THE ASIA-PACIFIC SCHOLAR
MEDICAL AND HEALTH PROFESSIONS EDUCATION

ORIGINAL ARTICLE

Submitted: 1 January 2025
Accepted: 12 August 2025
Published online: 7 October, TAPS 2025, 10(4), 44-54
https://doi.org/10.29060/TAPS.2025-10-4/OA3613

Tele-therapy based tele-clinical learning in Speech and Hearing Sciences – Evaluation and validation of an evaluation tool

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Abstract

Introduction: Tele-clinical training is an effective approach, increasingly adopted post-pandemic and in resource-limited settings. However, it requires systematic development. This study details the first-time implementation of a tele-clinical training in an undergraduate Speech and Hearing Sciences programme, exploring student experiences and validating a novel evaluation tool, specifically designed for tele-clinical training programmes.

Methods: The study used a mixed-method approach. Quantitative data were gathered from 128 students using the developed 23-item Kelaniya Tele-Clinical Evaluation Tool (KeTCET), which covers three broad areas: Learning Environment, Supervisory Attributes, and Telehealth Teaching Practices. Qualitative insights from 13 participants were thematically analysed. The tool was validated for reliability and psychometric robustness using expert feedback and statistical evidence.

Results: Quantitative analysis showed high domain scores: Learning Environment 80.64%, Supervisory Attributes 81.67%, and Telehealth Teaching Practices 80.31%. Strong positive correlations between domains ($r > 0.86$, $p < 0.001$) indicated interconnectedness. The 23-item evaluation tool demonstrated high internal consistency (Cronbach Alpha = 0.98) and a single-factor structure (Eigenvalue = 17.12, 74.44% variance explained). Qualitative data highlighted strengths in supervisor interaction and resource availability, also noting challenges such as issues in connectivity and limited peer learning. Students appreciated structured feedback and supervisor presence during tele-clinical sessions.

Conclusions: The successful development of a tele-clinical programme requires consideration of multiple elements broadly categorised as pedagogical environment, supervisory characteristics, and virtual teaching practices. Well-structured programmes can effectively meet training needs in resource-limited settings, although strengths and challenges may vary across learning environments. The validated 23-item KeTCET offers a reliable framework for evaluating and improving tele-clinical programmes.

Keywords: *Tele-clinical Programmes, Tele-clinical Supervision, Speech and Language Therapy, Audiology, Tele-clinical Evaluation, Tool Development, Undergraduate Clinical Training, KeTCET*

Practice Highlights

- Tele-Practice based clinical programmes can be delivered successfully even in countries with limited resources.
- Robust planning is required to ensure that tele-clinical programmes address specific training needs and satisfy student expectations.
- Incorporating virtual clinical training modules into the regular curriculum can effectively address some of the barriers students have identified in tele-clinical learning.
- The unique features of tele-clinical training should guide the formulation of tailored guidelines and supervisory models for the virtual format.
- The evaluation of tele-clinical programmes is most effective when customised tools are developed to incorporate elements of the virtual format of training.

I. INTRODUCTION

The COVID-19 pandemic necessitated a global shift to online platforms in healthcare and education. Higher education institutions implemented online teaching methods, including webinars and interactive sessions (Hameed et al., 2020), while healthcare education adopted tele-medicine as a platform to continue clinical training, ensuring graduate preparedness for professional practice. Speech and language therapy and audiology professionals swiftly utilised tele-therapy, a method previously endorsed by the American Speech-Language-Hearing Association (ASHA, n.d.). This model of service delivery employs synchronous, asynchronous, and hybrid methods, tailored to patient needs and available resources. Beyond the pandemic, tele-medicine programmes offer enduring benefits, including improved access to care for remote and underserved populations, enhanced patient satisfaction and cost-effectiveness (Car et al., 2020). The World Health Organization emphasises the role of tele-medicine in broadening healthcare access, especially for people in remote areas and underserved communities (WHO, 2022).

Tele-clinical programmes, that is, clinical training conducted using tele-therapy have proven to be an effective method in clinical teaching and skills training. Considerable evidence demonstrates the tele-clinical programmes can be successfully used for clinical training, not limiting it to practical skills (Anderson et. al., 2023) but also addressing attitudinal changes (Wearne et. al., 2015) and clinical soft skills (Bramstedt et. al., 2014; Liu et. al., 2022).

Clinical supervision, distinct from classroom teaching, involves case-based learning, critical thinking, and professional behaviour modelling (Council of Academic Programmes in Communication Sciences and Disorders (CAPCSD), 2013). Traditionally conducted face-to-face clinical supervision shifted to tele-clinical supervision during the pandemic, utilizing a variety of strategies (Shawwa, 2023). However, much of the available literature on tele-supervision does not clearly state whether important aspects of clinical teaching, such as supervisor–student relationships and feedback (Kilminster & Jolly, 2000), were considered during programme design.

Evidence suggests that the effectiveness of tele-supervision depends significantly on the qualities of both the supervisor and the supervisee (Martin et al., 2017). Positive supervisory relationships, characterised by structure and support (Martin et al., 2014) are achievable in both virtual and face-to-face formats (Reese et al., 2009). Effective tele-supervision also depends on communication strategies, supervisor availability, and feedback models (Gibson et al., 2007; Snowdon et. al., 2019). Technological barriers, such as poor connectivity and equipment issues, can hinder outcomes, necessitating proactive solutions (Martin et al., 2017; Reese et al., 2009; Tarlow et al., 2020).

Systematic evaluation of student experiences in tele-clinical programmes is essential to understand their effectiveness. Most studies that report on tele-clinical programmes in allied health sciences (e.g., Bacon et al., 2023; Snowdon et al., 2019) and medicine (e.g,. Pit et al., 2021; Wearne et al., 2015) rely primarily on qualitative interview data. Ideally, such qualitative data should be supplemented with the use of a validated and reliable tools specifically designed to evaluate a virtual model of clinical training. This ensures that tele-clinical learning meets the professional standards and training requirements of audiology and speech and language therapy. The objectives of this study were to evaluate student experiences in an undergraduate Speech and Hearing Sciences tele-clinical training programme, and to validate a feedback tool to evaluate similar tele-clinical programmes.

II. METHODS

A. Context and Setting

The BSc (Hons) Speech and Hearing Sciences is a full-time, four-year undergraduate programme. The qualification allows graduates to practice as speech and language therapists or audiologists following registration at the national medical regulatory body. The programme consists of theoretical classroom-based sessions, synchronous to intensive supervised clinical training offered across the four years of study. Speech and Language Therapy (SLT) undergraduates are trained to work with communication and swallowing disorders while audiology undergraduates train in the detection and management of hearing loss, across the life span.

The data gathered in this study reflects experiences from the pandemic period, when clinic and hospital-based teaching was significantly limited. For almost two and a half years since the commencement of the pandemic, SLT and audiology service provision shifted fully into a tele-therapy programme. Simultaneously, students were enrolled in a tele-clinical programme, offered two to three times per week, where they worked with the patient under the supervision of an academic or qualified clinician. All sessions took place using the Zoom platform, which was made freely available to students by the university. Tele-therapy for adult patients requiring SLT services was delivered primarily using a synchronous method and for paediatric clients using an asynchronous or a mixed method. Audiology clinical services were primarily synchronous. The tele-clinical

training was designed to align with the method of tele-therapy (Table 1).

Format	Synchronous Method	Asynchronous Method	Hybrid Method
Tele-therapy	Conducted in real time using audio or video interactive sessions.	Clinical management through stored images and captured data.	Combines both synchronous and asynchronous methods.
Tele-clinical Supervision	Students conduct session. Supervisor joins in. Feedback is provided simultaneously and after session.	Students join session. Supervisor shares recorded videos and relevant clinical information/documentation. Students are given time to reflect.	Students conduct session. Supervisor joins in. Following a short real-time session, a recorded video is watched together. A discussion follows.

Table 1. Modes of Tele-therapy and tele-supervision delivery

The general arrangement of a synchronous session was that the patient, student and supervisor joined the session at a mutually agreed time, but from three separate locations. Material for the therapy session, if required, was developed and shared on the screen by the student. For paediatric clients, parents arranged the toys needed. In audiology, students gathered patient data through interviews and questionnaires with limited use of conventional hearing tests. Auditory verbal training (AVT sessions) in audiology followed a similar format to SLT synchronous sessions. The supervisor remained a silent observer unless intervention was required. In all sessions, supervision concluded with an interactive patient discussion, facilitated by the supervisor using Zoom features such as whiteboard, break out rooms etc.

The evaluation of the tele-clinic programme was conducted using mixed methods by collecting students' perceptions quantitatively (Phase I) and qualitatively (Phase II).

B. Phase 1- Development of Evaluation Tool and Quantitative Feedback

The quantitative evaluation of the tele-clinical programme was conducted with the aim of developing and validating a standardised tool for evaluating similar programmes.

1. Tool Development

As there are no existing tools available to evaluate SLT or audiology clinical programmes, whether face-to-face or virtual, a new evaluation tool was developed based on the Clinical Learning Environment, Supervision and Nurse Teacher evaluation scale (CLES +T) (Mikkonen et al., 2017) and the Nursing Clinical Facilitator Questionnaire (NCFQ) (Espeland & Indrehus, 2003). The resulting 23-item tool, named the Kelaniya Tele-Clinical Evaluation Tool (KeTCET), was designed to map onto three primary domains: pedagogical/learning environment (LE; 9 items), supervisory relationship (SA; 6 items), and telehealth teaching practices (TTP; 8 items). The stem question used here was, how often did you experience this aspect in the online clinical learning sessions provided for the SHS programme during university closure? (Table 2). Participants rated each item on a 5-point Likert scale (0 – never, 1 – rarely, 2 – sometimes, 3 – often and 4 – always).

To enhance face and content validity, a panel of 10 experts in speech and language therapy and/or audiology rated the tool items on a five-point scale for [a] content appropriateness, [b] relevance, and [c] technical accuracy (1 = Very Low, 5 = Very High). Experts could also provide comments to refine the items. The panel scored the items high across all three aspects (mean[a]=4.8; mean[b]= 4.8; mean[c]=4.7). A measure of item relevance, I-CVI (Item- Content validity Index) scores for all items (n=23) were > 0.9. Minor language adjustments suggested were incorporated. The tool was then translated into Sinhala and Tamil and pre-tested with five students (three Sinhala speakers and two Tamil speakers) to confirm clarity and translation accuracy.

2. Study Participants

All 155 SLT undergraduate students in the SLT and audiology programmes who had attended at least 80% of the tele-clinical training sessions were considered eligible for participation in phase I. All eligible students were invited to participate in the study. At the time of data collection, these students were in their second, third, and fourth years of study. The minimum sample size required was calculated based on the recommended item-to-response ratio of 1:5 for factor analysis (Bujang et al., 2012; Gorsuch, 1983), requiring at least 115 responses. A total of 128 students responded (82.6%) to phase I.

	Learning Environment
1.	Professionalism and mutual trust
2.	Enabling identity formation and promoting learning
3.	Developing relationships with supervisor and peers
4.	Optimised logistics and access to an interactive virtual learning platform
5.	Mechanism for constructive and timely feedback
6.	Encouraging autonomy in learning
7.	Promoting teamwork
8.	Equity and equal opportunity to participate and learn
9.	Known session structure
	Supervisor Attribute
1.	Expertise
2.	Ability to integrate taught content with remote clinical learning
3.	Supervision skills including timely feedback
4.	Communication skills to suit virtual training
5.	Preparation
6.	Familiarity (knowing the supervisor through face-to-face contact priorly
	Telehealth Teaching Practices
1.	Patient care and rapport building with the patient with a virtual space
2.	Learning with virtual clinical encounters
3.	Dedicated or adapted resources to suit virtual learning
4.	Clinical documentation development and maintenance for virtual learning
5.	Creating meaningful learning situations
6.	Supervision and personalised attention
7.	Peer learning
8.	Competency marking for virtual learning/ Adapted assessment methods

Table 2. List of 23 items included in the developed tool

3. Data Collection

The participant information sheet and the online-converted 23-item tool were disseminated to participants through a link shared by an independent assistant lecturer, who was not a teacher on the programme, in order to avoid bias and any undue pressure to participants. In the first section of the online response form, participants provided written, informed consent by clicking on the 'I agree to participate' icon. At the time of evaluation, all students had received a minimum of 18 months training through the tele-clinical programme.

4. Data Analysis

The reported frequency of student experience was dichotomised as 'never to sometimes' (0-2) and 'often or always' (3 and 4). The initial analysis involved generating item-wise dichotomised frequencies to identify the aspects most frequently experienced in the offered programme. Subsequently, evidence supporting the validity and reliability of the evaluation tool was obtained through responses, assessed using internal consistency (Cronbach's alpha), correlations between subjectively identified domains, and exploratory factor analysis.

C. Phase II – Qualitative evaluation of the Programme

1. Participants

In Phase II, 10% of the population (n= 13) who participated in Phase I of the study were purposively selected. These students represented the socio-demographic and educational characteristics of the population.

2. Data Collection

The selected participants were invited to participate in a focus group discussion, which was conducted by the researchers in native languages. The discussion lasted for approximately 65 minutes. It was audio-recorded and transcribed verbatim.

3. Data Analysis

Data analysis was guided by the procedure outlined by Braun and Clarke (2006). Transcripts were first coded by two team members (GK and BD) and reviewed by the third (DB). Data collection and analysis happened synchronously, where new codes were identified after each interview. Thematic analysis was inductively performed; themes were not identified a priori but emerged from the data. These themes reflected the subjective domains of the questionnaire but were not limited to them, allowing for the exploration of novel insights.

III. RESULTS

The findings are reported in terms of participants' characteristics, students' perceptions about the programme, and the psychometric properties of the evaluation tool.

A. Participants Characteristics

A total of 128 responded to phase I of the study (82.6%); 122 females and 6 males. The mean age was 24.43 years (SD= l4.24). 98 students were from the Speech and Language Therapy programme and 30 were from the Audiology programme. Out of the respondents, 48 were in their second year, 49 in their third year and 31 in their final year. The composition of the 13 students who participated in the focus group discussion is as follows: 12 females and 1 male student; four students from the second year, four students from the third and five students from the final year.

B. Perception about the Tele-clinical Programme

Quantitative analysis showed that the tele-clinical programme achieved high average scores (>80%) across all domains. Teachers appeared to have fostered professionalism and equity in the virtual learning environment, prepared well, and brought in meaningful learning situations. However, they may need to focus on building better familiarity with the student, encouraging peer learning and reflecting on strategies to better develop clinical skills in the virtual learning environment (Table 3).

Domain	Max Domain Score	Mean Score (SD)	% Score	High-Scoring Attributes	Low-Scoring Attributes
Learning Environment (LE)	36	29.03 (7.6)	80.64%	Professionalism, equity	Supervisor familiarity
Supervisory Attributes (SA)	24	19.6 (5.3)	81.67%	Supervisor preparation	Facilitating peer learning
Telehealth Teaching Practices (TTP)	32	25.7 (7.04)	80.31%	Meaningful learning situations	Clinical skill development via virtual encounters

Table 3. Domains-level perception scores

In the correlational analysis, a strong interconnectedness between the three domains was observed which suggests that improvements or strengths in one domain are likely to support and enhance the effectiveness of the others (Table 4).

Domains	Learning Environment (LE)	Supervisory Attributes (SA)	Telehealth Teaching Practices (TTP)
Learning Environment (LE)	1	0.876 ($p < 0.001$)	0.881 ($p < 0.001$)
Supervisory Attributes (SA)	0.876 ($p < 0.001$)	1	0.863 ($p < 0.001$)
Telehealth Teaching Practices (TTP)	0.881 ($p < 0.001$)	0.863 ($p < 0.001$)	1

Table 4. Correlation between subjective domains of the evaluation tool

In the correlational analysis, a strong interconnectedness between the three domains; LE, SA and TTP was observed which suggests that improvements or strengths in one domain are likely to support and enhance the effectiveness of the others (Table 3).

The qualitative data highlight both the strengths and challenges of the tele-clinical programme. Participants in the tele-clinical programme highlighted various experiences across the three subjective domains, Learning Environment (LE), Supervisory Attributes (SA), and Telehealth Teaching Practices (TTP). These findings help explain the pattern of rating of items observed in the qualitative analysis.

Under LE, students appreciated the time supervisors took to interact with them, fostering a sense of connection. "The interaction with the lecturer was good. We had an opportunity for that" (P17). However, many noted that the lack of structure in sessions hindered effective task management. "If it were more structured, and if we had a better plan to submit documents within like two hours

after the session, that would have been ideal" (P94). Virtual clinics also presented environmental challenges, with frequent disruptions due to background noise or technical issues. "Sometimes there was so much noise we couldn't focus" (P52). Additionally, students had to creatively adapt therapy methods for the virtual format, often requiring supervisor feedback. "We really had to think of different ways to test and manage hearing issues" (P49).

In the SA domain, participants valued supervisors who provided context before and after sessions, which clarified the learning process. "Supervisors gave us a description about the client before they came into the session and then did the same after the session" (P3). Supervisory styles had a significant impact on student confidence. For example, students noted that when supervisors turned on their video cameras, their visible presence positively influenced their performance.
"Some supervisors turned on their videos. It made us feel confident" (P23). Students also expressed a need for independent practise opportunities, even within the limitations of tele-clinics. "Supervisors allowed us to do exactly what we did in FTF sessions" (P19).

For TTP, students appreciated resources like a shared material library, which facilitated session preparation. "The best part of it was the material library that the staff made for us" (P12). However, connectivity issues, such as poor internet connections and power outages, often disrupted sessions. "It was terrible when my clinical partner had a very poor connection" (P53). Technical limitations, such as using small phone screens or faulty laptops, further impeded learning. "Some didn't have laptops and used phones. The screen is small so we can't see" (P19). Patient-related factors, like poor camera positioning or noisy environments, added stress to students. "Parents kept the tab on a table, then sat on the floor to play. So, we couldn't see anything" (P23).

In summary, it appeared that while students valued interaction, feedback, and innovative resources, they faced issues with session structure, connectivity, and technical limitations. Supervisory presence and adaptability were crucial for building confidence and overcoming challenges.

Item		Component 1
SA3	Supervision skills including timely feedback	.923
SA2	Ability to integrate taught content with remote clinical learning	.900
SA1	Expertise	.893
LE5	Mechanism for constructive and timely feedback	.888
SA4	Communication skills to suit virtual training	.884
TTP6	Supervision and personalised attention	.880
LE8	Equity and equal opportunity to participate and learn	.876
TTP5	Creating meaningful learning situations	.874
LE3	Developing relationships with supervisor and peers	.871
SA5	Preparation	.871
TTP1	Patient care and rapport building with the patient with a virtual space	.864
TTP4	Clinical documentation development and maintenance for virtual learning	.861
TTP2	Learning with virtual clinical encounters	.859
LE2	Enabling identity formation and promoting learning	.858
LE6	Encouraging autonomy in learning	.856
TTP7	Peer learning	.856
TTP3	Dedicated or adapted resources to suit virtual learning	.851
LE7	Promoting teamwork	.851
LE9	Known session structure	.850
TTP8	Competency marking for virtual learning/ Adapted assessment methods	.842
SA6	Familiarity (knowing the supervisor through face-to-face contact priorly	.836
LE1	Professionalism and mutual trust	.812
LE4	Optimised logistics and access to an interactive virtual learning platform	.775

[a] Extraction Method: Principal Component Analysis only one component was extracted. Cannot be rotated.

Table 5. The Principal Component Analysis of the 23 items of the evaluation tool

C. The Psychometric Properties of the Tool

The internal consistency of the 23 items, as measured by Cronbach's alpha, was very high ($\alpha = 0.98$). While a high alpha value may indicate internal consistency, it can also suggest item redundancy. To assess this, inter-item and item-total correlations were examined. All items showed acceptable item-total correlations (>0.3), suggesting minimal redundancy. Although only one factor was extracted in the principal component analysis (Eigenvalue = 17.12), varimax rotation was initially applied during the exploratory analysis phase to evaluate whether multiple factor structures might emerge. This step was performed prior to confirming the single-factor solution. Since all items loaded strongly (>0.7) onto a single component and no additional eigenvalues exceeded 1 (Table 5), the use of rotation was ultimately deemed unnecessary, and only the unrotated solution is reported. Although the tool was originally structured around three subdomains (Learning Environment, Supervisory Attributes, and Telehealth Teaching Practices), exploratory factor analysis revealed a single

latent factor structure. This suggests that in the context of tele-clinical learning, these domains may not function as distinct constructs but rather as interrelated facets of a unified student experience. While this does not contradict theoretical expectations, it highlights the integrated nature of tele-clinical learning, where pedagogical, supervisory, and teaching practice components coalesce in a single virtual training environment.

The data gathered for this study and analysed above can be accessed by readers for viewing purposes only, from the Figshare data repository at https://doi.org/10.6084/m9.figshare.28116863 (Atapattu-Bakmeewewa et. al., 2025).

IV. DISCUSSION

This study evaluated undergraduate SLT students' experiences in a tele-clinical programme revealing positive outcomes with domain scores exceeding 80%. Qualitative insights highlighted professionalism, equity and meaningful learning to be the strengths of this programme. The validated 23-item tool demonstrated strong psychometric properties, with high reliability (α = 0.98) and a single-factor structure, supporting its adaptability.

A. Student Experiences in a Tele-Clinical Programme

Although prior studies have shown a preference for face-to-face clinical teaching (Bacon et al., 2023), findings from our study add to growing evidence that support a shift in thinking. Our tele-clinical programme was implemented over an extended period and was well-established at the time of evaluation. This may have contributed to higher acceptance scores reported. Evaluating the effectiveness of virtual clinical training has often relied on either qualitative research (e.g., Gammon et al., 1998; Gibson et al., 2007) or quantitative surveys (e.g., Heckner & Giard, 2005).

This study employed a robust mixed-methods approach, analysing quantitative data from 128 participants and complementing it with qualitative insights from 13 randomly selected individuals. High ratings across the 23 evaluated items, with over 80% agreement, suggest that delivering an effective tele-clinical programme is feasible, even in resource-limited contexts. Qualitative findings, however, highlight the importance of thorough planning and holistic design, also the need to integrate elements from multiple domains.

Our findings indicated that students had similar expectations in the virtual programme as those in face-to-face training, particularly support for developing online materials. Learning material such as scaffolds and scripts have been identified by students as enablers of tele-clinical learning (Bacon et al., 2023). Gracious et al. (2024) report that the versatility of virtual environments may at times lead to unrealistic expectations, such as improved grades or increased institutional support. Unmet expectations may in turn be associated with dissatisfaction with the virtual tele-clinical concept.

We therefore comprehensively discussed student expectations before the programme delivery to enhance the acceptance and effectiveness of virtual clinical programmes. Technical disruptions, reduced reading of non-verbal cues, background noise, patient camera placement and limited IT literacy were shared challenges (See, Gibson et al., 2007; Tarlow et al., 2020). Training (Pit et al., 2021) and pre-session briefings (Heckner & Giard, 2005) are considered effective strategies to mitigate such barriers.

There is evidence that supervisory familiarity, that is prior supervisor contact, improves outcomes in tele-clinical programmes (Martin et al., 2018). Supervisor familiarity was included as an item in our tool but was not a high-scoring attribute possibly because our tele-clinical programme was taught by permanent academic staff, already familiar to the students. As a result, students may have focused more on the other attributes. Participants, however, emphasised the need for supervisory traits that foster supervisor-student engagement. This aligns with findings from Reese et al. (2009), who reported no significant differences in supervisory satisfaction between virtual and face-to-face formats, if the supervisor maintained a supportive attitude.

Students in our study not only advocated for equal participation and autonomy within the tele-clinical programme (Gracious et al., 2024; Tarlow et al., 2020) but also used it as a descriptor when differentiating between different supervisory styles. This reflects findings by Miller and Gibson (2004) who emphasised the importance of power balance and involvement in clinical supervision, which may hold even greater significance in virtual settings. The study further suggests that the successful delivery of tele-clinical programmes depends on trainee characteristics; more mature students or those with prior face-to-face experience, may adapt better (Martin et al., 2023; Reese et al., 2009). Integrating virtual clinical modules into undergraduate curricula presents a viable strategy for providing students with essential tele-clinical experience. This would additionally address evolving training demands, support the development of competencies among future therapists and contribute to a

sustainable transformation in patient access to healthcare services (Iancu et al., 2020; Jeffries et al., 2022).

Our findings indicate that educators overlooked certain elements, such as promoting peer learning. This highlights the importance of robust planning in tele-clinical practice. Without it, critical elements such as opportunities for continuing professional development (CPD), skills around ethics, concepts of multidisciplinary collaboration and patient and family advocacy may be inadvertently overlooked, especially in simulated environments (Jeffries et al., 2022). Such elements if missed, can lead to a potentially negative impact on the long-term professional growth of learners. Recognizing and addressing the pitfalls in tele-clinical practice, as applicable to the setting in which it is delivered, is a crucial step to optimizing its effectiveness. Tutors must assess training needs, patient suitability, human resources, and available infrastructure for both teachers and trainees, during programme development. Research shows that integrating synchronous (live) and asynchronous (self-paced) learning helps make tele-clinical programmes more effective (Perle & Zheng, 2024; Snowdon et al., 2019).

The unique features of tele-clinical training should guide the formulation of context-specific guidelines and supervisory frameworks (Gibson et al., 2007), taking in to account the unique training requirements of allied-health professions such as speech and language therapy, audiology, occupational therapy, and physiotherapy (Bacon et al., 2023), all of which require a combination of direct and reflective supervision.

B. Development of the Evaluation Tool

Our findings suggest that the success of a tele-clinical programme relies on the integrated consideration of the pedagogical environment, supervisory attributes and virtual teaching practices. Data showed these aspects appeared to be highly complementary to each other as the statistical analyses strongly suggest that they are highly interconnected and strongly correlated. The 23-item single-domains tool, which we wish to name as KeTCET (Kelaniya Tele-Clinical Evaluation Tool), has provided basic but strong psychometric evidence as a tool for evaluating tele-clinical programmes. The KeTCET aligns closely with established practices in educational tool design and draws on the strengths of existing instruments in clinical education evaluation. Its 23-item structure is consistent with tools like the (CLES+T) scale, which features 34 items across subdomains such as pedagogical environment and supervisory attributes (Saarikoski et al., 2008), and the Manchester Clinical Supervision Scale (MCSS), which comprises 26 items to evaluate supervision quality (Winstanley & White, 2011). The compact structure of KeTCET balances comprehensiveness and practicality, making it an efficient yet thorough evaluation tool.

KeTCET's development followed a rigorous validation process involving item selection from already existing validated instruments and expert feedback for content appropriateness, cultural relevance, and technical accuracy. This aligns with recommended methodologies for reliable tool development (DeVellis & Xie, 2021). The tool underwent pilot testing to ensure clarity and relevance, a process comparable to the development of other notable tools like the Surgical Mini-CEX and the Physician Work Environment Survey (Friedberg et al., 2014; Norcini et al., 2003). KeTCET demonstrated high internal consistency ($\alpha = 0.98$), surpassing the widely accepted reliability benchmark (Nunnally, 1978) and factor analysis confirmed a single-factor structure (Eigenvalue = 17.12, 74.44% variance explained), supporting its psychometric robustness (Kline, 1999).

The domains assessed by KeTCET, pedagogical environment, supervisory traits, and virtual teaching practices, mirror the constructs of established tools but are uniquely tailored to address the challenges of tele-clinical education. By integrating these domains synchronously, KeTCET effectively evaluates the complexities of virtual supervision, bridging a gap left by tools primarily designed for face-to-face settings. Its strong psychometric properties establish it as a reliable and effective instrument for assessing tele-clinical programmes, particularly in speech and hearing sciences.

While existing tools like CLES+T and MCSS are used successfully to evaluate traditional clinical education and supervision, KeTCET extends this utility to tele-clinical settings. Its tailored approach involving a synchronous integration of pedagogical elements, supervisory attributes, and virtual teaching practices positions it as a highly appropriate tool for evaluating tele-clinical programmes. The initial psychometric evidence supporting KeTCET underscores its potential to advance the evaluation of tele-clinical supervision, ensuring robust assessments that inform programme development and improvement.

Beyond individual programme evaluation, KeTCET shows potential as a comparison tool for checking institutional programmes and as a starting point for changes in clinical education. Its organised framework could help make evaluation practices more uniform across institutions and different settings. This may lead to fairer and more consistent assessments in tele-clinical training.

C. Future Directions

While the study highlights the potential use of telehealth for medical education, further improvements could consider including supervisor experiences for a more comprehensive perspective. Future work can also expand to involve diverse programmes and evaluating long-term impacts of tele-clinical programmes. Validation in varied contexts and exploration of peer learning mechanisms would enhance its applicability and effectiveness in clinical training.

V. CONCLUSION

Tele-clinical supervision programmes offer a viable solution to train healthcare professionals, especially in resource-limited settings. This study shows their potential for high student acceptance and effectiveness when systematically designed. Addressing pedagogical environments, supervisor traits, and virtual teaching practices with synchronous and asynchronous elements is crucial. The validated 23-item tool (KeTCET) provides a strong framework for the evaluation of tele-clinical programmes, paving the way for future longitudinal research on long-term outcomes.

Notes on Contributors

Dinushee Atapattu-Bakmeewewa, Bhagya Devagiri, Gayanthi Kodituwakku and Madawa Chandratilake contributed to the conceptualization and implementation of this research and have also contributed to the writing of this manuscript.

Ethical Approval

This study was reviewed and approved by the Ethical Review Committee of the Faculty of Medicine, University of Kelaniya, Sri Lanka (Ref. no. P-84-08-2021).

Data Availability

The data set generated for the quantitative part of this study is available at the following URL: https://doi.org/10.6084/m9.figshare.28116863.

Acknowledgement

The authors wish to thank all students for their participation and Emeritus Prof. Pathmeswaran for his guidance in the analysis of data.

Funding

This project and manuscript did not receive any funding.

Declaration of Interest

None of the authors has any conflict of interest or financial interest to declare.

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