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Developing and Validating a Questionnaire Assessing Teachers' Knowledge, Attitude, and Practice Toward Inclusive Education for DHH Students

(Membangun dan Mengesahkan Soal Selidik yang Menilai Pengetahuan, Sikap dan Amalan Guru Terhadap Pendidikan Inklusif untuk Pelajar DHH)

Sondos Ahmad Al-Ghanim[1,4], Khairul Farhah Khairuddin[2,3], Nashrah Maamor[1]*

[1] Audiology Program, Faculty of Health Sciences, Centre for Rehabilitation and Special Needs Studies (iCaRehab), Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia.
[2] Centre for Ears, Hearing and Speech (HEARS), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia.
[3] Special Education Program, Faculty of Education, Universiti Kebangsaan Malaysia, 43600 Bangi, Malaysia.
[4] Department of Applied Speech Language Pathology and Audiology, Faculty of Allied Medical Sciences, Zarqa University, Zarqa, Jordan.

*Corresponding Author: Dr. Nashrah Maamor
Email address: nashrah@ukm.edu.my.

Abstract

This study aimed to develop, validate, and assess the reliability of a linguistically and culturally appropriate Malay-language Knowledge, Attitude, and Practice (KAP) survey to evaluate teachers' preparedness for including Deaf and Hard-of-Hearing (DHH) students who use listening devices in mainstream classrooms. The instrument was created through literature reviews and expert input, with content and face validity established by expert and field testing. Reliability was assessed using internal consistency (Cronbach's α) and test-retest reliability (Intraclass Correlation Coefficient [ICC] and Cohen's kappa). The instrument demonstrated excellent content validity, indicating unanimous expert agreement on item relevance and representativeness (CVI= 1). Face validity feedback confirmed the linguistic clarity, appropriateness, and relevance of the items. Test-retest reliability showed excellent stability for the knowledge domain (ICC= 0.95), while Cronbach's alpha values for the attitude (α= 0.86) and practice (α= 0.78) domains indicated good internal consistency. Cohen's kappa values for knowledge categorical items reflected substantial to almost perfect agreement. The results confirmed that Teachers' Questionnaire on the Inclusion of DHH Students in Mainstream Education (TIDE-Q) is a psychometrically sound tool for evaluating teachers' preparedness to support the communication and educational needs of DHH students who use spoken language in mainstream schools.

Keywords: Deaf and Hard-of-Hearing, Inclusion, KAP (knowledge, Attitude, and Practice), Questionnaire, Teachers

Abstrak

Kajian ini bertujuan untuk membangunkan, menentusahkan kesahan, dan menilai kebolehpercayaan instrumen soal selidik Pengetahuan, Sikap, dan Amalan (PSA) versi bahasa Melayu. Instrumen ini diadaptasi agar bertepatan dengan konteks linguistik dan silang budaya tempatan bagi menilai tahap kesediaan guru dalam menyokong penglibatan murid Pekak dan Kurang Pendengaran (PKP) yang menggunakan peranti pendengaran di kelas aliran perdana. Proses pembangunan instrumen ini digarap menerusi tinjauan literatur yang komprehensif dan penilaian pakar, manakala kesahan kandungan dan kesahan muka ditentusahkan melalui panel pakar serta kajian lapangan. Kebolehpercayaan instrumen dinilai berdasarkan pekali ketekalan dalaman (Cronbach's α) serta kebolehpercayaan uji-ulang uji menggunakan Pekali Korelasi Intrakelas (ICC) dan Kappa Cohen. Dapatan kajian menunjukkan bahawa instrumen ini memiliki kesahan kandungan yang cemerlang dengan persetujuan pakar yang sebulat suara terhadap kesesuaian dan keterwakilan item (CVI = 1). Penilaian kesahan muka turut mengesahkan kejelasan linguistik, kesesuaian, dan kerelevanan setiap item. Analisis kebolehpercayaan uji-ulang uji merekodkan tahap kestabilan yang cemerlang bagi domain pengetahuan (ICC = 0.95), manakala nilai Alpha Cronbach bagi domain sikap (α= 0.86) dan amalan (α= 0.78) membuktikan tahap ketekalan dalaman yang baik. Di samping itu, nilai Kappa Cohen bagi item berskala kategori dalam domain pengetahuan mencerminkan tahap persetujuan yang kukuh hingga hampir sempurna. Kesimpulannya, dapatan ini membuktikan bahawa Soal Selidik Guru mengenai Penyertaan Murid PKP dalam Pendidikan Aliran Perdana (TIDE-Q) merupakan instrumen yang memiliki ciri psikometrik yang mantap. Instrumen ini disahkan sesuai dan boleh diharap untuk menilai kesediaan

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guru dalam menyokong keperluan komunikasi serta pendidikan murid PKP yang menggunakan bahasa lisan di sekolah aliran perdana.

Kata kunci: Pekak dan Kurang Pendengaran, Pendidikan Inklusif, PSA (Pengetahuan, Sikap, dan Amalan), Soal Selidik, Guru

INTRODUCTION

Hearing disability affects millions of people worldwide, which obstructs communication, social life, and participation in everyday activities (Furness et al. 2019). The World Health Organization (WHO) estimates that 34 million children worldwide face hearing loss and thus need rehabilitation, with this figure expected to increase to more than 700 million by the year 2050 (World Health Organization 2024). In the last 20 years, Deaf and Hard-of-Hearing (DHH) children in mainstream educational institutions have grown significantly (Khairuddin et al. 2018; Silvestri & Hartman 2022). This trend reflects advances in audiological technology, early detection and intervention guidelines, and global paradigms supporting inclusive education as a constructive right (Khairuddin et al. 2018; Pim et al. 2020). The Convention on the Rights of Persons with Disabilities (CRPD) mandates equal access to inclusive, quality, and free education for children with disabilities (United Nations 2006, 2018); thus, in Malaysia, the Malaysian Education Blueprint 2013-2025 outlines ambitious targets to educate 75% of children with disabilities, including DHH students, in mainstream classrooms by 2025 (Ministry of Education 2013).

Although improvements in policy and technology can be observed, inclusive education of DHH students proves to be a difficult challenge so far (Alasim 2018; Khairuddin et al. 2018). Factors such as communication barriers, insufficient awareness among teachers and peers about the issues of hearing loss, insufficient training of teachers on inclusion and disabilities, and the inflexibility of mainstream school systems hinder the successful inclusion of these children (Alasim 2018; Khairuddin et al. 2018; Sarant et al. 2018). DHH students who use listening devices, such as hearing aids (HAs) and cochlear implants (CIs), and communicate verbally need special accommodations and supports in the mainstream schools. These students require optimal hearing in generally noisy teaching situations and benefit from specific strategies, including special seating arrangements and the implementation of assistive listening devices (ALDs) like the FM systems, which are critical for overcoming barriers like distance and background noise (Zanin & Rance 2016). Research has stated that the spoken mode of communication is the key within the classroom for most DHH children, which facilitates delivery of the curriculum and communication (Todorov et al. 2021). These results reveal the necessity of the stakeholders, including teachers, to be informed and prepared to operate in the area of specific language and communication needs of DHH students with listening devices, since this step is basic to their successful development of verbal speech and proper inclusion into classroom life.

As the number of countries promoting inclusive education increases, the mainstream educators are expected to accommodate the diverse needs of the DHH learners (Khairuddin et al. 2018; Silvestri & Hartman 2022). The studies have always shown that knowledge, attitudes, and practices of teachers play a significant role in the quality of inclusion and educational outcomes of DHH students (Florian 2019; Furness et al. 2019; Montgomery & Mirenda 2014; Muñoz-Martínez et al. 2020; Solís et al. 2019). A Positive attitude of teachers toward inclusion has been associated with better social skills and a stronger sense of belonging in DHH learners (Montgomery & Mirenda 2014). However, general education teachers often lack sufficient training, knowledge, and attitudes on the needs of DHH students (Alnasser 2020; Guardino 2015; Khairuddin et al. 2018; Pérez-Jorge et al. 2021). As it was stated by professional organizations including the Council on Education of the Deaf (CED) and the Council for Exceptional Children (CEC), teachers working with DHH learners must have certain competence to support these students within inclusive education (Guardino 2015). Although research in different contexts has designed Knowledge, Attitudes, and Practices (KAP) instruments to determine the readiness of a teacher (Nilisha & Ranjan 2022), existing tools have notable limitations. Some tools primarily examine general awareness of hearing impairment without adequately addressing practical aspects of DHH inclusion (Dsouza & Ranjan 2021). While others evaluate broader special education competencies, they do not capture the specific instructional and environmental demands associated with DHH learners, such as auditory access and the use of assistive listening technologies (Deng et al. 2016). In addition, instruments such as the Opinions Relative to Integration (ORI) scale (Antonak & Larrivee 1995) focus mainly on attitudes and self-efficacy, without incorporating a comprehensive assessment of knowledge and classroom practices. Furthermore, Malaysia lacks a validated scale to comprehensively measure teachers' knowledge, attitudes, and practices regarding DHH inclusion in mainstream education.

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The KAP framework provides a structured approach to evaluating specific domains within a target population. KAP surveys have become especially popular in health sciences due to their ability to provide valuable insights into health-related behaviors, beliefs, and practices (Andrade et al. 2020). The framework emphasizes the importance of designing domain-specific questions, ensuring clarity in phrasing, and validating instruments. Validation processes such as face and content validity are critical to ensuring the relevance of the instrument (Andrade et al. 2020).

Validity is how correctly a research tool measures a construct it tries to operationalize. This is assessed using several categories that include face validity, content validity, construct validity, and criterion validity (Larsson et al. 2015). Face validity determines whether the members of the research sample are able to correctly interpret and comprehend the items used in the research instrument (Lau et al. 2017). In its turn, content validity asks to conceptualize the target construct and operationalize its elements (Larsson et al. 2015). The process often implies a panel of experts to look through the instrument in a systematic way to determine its relevance to measure the intended outcomes (Lau et al. 2017). Content validity can be assessed using various methods, with the Content Validity Index (CVI) being one of the most frequently utilized approaches in instrument development (Rodrigues et al. 2017).

Reliability is a complement to validity, as it guarantees reproducibility and consistency of the instrument. Although reliability is necessary to the quality of studies, it is not sufficient on its own, as it is highly necessary to incorporate validity (Taherdoost 2016). It is normally assessed by means of internal consistency, which checks the consistency of the items in the same scale (Taherdoost 2016) and test-retest reliability, which determines the level of reliability of answers between distinct periods (Larsson et al. 2015). Collectively, these sources of reliability establish that a tool can deliver reliable multicontextual and longitudinal measures.

Therefore, this study aims to develop, validate, and test the reliability of a comprehensive instrument for teachers working with DHH students in mainstream educational settings who use listening devices. The instrument, titled *Teachers' Questionnaire on the Inclusion of DHH Students in Mainstream Education* (TIDE-Q), is designed to assess teachers' knowledge, attitudes, and practices related to supporting the effective inclusion and learning outcomes of DHH students.

METHODS AND MATERIALS

Study Design

This cross-sectional study was conducted in two phases: the development of the survey items of the TIDE-Q and the psychometric evaluation of the instrument.

Ethical Consideration

Ethical approval was granted by the Institutional Ethics Committee, the National University of Malaysia (UKM) (UKM PPI/111/8/JEP-2024-657). Research permissions were obtained from the Ministry of Education Malaysia and the Selangor State Education Department. Consent was obtained from school principals and participating teachers prior to data collection. The objectives and procedures of the study were explained to all participants, who were also informed about their

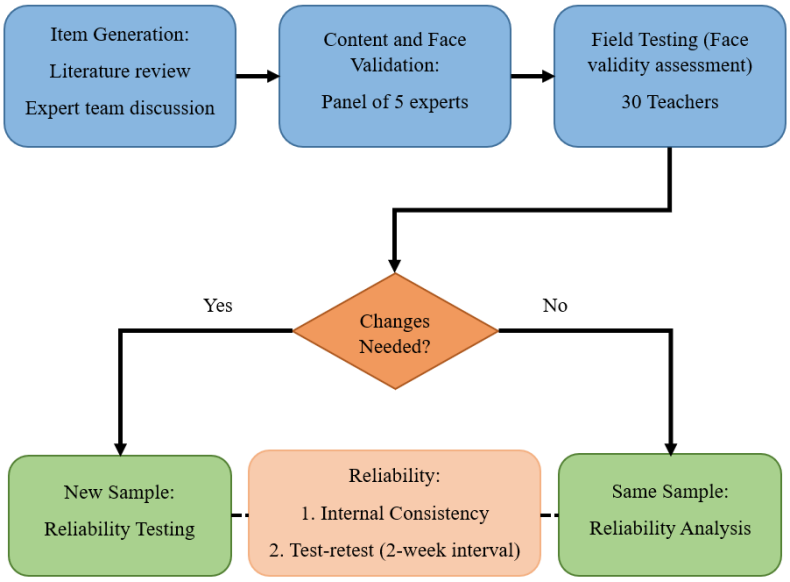

FIGURE 1. Development and Validation Process of the TIDE-Q Questionnaire

rights of voluntary participation and withdrawal without any penalty at any time. Confidentiality of all responses was assured, and data were handled in accordance with institutional and national ethical guidelines.

Phase I: Instrument Development

The development of the TIDE-Q was conducted in three stages: item generation, content validation, and field testing with target users, as illustrated in Figure 1.

TIDE-Q and the Development Process

The TIDE-Q was designed to comprehensively assess teachers' readiness to support DHH students who use listening devices in mainstream classrooms. The instrument comprises four sections: a demographic section gathering information on teachers' background, experience, and training; a knowledge domain assessing understanding of hearing loss, inclusive education principles, classroom acoustics, assistive listening devices, and communication strategies; an attitude domain measuring beliefs and perceptions toward DHH inclusion; and a practice domain evaluating classroom strategies and accommodations for supporting DHH students.

A comprehensive review of relevant literature using research databases such as PubMed, Web of Science, and Scopus was conducted to identify key domains necessary to assess teachers' knowledge, attitudes, and practices regarding the inclusion of DHH students in mainstream educational settings. Following the literature review, team discussions were held with two experts specializing in audiology and education to refine the initial items and ensure alignment with the study objectives.

The knowledge domain was formulated to reflect some foundational aspects about the inclusive education of DHH children, such as elementary knowledge about hearing loss and its effects, inclusive principles, physical setting and classroom acoustics, assistive listening devices, teaching/ communicating tactics, and classroom management. The initial content of this section had 16 items framed in the true/false/not sure and tick-all-that-apply format. The attitude domain was adapted from the Opinions Relative to the Integration of Students with Disabilities (ORI) instrument (Antonak & Larrivee 1995), which is applied in evaluating teacher attitudes towards inclusive education. The developers of the ORI scale gave permission to use and adapt to this study. There were 18 items that were retained for the final questionnaire. The practice domain was devoted to the strategies of classroom management in assisting DHH students. The attitude and practice questions were presented in a six-item Likert scale with a minimum of "strong disagreement" to a maximum of "strong agreement". In addition to these three domains, the questionnaire included sections on demographic information, such as age, gender, educational background, prior experience and training related to DHH students, and their familiarity with specific concepts.

The questionnaire was initially developed in English and translated into Malay (target language) using a forward-translation process conducted by bilingual experts. The translated questionnaire (Malay) was subsequently translated into English (source language) through a back-translation process (Appendix A). This step aimed to ensure linguistic accuracy and cultural appropriateness for the target population. An initial pool of 56 items was generated across these three domains (knowledge, attitude, practice).

Content and Face Validation

Content validation process was conducted to ensure the relevance, linguistic clarity, and appropriateness of each item within its respective domain. Each expert received a content validation form, an invitation letter, and an appointment acceptance form (6 August and 15 October 2024). Five experts were selected based on their expertise in audiology, speech and language, inclusive education, and related fields (Table 1). Each expert reviewed and critiqued the questionnaire items using a 4-point Likert scale (1= not relevant/clear, 2= somewhat relevant/clear, 3= quite relevant/clear, 4= highly relevant/ clear). To compute relevance and clarity scores, ratings of "1" and "2" were assigned a score of zero, while ratings of "3" and "4" were assigned a score of one. The experts were also encouraged to provide both verbal and written comments to suggest improvements to item clarity, linguistic appropriateness, wording, and alignment with the targeted domains. All experts' comments were systematically reviewed and documented (Appendix A).

TABLE 1. Expert panel areas of expertise for content and face validity evaluation

Expert	Expertise
Expert 1	Audiology (PhD)
Expert 2	Speech and Language Sciences (PhD)

Expert 3	Special Education (PhD)
Expert 4	Deaf Education and Reading Specialist (Master degree), Audiologist
Expert 5	Teacher in a Deaf School, Hearing Aid User and Verbal Communicator

Content validity was quantified using both the Item Content Validity Index (I-CVI) and Scale-level Content Validity Index (S-CVI), with values of 1.0 being considered acceptable and retained in the final questionnaire (Polit et al. 2007; Yusoff 2019). Moreover, the S-CVI is assessed through Universal Agreement (S-CVI/UA) and Average (S-CVI/Ave) (Yusoff 2019). S-CVI/UA reflects the proportion of items achieving unanimous expert agreement, while S-CVI/Ave represents the average I-CVI across all items (Rodrigues et al. 2017; Yusoff 2019; Zamanzadeh et al. 2015). Face validity was assessed in two complementary stages. First, an expert panel evaluated the clarity, comprehensibility, and appropriateness of each item, and the Face Validity Index (FVI) was calculated to quantify agreement (Bonnet 2024; Yusoff 2019). Second, the questionnaire was field tested with 30 teachers from the target population to assess practical clarity, length, and usability.

Field Testing

A field testing stage (n= 30) was established as a stage to determine the face validity of the questionnaire and test its clarity, usability, and general acceptability by the target population (October 17, 2024- the end of October 2024) (Allen et al. 2023; Bujang et al. 2024). Two SEIP schools in the Klang Valley were purposively selected from a list provided by the Ministry of Education's Special Education Division, with preference given to schools enrolling DHH students. Questionnaires were distributed to eligible teachers within these schools to maximize participation of those experienced in teaching verbal DHH students using listening devices. Each teacher received a paper-based questionnaire in a sealed envelope, including an instruction sheet and an informed consent form. Following completion of the finalized questionnaire, participants completed a feedback survey to gather their views on different aspects of the instrument. The response survey obtained the view of the difficulty in filling out the questionnaire, the design and format of the questionnaire, and the length appropriateness. They also had to answer a question of whether the instructions were understandable to detect some vague terms or incomprehensible response choices and provide terms that are sensitive to them. Lastly, they were also urged to give further comments or suggestions on how to improve the instrument. The research team carefully analyzed the feedback and responses offered by the participants.

Phase II: Psychometric Evaluation

Based on the results of the field testing, if modifications to the questionnaire were required, a new sample of 30 teachers would be recruited for psychometric evaluation; if no substantial changes were needed, the same field sample's responses would be used. The psychometric evaluation phase focused on assessing the reliability of the questionnaire through two key methods: internal consistency and test-retest reliability. Cronbach alpha coefficients (threshold≥ 0.7) determined internal consistency reliability in the Likert-scale domains of attitude and practice (Taherdoost 2016). Cohen's Kappa assessed test-retest reliability for knowledge items. To obtain test-retest reliability in all areas, the questionnaire would be re-administered to the same 30 teachers two weeks after the first administration (20 November 2024-10 December 2024). For total scores of the knowledge, attitude, and practice domains, the Intraclass Correlation Coefficient (ICC) was calculated using a two-way mixed-effects model with absolute agreement. ICC values ≥ 0.75 were interpreted as indicating excellent reliability (Koo & Li 2016). For knowledge items, Cohen's Kappa (k) ≥ 0.6 was considered moderate to strong agreement (Mchugh 2012). Data analysis was done using the IBM SPSS version 29.0.

RESULTS

The final TIDE-Q instrument comprises 52 items across four sections: demographics (11 items), knowledge (11 items), attitude (18 items), and practice (12 items). The complete validated questionnaire in both English and Malay versions is provided in Appendix B.

Content and Face Validation

The I-CVI values for the majority of items across all domains exceeded the threshold of 0.8, while seven items received I-CVI values of 0.8. The FVI values for clarity were generally satisfactory, with most items scoring between 0.8 and 1, while five items received a score of 0.6. In addition, the S-CVI/UA was 0.88 (49 out of 56 items), indicating that 88%

of the items achieved unanimous agreement among the expert panel. The S-CVI/Ave was 0.97 (54.6 out of 56), demonstrating near-perfect average relevance across all items. (Table 2).

TABLE 2. Initial content validity index (CVI) and face validity index (FVI) results: item-level and scale-level validation (first round)

Domain	**Item**	**I-CVI**	**FVI**	**Final Decision**	**Domain**	**Item**	**I-CVI**	**FVI**	**Final Decision**
Socio-demographic	SD1	1	1	Retained	Attitude	A3	1	0.8	Revised
	SD2	1	1	Retained		A4	0.8	0.8	Revised
	SD3	0.8	0.8	Retained		A5	0.8	0.8	Revised
	SD4	1	1	Retained		A6	1	1	Revised
	SD5	1	1	Retained		A7	1	0.8	Revised
	SD6	1	1	Retained		A8	1	0.6	Revised
Experience	EX1	1	1	Revised		A9	1	1	Revised
	EX2	1	0.8	Revised		A10	0.8	1	Revised
	EX3	1	0.8	Revised		A11	0.8	0.6	Revised
	EX4	1	0.6	Revised		A12	1	1	Revised
Knowledge	K1	1	0.8	Revised		A13	1	1	Revised
	K2	1	1	Removed		A14	1	1	Revised
	K3	0.8	0.8	Removed		A15	1	1	Revised
	K4	1	1	Revised		A16	1	1	Revised
	K5	1	1	Revised		A17	1	0.8	Revised
	K6	1	1	Revised		A18	1	0.8	Revised
	K7	1	0.8	Revised	Practice	P1	1	1	Revised
	K8	1	0.8	Revised		P2	1	0.8	Revised
	K9	1	0.6	Revised		P3	1	0.8	Revised
	K10	1	0.8	Revised		P4	1	1	Revised
	K11	1	1	Revised		P5	1	0.8	Revised
	K12	1	1	Revised		P6	1	1	Revised
	K13	1	1	Removed		P7	1	0.8	Revised
	K14	1	1	Revised		P8	1	1	Revised
	K15	1	0.8	Revised		P9	1	1	Revised
	K16	1	1	Revised		P10	1	0.8	Revised
Attitude	A1	0.8	0.6	Revised		P11	1	1	Revised
	A2	1	1	Revised		P12	1	1	Revised
S-CVI/UA= 49/ 56= 0.88					S-CVI/AVE= 54.6/56= 0.97				

*The values of CVI and FVI are from the initial (pre-revision) expert review; the team discussion and qualitative responses affected the final decisions concerning the items.

The retention or revision of items was made through a junction of quantitative ratings (CVI and FVI), qualitative statements of the expert panel, and research discussions within the team (Appendix A). All experts agreed on the revised questionnaire, achieving a target CVI of 1 for all items in the final version.

Field Testing

Table 3 shows the results of the field-testing stage. According to findings in the field-testing study and discussions among the research team, certain changes were made to enhance usability and clarity while ensuring the validity of the content was maintained. Two items in the knowledge domain were removed due to redundancy and limited relevance based on the field-testing study findings. Additionally, some items in the knowledge domain transformed their response format from “tick-all-that-apply” to “true/false/not sure”, simplifying the response process and reducing cognitive load for participants.

TABLE 3. field Testing Stage Results

Area Assessed	Response Options	Frequency (n)	Percentage (%)
Difficulty of completing the survey	1= very easy	23	76.7
	2= easy		
	3= difficult	7	23.3
	4= very difficult		
Design and format of the survey	1= poor	1	3.3
	2= good	23	76.7
	3= excellent	6	20
Length of the survey	2= appropriate	21	70
	3= long	9	30
Clarity of language and instructions	Clear	26	86.7
Ambiguous or unclear items	None	21	70

Psychometric Evaluation

The attitudes domain demonstrated strong internal consistency with a Cronbach's alpha of 0.86 across its 18 items, while the practice domain showed acceptable internal consistency with a Cronbach's alpha of 0.78 across its 12 items. The ICC values indicated excellent reliability for total scores, with ICC= 0.95 for knowledge, ICC= 0.88 for attitude, and ICC= 0.79 for practice (Table 4). Internal consistency was not calculated for the knowledge domain because of its multidimensional nature, which involves assessing distinct factual subdomains rather than a single underlying construct.

TABLE 4. Internal Consistency Coefficient (α) and Test-Retest Reliability (ICC) Results

Cronbach's alpha (α)			
Domain	Number of Items	Cronbach's α	Interpretation
Attitude	18	0.86	Strong internal consistency
Practice	12	0.78	Acceptable internal consistency
Intraclass Correlation Coefficient (ICC)			
Domain	ICC	P	Interpretation
Knowledge	0.95	<.001	Excellent reliability
Attitude	0.88	<.001	Good reliability
Practice	0.79	0.01	Good reliability

For knowledge individual items, Cohen's weighted kappa (k) was used to assess agreement between test and retest responses, with all kappa values exceeding the threshold of $k \geq 0.60$ (Table 5).

TABLE 5. Test-Retest Reliability Results: Cohen's Kappa

Item Pair	Kappa (k)	P value	Interpretation
K1-K1R	0.92	<.001	Almost perfect agreement
K2-K2R	0.79	<.001	Substantial agreement
K3-K3R	0.80	<.001	Substantial agreement
K4-K4R	1.00	<.001	Almost perfect agreement
K5-K5R	0.91	<.001	Almost perfect agreement
K6-K6R	0.78	<.001	Substantial agreement
K7-K7R	0.67	<.001	Substantial agreement
K8-K8R	0.87	<.001	Almost perfect agreement
K9-K9R	0.86	<.001	Almost perfect agreement
K10-K10R	0.76	<.001	Substantial agreement
K11-K11R	0.87	<.001	Almost perfect agreement

*Each Pair corresponds to a single knowledge item and its retest.

DISCUSSION

The primary aim of this study was to develop and validate a comprehensive instrument to assess teachers' knowledge, attitudes, and practices regarding the inclusion of DHH students in mainstream educational settings. The Teachers' Knowledge, Attitude, and Practice for Inclusion of Deaf and Hard-of-Hearing Students (TIDE-Q) survey was developed to address a critical gap in inclusive education research and practice by providing a tailored framework to evaluate teachers' preparedness for the inclusion of verbal DHH students using listening devices.

The findings demonstrated excellent content validity, with all retained items achieving unanimous agreement among the expert panel. This reflects a high level of consistency in expert judgment and supports the relevance and representativeness of the instrument items. The main aspect of content validation is the selection of experts (Sulong et al. 2023). Following Polit et al. (2007), when fewer than six experts are involved, all experts must agree on an item for it to be considered valid, resulting in an I-CVI value of 1.00. This criterion was strictly applied in this study, ensuring that only items achieving unanimous agreement among the expert panel were retained in the final version of the questionnaire.

Additionally, the S-CVI values exceeded recommended thresholds of $\geq$ 0.80 and S-CVI/Ave score of $\geq$ 0.90 respectively (Rodrigues et al. 2017; Shi et al. 2012), indicating excellent overall content validity. This perfect content validity (1.00) represents the excellent standard proposed by Polit et al. (2007) and confirms that the TIDE-Q instrument's items appropriately and comprehensively reflect the knowledge, attitudes, and practices of mainstream teachers regarding the inclusion of verbal DHH students who use listening devices. On the other hand, face validity can be assessed using qualitative or quantitative methods (Allen et al. 2023), both of which were employed in this study. In this study, expert review served as the first step in evaluating face validity, which was then assessed during the field-testing study.

As the second phase of face validity assessment, pilot studies serve a broader purpose by evaluating the performance characteristics of the chosen study design, study measures, research procedures, recruitment criteria, and other operational strategies being considered for use in subsequent larger studies (Bujang et al. 2024). Feedback from teachers provided valuable insights into potential ambiguities, redundancies, and usability issues in our research. Face validity reflects the clarity, difficulty, relevance, and sensitivity of a measure to its intended population (Allen et al. 2023). For example, several participants noted that technical terms such as "induction loop" were ambiguous or unfamiliar, particularly for teachers without specialized training in hearing support. Comments also highlighted that some questions were overly long, confusing, or not relevant. In response to this feedback, the research team refined the questionnaire while ensuring that the core validated content and constructs remained intact. This process aligns with other practices in scale development, where participants' feedback is used to enhance both practical usability and methodological rigor (Frantz & Holmgren 2019). The two-phase face validity approach employed in this study provided comprehensive validity evidence from both expert and user perspectives, strengthening the overall methodological rigor of the instrument development process.

Furthermore, the reliability analysis of the TIDE-Q instrument demonstrated robust psychometric properties across its domain, with statistical methods tailored to the nature of the data. For the attitude and practice domains, Cronbach's alpha assessed internal consistency, yielding values of 0.86 and 0.78, respectively. These results confirm strong coherence among items within each domain, supporting their use in measuring latent constructs such as beliefs and classroom strategies (Cho & Kim 2015; Tavakol & Dennick 2011). Cronbach's alpha coefficient ranges from 0 to 1, with 0.70 representing the threshold for acceptable consistency (George & Mallery 2003). Cronbach's alpha is suitable for scales with Likert-type items, as it measures the internal consistency of a set of items that collectively assess a single latent construct (Bujang et al. 2024; Cho & Kim 2015; Tavakol & Dennick 2011). This method assumes unidimensionality, meaning all items measure the same underlying trait, and tau-equivalency, where all items have equal factor loading (Cho & Kim 2015). When these assumptions are met, alpha provides a reliable estimate of internal consistency (Cho & Kim 2015). For the knowledge domain, test-retest reliability was employed instead of Cronbach's alpha due to the multidimensional nature of its items, which assess distinct factual subdomains. Cohen's kappa and ICC were used to assess stability over time. Cohen's kappa values ranged from 0.67 to 1.00, indicating substantial to almost perfect agreement (Mchugh 2012). The ICC for total knowledge score was 0.95, reflecting excellent reliability (Koo & Li 2016). Additionally, ICC values for test-retest reliability in attitude and practice domains provided additional support to their reliability, with ICC values of 0.88 for attitude and 0.79 for practice, indicating good test-retest reliability (Koo & Li 2016). To ensure reliable estimates across all statistical methods used in the study, a sample size of 30 participants was

selected based on recommendations by Bujang et al. (2024), who demonstrated that this number is sufficient for pilot studies assessing reliability using Cronbach's alpha, kappa, and ICC.

The development of the TIDE-Q questionnaire addresses a critical gap in assessing teachers' preparedness for inclusive education of DHH students. While existing tools, such as the KAP questionnaire developed by Dsouza and Ranjan (2021), focus on general awareness, knowledge, and practice of hearing impairment among school teachers, they lack specificity for DHH inclusion practices. Similarly, Deng et al. (2016) developed a questionnaire to evaluate inclusive teachers' competencies in China, but it broadly addressed special educational needs without targeting the unique challenges of DHH learners, such as auditory accessibility or assistive listening technology. Other instruments like the CEFI-R (Rojo-Ramos et al. 2023) and the Index of Inclusion (Fernández-Archilla et al. 2020) emphasize systematic inclusive practices but do not provide domain-specific insights into DHH inclusion. Furthermore, domain-focused tools such as the ORI scale (Antonak & Larrivee 1995) and the Teacher Efficacy for Inclusive Practices (TEIP) scale (Sahli Lozano et al. 2023) assess attitudes and self-efficacy but lack a multidimensional evaluation of knowledge and practices. By contrast, the TIDE-Q integrates three validated domains, including knowledge, attitudes, and practices that are tailored specifically to DHH inclusion while also capturing socio-demographic and experience-related data.

Limitation and Future Direction

Although the questionnaire TIDE-Q is psychometrically sound, some limitations ought to be recognized. Although the sample size of 30 participants was chosen according to previous recommendations (Bujang et al. 2024), a larger number of participants would make generalizations more feasible and allow gaining a better understanding of differences in teacher readiness for DHH inclusion.

Additionally, while test-retest reliability was conducted within the knowledge domain, tests of internal consistency were not indicated. Future studies may consider other options of measuring internal consistency as a way of having thorough reliability tests in this domain.

Since the instrument will be used in a bigger study where the knowledge, attitudes, and practices of teachers with respect to DHH inclusion in Malaysia will be analyzed, the instrument will be very fundamental in highlighting gaps in teachers' preparation and guiding specific interventions. Furthermore, future directions include validating an English language version of the TIDE-Q to support its administration in other nations. Comparative analysis of DHH inclusion across the world would assist in the development of the evidence base of inclusive education because cross-cultural adaptation and validation would allow international comparisons of their inclusion practices.

CONCLUSION

This study successfully developed and validated the *Teachers' Questionnaire on the Inclusion of DHH students in Mainstream Education* (TIDE-Q) as a comprehensive tool for assessing teachers' KAP on supporting the inclusion of DHH students in mainstream educational settings. The instrument demonstrated strong psychometric properties, including high reliability and validity, through rigorous content validation, internal consistency, and test-retest reliability analysis.

DATA AVAILABILITY

All data are fully available without restriction and upon request.

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DECLARATION OF COMPETING INTEREST

The authors have declared that no competing interests exist.

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