de nouvelles informations en dormant			1	2	3	4	5	6	7	8	9	10	11	12
M10	Le cerveau des humains est particulièrement compatible avec le multi-tâches			1	2	3	4	5	6	7	8	9	10	11	12
M11	Certaines personnes sont plutôt « cerveau droit » et d'autres plutôt « cerveau gauche », ce qui contribue à expliquer les différences dans la manière dont on apprend			1	2	3	4	5	6	7	8	9	10	11	12
M12	Les individus apprennent mieux lorsque le contenu du cours est présenté sous forme de courtes sessions ou de modules			1	2	3	4	5	6	7	8	9	10	11	12
M13	Il existe des périodes spécifiques de l'enfance après lesquelles certaines choses ne peuvent plus être apprises			1	2	3	4	5	6	7	8	9	10	11	12
M14	La mémorisation n'a aucun impact sur le processus d'apprentissage			1	2	3	4	5	6	7	8	9	10	11	12
M15	Les environnements qui offrent une plus grande quantité de stimuli améliorent le fonctionnement du cerveau des enfants d'âge préscolaire			1	2	3	4	5	6	7	8	9	10	11	12
M16	Les capacités mentales sont héréditaires et ne peuvent être modifiées par l'environnement ou l'expérience.			1	2	3	4	5	6	7	8	9	10	11	12
M17	Écouter de la musique classique permet d'améliorer les capacités mentales			1	2	3	4	5	6	7	8	9	10	11	12
M18	Quand une région du cerveau est endommagée, d'autres peuvent prendre en charge sa fonction			1	2	3	4	5	6	7	8	9	10	11	12
M19	De courtes séances d'exercices de coordination peuvent améliorer le fonctionnement du cerveau (par exemple, toucher la cheville droite avec la main gauche et vice versa)			1	2	3	4	5	6	7	8	9	10	11	12
M20	Nous n'utilisons environ que 10 % de notre cerveau			1	2	3	4	5	6	7	8	9	10	11	12
M21	Les personnes ayant un cerveau plus gros sont plus intelligentes			1	2	3	4	5	6	7	8	9	10	11	12
M22	La production de nouvelles connexions dans le cerveau se poursuit tout au long de la vie			1	2	3	4	5	6	7	8	9	10	11	12
M23	Les cerveaux masculins et féminins sont conçus pour différents types de compétences			1	2	3	4	5	6	7	8	9	10	11	12
M24	Le cerveau est actif 24 heures sur 24			1	2	3	4	5	6	7	8	9	10	11	12
M25	Les suppléments tels que les Oméga-3 et les Oméga-6 ont un effet positif sur les performances cognitives			1	2	3	4	5	6	7	8	9	10	11	12
M26	Le développement du cerveau est achevé lorsque les individus atteignent la fin de la puberté			1	2	3	4	5	6	7	8	9	10	11	12
M27	Le développement normal du cerveau humain implique la naissance et la disparition de cellules cérébrales			1	2	3	4	5	6	7	8	9	10	11	12
M28	Quand on dort, le cerveau ne fonctionne pas			1	2	3	4	5	6	7	8	9	10	11	12
M29	En moyenne, le cerveau des hommes est plus gros que celui des femmes			1	2	3	4	5	6	7	8	9	10	11	12
M30	L'humain naît avec tous les neurones dont il disposera tout au long de sa vie			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 6. *Neuromyths items learning process and intelligence characteristics: Greek version.*

Αρ.	**Προτάσεις**	**Σωστό**	**Λάθος**	**Για κάθε στοιχείο, αναφέρετε ποιες πηγές επηρέασαν τις απαντήσεις σας (Μπορείτε να ελέγξετε περισσότερες από μία απαντήσεις)**											
				1.Προπτυχιακή/πτυχιακή εκπαίδευση	2. Προγράμματα επαγγελματικής ανάπτυξης	3. Η επαγγελματική μου εμπειρία	4.Μέσα κοινωνικής δικτύωσης(Twitter (X), Instagram, LinkedIn, YouTube etc.)	5. Διαδικτυακοί τόποι	6. Συνάδελφοι - Φίλοι	7. Ακαδημαϊκές δημοσιεύσεις	8. Άλλες εκδόσεις, όπως βιβλία, επιστημονικά ή δημοφιλή περιοδικά	9.Κινηματογράφος	10.Τηλεοπτικά προγράμματα	11. Διαφημίσεις	12. Διαίσθηση
M1	Τα άτομα μαθαίνουν καλύτερα όταν λαμβάνουν πληροφορίες με βάση τα διαφορετικά μαθησιακά τους προφίλ (πχ: οπτικό, ακουστικό, κιναισθητικό, κλπ.).			1	2	3	4	5	6	7	8	9	10	11	12
M2	Το κυρίαρχο προφίλ νοημοσύνης των μαθητών (πχ: λογικομαθηματικό, γλωσσικό, χωροταξικό) πρέπει να λαμβάνεται υπόψη στη διδασκαλία.			1	2	3	4	5	6	7	8	9	10	11	12
M3	Κατά τη διαδικασία της μάθησης, το μυαλό συσχετίζει νέες πληροφορίες με προηγούμενες γνώσεις.			1	2	3	4	5	6	7	8	9	10	11	12
M4	Διαφορετικά μέρη του εγκεφάλου λειτουργούν ανεξάρτητα κατά τη διάρκεια της μαθησιακής διαδικασίας.			1	2	3	4	5	6	7	8	9	10	11	12
M5	Η μάθηση προκύπτει από τις αλλαγές μεταξύ των νευρικών συνάψεων στον εγκέφαλο.			1	2	3	4	5	6	7	8	9	10	11	12
M6	Η μάθηση είναι μια καθαρά γνωστική δεξιότητα, όχι συναισθηματική.			1	2	3	4	5	6	7	8	9	10	11	12
M7	Η μάθηση είναι ανεξάρτητη από το γνωστικό υπόβαθρο των ατόμων.			1	2	3	4	5	6	7	8	9	10	11	12
M8	Μερικές νοητικές διαδικασίες (εμπειρία, μάθηση) που επαναλαμβάνονται για μεγάλο χρονικό διάστημα μπορούν να αλλάξουν τη δομή και τη λειτουργία ορισμένων περιοχών του εγκεφάλου.			1	2	3	4	5	6	7	8	9	10	11	12
M9	Τα άτομα μπορούν να μάθουν νέες πληροφορίες ακόμα και όταν βρίσκονται σε κατάσταση ύπνου.			1	2	3	4	5	6	7	8	9	10	11	12
M10	Οι άνθρωποι είναι καλοί στο να κάνουν πολλά πράγματα ταυτόχρονα.			1	2	3	4	5	6	7	8	9	10	11	12
M11	Το γεγονός ότι μερικοί άνθρωποι έχουν πιο ανεπτυγμένο το δεξιό ημισφαίριο του εγκεφάλου ενώ άλλοι το αριστερό, βοηθά στο να εξηγήσουμε τις διαφορές στο πώς μαθαίνουμε.			1	2	3	4	5	6	7	8	9	10	11	12
M12	Τα άτομα μαθαίνουν καλύτερα όταν το περιεχόμενο του μαθήματος παρουσιάζεται σε σύντομες περιόδους ή ενότητες.			1	2	3	4	5	6	7	8	9	10	11	12
M13	Υπάρχουν συγκεκριμένες περίοδοι στην παιδική ηλικία μετά τις οποίες ορισμένα πράγματα δεν μπορούν πλέον να αποτελέσουν αντικείμενο μάθησης.			1	2	3	4	5	6	7	8	9	10	11	12
M14	Η απομνημόνευση δεν έχει καμία επίδραση στη διαδικασία μάθησης.			1	2	3	4	5	6	7	8	9	10	11	12
M15	Περιβάλλοντα που προσφέρουν περισσότερα ερεθίσματα βελτιώνουν τον εγκέφαλο των παιδιών προσχολικής ηλικίας.			1	2	3	4	5	6	7	8	9	10	11	12
M16	Η διανοητική ικανότητα είναι κληρονομική και δεν μπορεί να αλλάξει από το περιβάλλον ή την εμπειρία.			1	2	3	4	5	6	7	8	9	10	11	12
M17	Η ακρόαση κλασσικής μουσικής βελτιώνει την διανοητική ικανότητα.			1	2	3	4	5	6	7	8	9	10	11	12
M18	Όταν ένα μέρος του εγκεφάλου έχει υποστεί βλάβη, άλλα μέρη μπορούν να αναλάβουν τη λειτουργία του.			1	2	3	4	5	6	7	8	9	10	11	12
M19	Σύντομες περίοδοι ασκήσεων συντονισμού μπορούν να βελτιώσουν τη λειτουργία του εγκεφάλου (για παράδειγμα, το να αγγίζεις το δεξιό αστράγαλό με το αριστερό χέρι και το αντίστροφο).			1	2	3	4	5	6	7	8	9	10	11	12
M20	Χρησιμοποιούμε μόνο το 10% του εγκεφάλου μας.			1	2	3	4	5	6	7	8	9	10	11	12
M21	Τα άτομα με μεγαλύτερους εγκεφάλους είναι εξυπνότερα.			1	2	3	4	5	6	7	8	9	10	11	12
M22	Ο εγκέφαλος συνεχίζει να δημιουργεί νέες συνδέσεις κατά τη διάρκεια της ζωής του ατόμου.			1	2	3	4	5	6	7	8	9	10	11	12
M23	Οι εγκέφαλοι των ανδρών και των γυναικών είναι σχεδιασμένοι για διαφορετικούς τύπους δεξιοτήτων.			1	2	3	4	5	6	7	8	9	10	11	12
M24	Ο εγκέφαλος παραμένει ενεργός 24 ώρες το εικοσιτετράωρο.			1	2	3	4	5	6	7	8	9	10	11	12
M25	Συμπληρώματα διατροφής όπως Ωμέγα-3 και Ωμέγα-6 έχουν θετική επίδραση στην ακαδημαϊκή επιτυχία.			1	2	3	4	5	6	7	8	9	10	11	12
M26	Η ανάπτυξη του εγκεφάλου έχει ολοκληρωθεί μέχρι το τέλος της εφηβείας.			1	2	3	4	5	6	7	8	9	10	11	12
M27	Η φυσιολογική ανάπτυξη του ανθρώπινου εγκεφάλου περιλαμβάνει τη γέννηση και το θάνατο των εγκεφαλικών κυττάρων.			1	2	3	4	5	6	7	8	9	10	11	12
M28	Ο εγκέφαλος «κλείνει» κατά τη διάρκεια του ύπνου.			1	2	3	4	5	6	7	8	9	10	11	12
M29	Κατά μέσο όρο, οι άνδρες έχουν μεγαλύτερο εγκέφαλο από τις γυναίκες.			1	2	3	4	5	6	7	8	9	10	11	12
M30	Οι άνθρωποι γεννιούνται με όλους τους νευρώνες που θα έχουν κατά τη διάρκεια της ζωής τους.			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 7. *Neuromyths items learning process and intelligence characteristics: Kazakh version.*

Ар.	Протάσεις	Σωστό	Λάθος	Әрбір сұраққа берген жауабыңызға қандай дереккөз әсер еткенін көрсетіңіз (бірнеше дереккөзді таңдауыңызға болады)											
				1. Бакалавриат/магистратура білімінен	2. Кәсіби даму бағдарламаларынан	3. Кәсіби тәжірибемнен	4. Әлеуметтік желіден (Мысалы: Twitter (X), Instagram, Linkedln, YouTube)	5. Веб-сайттардан	6. Әріптестерімнен немесе достарымнан	7. Академиялық басылымдардан	8. Кітаптар, журналдар, танымал журналдар сияқты басқа басылымдардан	9 Фильмдерден	10. Теледидар бағдарламаларынан	11. Жарнамалардан	12. Мен бұл тұжырыммен келісемін
M1	Адамдар ақпаратты өздерінің басымдығы жоғары қабылдау дағдыларына сай жақсырақ меңгереді. (мысалы: аудиал, визуал, кинестетикалық) (			1	2	3	4	5	6	7	8	9	10	11	12
M2	Оқу (үйрену) кезінде оқушылардың басым интеллектуал дағдысы (мысалы: математикалық, сөздік, кеңістіктік) ескерілуі керек			1	2	3	4	5	6	7	8	9	10	11	12
M3	Оқу (үйрену) үдерісінде ақыл-ой жаңа ақпаратты бұрынғы білімімен байланыстырады			1	2	3	4	5	6	7	8	9	10	11	12
M4	Оқу (үйрену) процесінде ми бөлімдері бір-бірінен бөлек-бөлек жұмыс істейді			1	2	3	4	5	6	7	8	9	10	11	12
M5	Оқу (үйрену) мидағы нейрондар арасындағы синапс байланыстардың өзгеруі арқылы жүреді			1	2	3	4	5	6	7	8	9	10	11	12
M6	Оқу (үйрену) эмоциялық емес, таза когнитивті дағды			1	2	3	4	5	6	7	8	9	10	11	12
M7	Оқу (үйрену) жеке тұлғалардың білім деңгейіне қарамастан жүзеге асады			1	2	3	4	5	6	7	8	9	10	11	12
M8	Ұзақ уақыт бойы қайталанатын кейбір ақыл-ой үдерісі (тәжірибе, оқу) мидың кейбір аймақтарының құрылымы мен қызметін өзгертуі мүмкін			1	2	3	4	5	6	7	8	9	10	11	12
M9	Адамдар ұйықтап жатқанда жаңа ақпаратты меңгере алады			1	2	3	4	5	6	7	8	9	10	11	12
M10	Адамдар көп тапсырманы бір мезетте жақсы орындай алады			1	2	3	4	5	6	7	8	9	10	11	12
M11	Кейбір адамдардың «оң жақ ми сыңары», ал басқаларының «сол жақ ми сыңары» жақсы жұмыс істейді. Бұл біздің оқу (үйрену) жолындағы айырмашылықтарымызды түсіндіруге көмектеседі			1	2	3	4	5	6	7	8	9	10	11	12
M12	Адамдар мазмұны қысқа сессиялардан немесе модульдерден тұратын курстарды жақсырақ меңгереді (үйренеді)			1	2	3	4	5	6	7	8	9	10	11	12
M13	Балалық шақта белгілі бір ерекше кезеңдер болады. Кейбір нәрселерді сол аралықта ғана үйренуге болады			1	2	3	4	5	6	7	8	9	10	11	12
M14	Есте сақтау қабілеті оқу (үйрену) процесіне әсер етпейді			1	2	3	4	5	6	7	8	9	10	11	12
M15	Көбірек ынталандыратын орталар мектеп жасына дейінгі балалардың миын жақсартады			1	2	3	4	5	6	7	8	9	10	11	12
M16	Ақыл-ой қабілеті тұқым қуалайды және оның қоршаған ортасы немесе өмірлік тәжірибесі өзгерте алмайды			1	2	3	4	5	6	7	8	9	10	11	12
M17	Классикалық музыканы тыңдау ақыл-ой қабілетін жақсартады			1	2	3	4	5	6	7	8	9	10	11	12
M18	Мидың бір аймағы зақымдалғанда, оның функциясын мидың басқа аймақтары орындауға кіріседі			1	2	3	4	5	6	7	8	9	10	11	12
M19	Қысқа мерзімді үйлестіру жаттығулары ми қызметін жақсартады			1	2	3	4	5	6	7	8	9	10	11	12
M20	Біз миымыздың тек 10%-ын пайдаланамыз			1	2	3	4	5	6	7	8	9	10	11	12
M21	Миы үлкен адамдар ақылдырақ			1	2	3	4	5	6	7	8	9	10	11	12
M22	Мидағы жаңа байланыстардың қалыптасуы өмір бойы жалғасады			1	2	3	4	5	6	7	8	9	10	11	12
M23	Ерлер мен әйелдердің миы әртүрлі дағдыларға арналған			1	2	3	4	5	6	7	8	9	10	11	12
M24	Ми тәулігіне 24 сағат белсенді			1	2	3	4	5	6	7	8	9	10	11	12
M25	Омега-3 және омега-6 сияқты қоспалар оқу жетістіктеріне оң әсер етеді			1	2	3	4	5	6	7	8	9	10	11	12
M26	Балалардың жыныстық жетілуі аяқталғанда, мидың дамуы да соңына жетеді			1	2	3	4	5	6	7	8	9	10	11	12
M27	Адам миының қалыпты дамуы ми жасушаларының тууы мен өлуінен тұрады			1	2	3	4	5	6	7	8	9	10	11	12
M28	Біз ұйықтап жатқанда, ми өз жұмысын тоқтатады			1	2	3	4	5	6	7	8	9	10	11	12
M29	Орташа алғанда, ерлердің миы әйелдерге қарағанда үлкенірек			1	2	3	4	5	6	7	8	9	10	11	12
M30	Адам баласы оның өмірінде болатын барлық нейрондарды толық иемдене туады			1	2	3	4	5	6	7	8	9	10	11	12

Appendix 8. *Neuromyths items learning process and intelligence characteristics: Malay version.*

				Untuk setiap item, sila tunjukkan sumber yang paling mempengaruhi jawapan and (anda boleh memilih lebih daripada satu jawapan											
		Betul	**tak betul**	1. Pendidikan sarjana muda/ Pendidikan	2 Program perkemabangan profesional	3Pengalaman profesional	4. Media sosial	5. laman web	6. Rakan sekerja atau kawan	7. Penerbitan akademik	8. Penerbitan lain seperti buku, journal, majalah popular	9 Wayang	10. televisyen	11. Iklan	12. Intuisi saya
M1	Individu belajar dengan lebih baik bila mereka menerima maklumat yang serasi dengan gaya pembelajaran dominan mereka (contohnya: visual, auditori, kinestetik dll)			1	2	3	4	5	6	7	8	9	10	11	12
M2	Profil kecerdasan pelajar yang dominan (contohnya: matematik, verbal, spatial) mesti dipertimbangkan semasa pengajaran.			1	2	3	4	5	6	7	8	9	10	11	12
M3	Dalam proses pembelajaran, minda kita akan mengaitkan maklumat baru dengan pengetahuan yang terdahulu.			1	2	3	4	5	6	7	8	9	10	11	12
M4	Bahagian otak yang berlainan akan beroperasi secara bersendiri semasa proses pembelajaran.			1	2	3	4	5	6	7	8	9	10	11	12
M5	Proses pembelajaran berlaku melalui perubahan dalam sambungan sinaptik antara neuron dalam otak.			1	2	3	4	5	6	7	8	9	10	11	12
M6	Pembelajaran hanya melibatkan kemahiran kognisi dan bukan emosi.			1	2	3	4	5	6	7	8	9	10	11	12
M7	Pembelajaran berlaku secara bebas dari (tidak dipengaruhi oleh) latar belakang individu.			1	2	3	4	5	6	7	8	9	10	11	12
M8	Semua proses mental (pengalaman, pembelajaran) yang berulang dalam jangka masa yang panjang akan mengubah struktur dan fungsi bahagian tertentu otak.			1	2	3	4	5	6	7	8	9	10	11	12
M9	Individu akan belajar maklumat baru walaupun semasa tidur.			1	2	3	4	5	6	7	8	9	10	11	12
M10	Manusia boleh melakukan pelbagai tugas dalam masa yang sama secara baik.			1	2	3	4	5	6	7	8	9	10	11	12
M11	Hakikat bahawa orang tertentu lebih cenderung kepada 'otak kanan' dan yang lain 'otak kiri' membantu menerangkan perbezaan dalam cara kita belajar.			1	2	3	4	5	6	7	8	9	10	11	12
M12	Individu belajar dengan lebih baik bila kandungan kursus dipersembahkan dalam sesi pendidikan atau secara bermodul.			1	2	3	4	5	6	7	8	9	10	11	12
M13	Terdapat perkara tentu yang boleh dipelajari semasa peringkat kanak-kanak yang tidak dapat dipelajari lagi dalam umur lain			1	2	3	4	5	6	7	8	9	10	11	12
M14	Penghafalan tiada impak ke atas proses pembelajaran.			1	2	3	4	5	6	7	8	9	10	11	12
M15	Persekitaran yang mampu membekalkan rangsangan yang banyak boleh meningkatkan fungsi otak di kalangan kanak-kanak pra sekolah.			1	2	3	4	5	6	7	8	9	10	11	12
M16	Kapasiti mental adalah secara keturunan dan tidak boleh diubah oleh persekitaran atau pengalaman.			1	2	3	4	5	6	7	8	9	10	11	12
M17	Mendengar music klasikal meningkatkan kapasiti mental			1	2	3	4	5	6	7	8	9	10	11	12
M18	Bila sebahagian daripada otak sudah rosak, bahagian lain boleh mengambil alih fungsinya			1	2	3	4	5	6	7	8	9	10	11	12
M19	Latihan koordinasi jangka pendek boleh meningkatkan fungsi otak (contohnya, menyentuh buku lali kanan dengan tangan kiri dan sebaliknya)			1	2	3	4	5	6	7	8	9	10	11	12
M20	Kita cuma gunakan 10% otak kita.			1	2	3	4	5	6	7	8	9	10	11	12
M21	Individu dengan otak yang lebih besar adalah lebih pandai			1	2	3	4	5	6	7	8	9	10	11	12
M22	Otak kita terus menerbitkan sambungan baru sepanjang umur individu			1	2	3	4	5	6	7	8	9	10	11	12
M23	Otak lelaki dan perempuan direkabentuk untuk jenis kemahiran yang berlainan			1	2	3	4	5	6	7	8	9	10	11	12
M24	Otak tetap aktif selama 24 jam sehari			1	2	3	4	5	6	7	8	9	10	11	12
M25	Makanan tambahan seperti Omega-3 dan Omega-6 mempunyai kesan positif ke atas pencapaian akademik			1	2	3	4	5	6	7	8	9	10	11	12
M26	Perkembangan otak adalah lengkap bila kanak-kanak mencapai akhir akil baligh			1	2	3	4	5	6	7	8	9	10	11	12
M27	Perkembangan biasa otak manusia melibatkan kelahiran dan kematian sel otak			1	2	3	4	5	6	7	8	9	10	11	12
M28	Otak tutup fungsi semasa tidur			1	2	3	4	5	6	7	8	9	10	11	12
M29	Secara lazim, lelaki mempunyai otak yang lebih besar daripada perempuan			1	2	3	4	5	6	7	8	9	10	11	12
M30	Manusia dilahirkan dengan semua neuron yang mereka ada dalam jangka hayat mereka			1	2	3	4	5	6	7	8	9	10	11	12