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Adaptation and modification of the professional identity formation scale for postgraduate trainees in basic health science: a mixed method study

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Abstract

Background The professional identity formation (PIF) of postgraduate trainees in basic health sciences is critical to their educational journey. Yet, appropriate measurement tools are lacking. This research aimed to adapt and modify an existing PIF scale to assess the professional identities of postgraduate basic health sciences trainees.

Methods A mixed-method study was conducted to validate a modified PIF scale. An instrument was developed following AMEE Guide 87 (A. R. Artino et al.) (1). Seven medical educationalists and basic health science postgraduate supervisors established its content validity and reliability. Cognitive interviews were conducted with 15 participants, and the tool was validated through the Delphi technique. Piloting was undertaken on a simple random sample of 500 postgraduate trainees. Psychometric analyses, including structure factor analysis, internal consistency testing, and qualitative content analysis, were used to evaluate the modified scale.

Results Five factors related to professional identity formation were identified: "Commitment to Professional Identity, belonging and Values," "Pursuit of Knowledge and Excellence," "Professional Growth and Collaboration," Personal Growth and Reflection," and "Confidence and impact." The modified PIF scale demonstrated robust psychometric properties, including a well-defined factor structure, significant reliability, and high internal consistency. With a Cronbach alpha 0.97, the PIF scale's five kept variables accounted for 99.99% of the variance.

Conclusions The study found the modified PIF scale to be a reliable tool for assessing the professional identities of postgraduate trainees in basic health sciences. It developed a 50-item tool with five valid factors to evaluate professional identity for postgraduate trainees.

Keywords Professional identity formation, Postgraduate trainees, Basic health sciences

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Background

Professional identity refers to the understanding and reinterpretation of communications within a professional working environment and aligning one's behaviour with the standards and culture of a particular professional [1]. Developing a professional identity is a continuous process that begins in the early stages of education and continues throughout one's career. Research into doctoral students' academic success and happiness is growing, but their professional identity remains less understood. Developing a professional identity involves integrating personal and professional aspects [8]. It involves continuous learning and growth, enabling educators to enhance their teaching practices, expand their pedagogical knowledge, and stay abreast of current educational trends and research [2]. A strong professional identity promotes best practices, effective collaboration, and improved patient outcomes. Healthcare providers with well-formed professional identities deliver more empathetic, responsive, and patient-centered care [3]. Postgraduate "basic health sciences" encompass biomedical research, clinical laboratory science, and medical education in anatomy, physiology, biochemistry, and pharmacology, supporting medical knowledge and clinical practice. Basic science is essential in health professions education (HPE) as it provides the scientific principles necessary for clinical practice [4][5]. Recognizing the role of basic scientists in health professions education is important, as they are responsible for teaching fundamental concepts in areas like anatomy, biochemistry, and microbiology in medical schools and health training institutions. Their role as a Researcher: Basic scientists research to advance knowledge in their respective fields [6]. As Curriculum Developers: Basic scientists and clinical educators collaborate to develop curricula that integrate basic science with clinical applications, providing a comprehensive education for students in patient care. As Mentors: They mentor postgraduate trainees in research, career development, and professional growth, fostering critical thinking skills and a strong professional identity [6]. This understanding can enlighten curriculum development, mentorship programs, and strategies for promoting professional growth among trainees[7, 8]

The concept of professional development can be viewed from various perspectives. One significant paradigm perceives it as a process that helps professionals address gaps in their knowledge and skill sets. In this sense, professional development is seen as a means to overcome deficiencies in a postgraduate trainee's level of performance [9]. However, due to the complexity and multidimensionality of this process, suitable measurement criteria are not always available [10]. The main theoretical frameworks and perspectives that support the investigation of professional identity development are discussed by Tabatabaei et al. [11]. It explores many theories, emphasizing how they relate to the situation of postgraduate trainees in the basic sciences [12]. Tajfel's social identity theory suggests that personal identity is shaped by group membership and its associated value. Professional identity is shaped by experiential learning, reflective practice, and social interactions. Key theories include Communities of Practice and Social Cognitive Career Theory (SCCT), which emphasize the role of social and contextual factors in learning and identity formation. SCCT emphasizes how individual behaviors interact with environmental factors, particularly through observational learning and self-efficacy, but may overlook some personal and contextual variations [13][1]. Professional identity is shaped by defining roles and values within specific contexts, influenced by social connections, experiences, and education [14]. The framework centers on professional identity construction, where individuals define their identities, responsibilities, and values within their work fields [15].

Moreover, different social and professional groups may have distinct views on what it means to be a professional, and these concepts and meanings can evolve [16]. Despite its impact, students of basic health sciences often lack awareness of the construct and its influence on their professional lives because most of the work on PIF has been done in the clinical sciences [9, 16]. The instrument adapted for this study was initially utilized on medical students in their clinical and pre-clinical years. Results from the tool selected for this study indicate that an exploratory factor analysis was performed on the Developing Scale of Tagawa, revealing a 5-factor structure that accounted for 59% of the variance. All 5 factors were included as anticipated attributes of medical doctors during the item development phase. Notably, all 15 items demonstrated a component coefficient exceeding 0.4, contributing to a cumulative percentage of 59.3% for all five factors. The Cronbach's alpha for the 15 items was 0.72, indicating acceptable internal consistency.

The Professional Identity Scale (PIS) was adapted and modified. An analysis of variance (ANOVA) indicated a statistically significant difference in mean PIS scores across the five years ($p < 0.05$). However, this study aims to comprehensively investigate professional identity formation (PIF) among postgraduate trainees in basic health sciences. It seeks to address the existing gap in the literature and provide valuable insights to inform the creation of more effective training programs and support systems for postgraduate trainees in basic health sciences. The main objectives include determining the content validity, respondent validity, and construct validity of a modified tool for measuring PIF in postgraduate trainees. The research questions are:

What is the content validity of the postgraduate PIF tool?
What is the respondent validity of the postgraduate PIF tool?
What is the construct validity and reliability of the mixed-method tool used to measure PIF?

This research aims to refine a questionnaire to capture the experiences of postgraduate trainees in basic health sciences. The goal is to evaluate how curricula, mentorship, and institutional support influence the professional identity of future healthcare leaders, enhancing their educational experiences and commitment to the field [17].

Moreover, qualitative study paradigms have explored PIF widely, emphasizing the need for more quantitative analysis with psychometric-based measures [16]. Existing instruments for evaluating professional identity lack psychometric validation for postgraduates in basic science [18]-[19]. The qualitative part of this study will explore the experiences and perspectives of postgraduate trainees in basic health sciences as they navigate and adapt their professional identities.

Methods

A research methodology called instrument development multiphase mixed method study design was adopted, which involved sequential exploratory qualitative and quantitative components. (Additional file#3: annex I). The study duration was six months, approved in the 135th meeting of Khyber Medical University AS&RB held online on 31st /05/2023 (ASRB002059/AM/IHPE).

This study was conducted at KMU, Khyber Pakhtunkhwa (KPK), Pakistan. All the institutes of basic sciences, the Institute of Basic Medical Sciences, Institute of Public Health, and Institute of Health Professions Education & Research, were included in the study. Sampling was done according to the steps in the AMEE guide 87 [20]: Instrument Development involved medical educationalists, trainees, and supervisors of all basic health sciences postgraduate programs offered by Khyber Medical University. The tool underwent a three-phase design and validation process, adhering to the principles for instrument development established by AMEE guide 87 [20], as shown in Figure 1. Items were merged from multiple established questionnaires, and new items were developed based on theoretical constructs. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were performed sequentially. EFA was used to explore the underlying factor structure without prior hypotheses, suitable for integrating items from diverse sources. CFA then validated this structure, ensuring robust data representation and confirming the factorial validity of the instrument [21].

Purposive sampling, a non-probability sample technique, was used for expert validation and cognitive interviews, in which the members were hand-selected based on the inclusion criteria. Simple random sampling was used for pilot testing.

Ten participants were included for expert validation of the modified and developed items, while 30 were selected for cognitive interviews [20]. As per the rule of thumb, According to the convention, there should be a minimum of 10 participants per scale item or a 10:1 ratio between respondents and items [22]. Ten participants per item

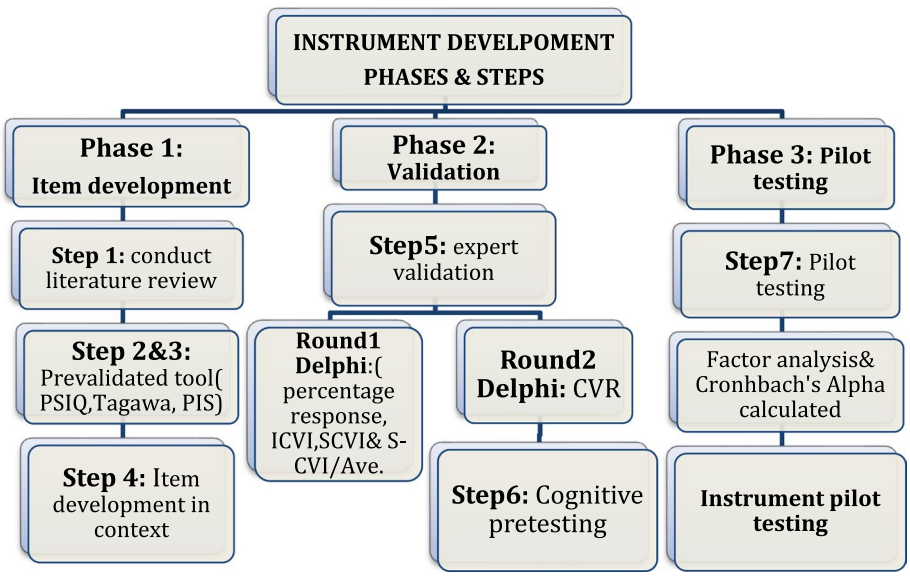

Fig. 1 Phases and Steps for instrument development (Mixed method research)

construct were used to calculate the sample size with 10% attrition [22]. So, for 50 items, the sample size for piloting was 500 participants with 10% attrition, which came out to be 450.

Phase 1: instrument design/item development

The literature review was conducted using the Haig and Dozier framework, which offered a systematic approach to synthesizing and analyzing existing research within the field. The protocol for literature searching was thoroughly outlined in BEME Guide No. 3 [23]. This framework facilitates a structured methodology for navigating the research landscape, enabling a comprehensive understanding of current studies. A systematic approach allows researchers to critically assess scholarly work, enhancing future research and addressing literature gaps. This evaluation process is essential for advancing knowledge [23, 24]. Scale questions were produced from the literature gathered from PubMed, Google Scholar, and other sources to discover publications on developing tools for PIF in medical and basic health. The search process commenced by utilizing Boolean operators to explore various combinations. All keywords by the Boolean operator "AND" and "OR" Search on PubMed, Eric, Science Direct, and Google Scholar for the above-mentioned search strategy included Journal articles, reviews, and systematic reviews, in the last 10 years, and English. Initially, titles were reviewed, followed by abstracts for those that matched. Articles aligned with the research objectives were eligible for inclusion. Further criteria refined the selection, leading to a comprehensive examination of full texts. The chosen articles were organized in Mendeley for reference management. A manual review assessed their relevance based on the inclusion criteria in the title, abstract, and conclusion. The full texts of the most relevant articles were examined and included. The already validated tools PSIQ and Tagawa [25] were used, adapted, and modified for postgraduate trainees in basic health sciences. The survey's design included closed-ended questions with predefined response options. (Additional file# 3: annex II)

Phase 2: judgmental evidence (validation)

The items' accuracy in reflecting the scale's construct was assessed through instrument validation and content validity. We employed a two-stage Delphi technique to ensure the content's validation [26]. For the Delphi survey, Experts identified for validation hold a Master's degree in health professions education and have experience in the subject field. Ten experts from KMU were selected for expert validation of the modified and developed items. A set of documents, including a cover letter, consent form, and questions, was sent to twelve specialists in round one. The cover letter explained the criteria for selecting experts, the research background, and how to rate the survey items. Participants were instructed to evaluate the significance of each item on a 5-point Likert scale concerning the construct. (5. Highly relevant or representative, 4. Relevant or representative, 3. Neutral, 2. Somewhat relevant or representative, 1. Not relevant or representative.) [27]. Furthermore, the panellists were instructed to provide any remarks they may have in the designated comment area. A questionnaire was concluded with an open-ended question that encouraged panellists to propose any additional components. Data were analysed with descriptive statistics such as means, I-CVI, S-CVI, and CVR using Statistical Package for Social Sciences (SPSS) version 21. Delphi studies employ a certain threshold of concurrence among specialists to assess consensus within a group of experts. The utilization of specialists quantitatively assesses the consensus. The statistical measures of the field include the mean, median, mode, standard deviation, and percentage agreement [28]. In round two, the questionnaire was sent to panellists who used Google Forms to respond in the first round. The experts were directed to classify each item according to its clarity and significance. To determine the relevance, participants were instructed to evaluate the items using a 5-point Likert scale, considering their relevance to the concept. To provide clarity, a 3-point Likert rating system was utilised. (1 = not straightforward, 2 = item needs revision, and 3 = highly clear; this indicates whether something is clear.). The study ended after reaching a consensus after completing the second phase. The items' content validity index (I-CVI) and the composite score for the content validity scale (S-CVI/Ave) were computed using the item's relevance to the construct in the previous round. Items with an I-CVI of 0.78 were excluded, items with an I-CVI ranging from 0.78 to 0.90 were modified, and items with an I-CVI of 0.90 were included.

The Delphi technique was used, and each item was revised for structure, relevance, and clearness. The dismissed questions were removed, and unclear phrasing was modified [29]. The content validity ratio (CVR) was determined using the Lawshe formula, which analyses the significance of survey items [30]. The items with a CVR between 0.60 and 0.80 were modified, while those with values below 0.60 were eliminated from the instrument. Cognitive interviewing approaches were used to investigate how postgraduate trainees of basic health sciences comprehend the meaning of survey items [31]. Participants were interviewed through Zoom meetings. Data were transcribed and analyzed using the Braun and Clark framework. which comprises six steps, Step 1: Familiarization with data, step 2: Initial codes, step 3:

Generating themes, step4:Reviewing theme, step5: Defining and naming theme,step6: Interpretation and reporting [32]. The study followed GRAMMS (Good Reporting of a Mixed Methods Study) guidelines for mixed-method research [33].

Phase 3: pilot testing

Participants were selected based on inclusion criteria and provided written informed consent. Demographic data was collected on a paper pro forma and through Google Forms. Two frequently used pilot testing methods involve assessing the instrument's construct validity and internal consistency [20]. Variables were classified into several dimensions using construct validity and assessed using factor analysis. The instrument was created through iteration. Its construct validity was verified by conducting exploratory factor analysis, followed by confirmatory factor analysis [20]. Reliability determined the internal consistency of the tool. Data was gathered from a sample of five hundred postgraduate trainees using Google Forms and a traditional paper-based approach. Factor analysis was done to assess construct validity. A combination of EFA and CFA was used to observe the scale's elements. The KMO test and Bartlett's test of sphericity were used to guarantee the sample size was appropriate for exploratory factor analysis (EFA). Following this, Confirmatory factor analysis (CFA) was implemented using AMOS (version 21.00) to authenticate the factor construction of the removed factors [34].

Data collection instrument

The Modified Professional Identity Scale is given in (Additional file# 3: Annexe II)

Ethical concerns

To ensure informed and voluntary consent, participants received a description of the investigation's design and methodology and were informed of their right to leave at any time. The data were securely password-protected, backed up regularly, and stored in a safe place accessible only to the researcher. The researcher will hold data for a maximum of five years, after which it will be discarded.

Results

The results of every step of the study are mentioned in Table 1

Phase 1: instrument design/item development

Items were established during phase one of the instrument design. After removing items and identifying duplicates in the PSI/PSIQ and Tagawa, 63 items were classified and identified as belonging to the category of PIF in basic health sciences.

Phase 2: judgmental evidence (validation)

The response rate for the validation of instruments in the initial round of the Delphi survey was 7/8. Items that met the predefined criteria and had an 80% consensus among experts were eliminated, while things that met the fair and good standards were selected for further evaluation in round two. (Additional file#1: annexe III). The response rate for the second round was 84%, with 7 out of 8 participants responding. The experts reached a consensus of 90% agreement on the items; hence, the Delphi rounds were ended. The S-CVI/Ave values were 0.83. By applying predetermined criteria for I-CVI and CVR, two components were eliminated, thirteen items were modified, and the remaining ones were retained. As a result, the tool was reduced to 50 items at this stage (Additional file# 1: Annexe IV). After gathering responses from fifteen people (n 15) during cognitive pretesting of the 50-item measure, ten items were rephrased with minor modifications, and one item was eliminated. Table 2 displays the findings from phase two (Additional file 1: Annexe VI)

Table 1 Steps in the development of the professional identity formation scale

Steps in the development of the professional identity formation scale for postgraduate basic health sciences	
Steps for instrument development	**Results**
a. Literature search	PubMed, Google Scholar, Eric, Science Direct (Haig and Dozier framework)
b. Content Specification & Item Generation	Pre-validation tool (Tagawa & PSIQ)
c. Adaptation and Modification of the existing tool	Modified tool with 63 items (PIF tool for basic health sciences postgraduates' trainees
d. Expert validation (Delphi procedure = two rounds; *N* = 7, *N* = 7)	Conducted in two rounds with medical educationalists and subject experts. Out of 63 items consensus was made on 50 items, and 13 items were removed. The value of S-CVI/Ave was 0.83
e. Cognitive interviews (*N* = 15)	50 items were assessed based on responses of the participants 10 items were rephrased: wording changed and adjusted to basic health sciences context
f. Instrument piloting (*N* = 500/500) Factor analysis	EFA and CFA showed a good fit. The significant value of Cronbach's Alpha was 0.84 to 0.97, suggesting good internal consistency of the tool

Thematic analysis

The results and findings from the thematic analysis are given in Table 2.

Phase 3: piloting

The piloting survey comprised two sections: demographic data and a set of 50 questions assessing professional identity formation (PIF) using a 5-point Likert Scale. Detailed demographic characteristics are summarized in Table 3.

Table 2 (Themes, sub-themes and representative quotes.)

Theme	Sub-Theme	Representative Quotes
Theme 1: Understanding	Item Wording and Structure	"*Item 12 may be redesigned separately and divided into two parts for better clarity, one qualification, and other test results.*"**(Participant-1)**
	Terminology and Clarity	*"Consider using 'new guidelines' or 'research-practice gap for patient and societal benefit' in item 37.***" (Participant-4)**
	Diverse Perspectives	*"The researchers recognized that various factors could influence participants' views and opinions, making it important to consider the diverse perspectives in the study.*"**(Participant-5)**
Theme 2: Judgment	Question Relevancy	*"Item 12 required rewording to differentiate between 'good test result' and 'qualification' as they have different meanings and could be confusing to the reader.*" **(Participant-1)**
	Redundancy and Similarity	*"Items 1 and 2 are quite similar. Suggested modification: Consider rephrasing item 2 to avoid redundancy with item 2.*"**(Participant 2)**
Theme 3: Response	Comprehensive and Well-Defined	*"The questionnaire is comprehensive and well-defined, making it an enjoyable reading experience.*"**(Participant 6)**
	Clarity and Participant Benefits	*"Item 37 would benefit from rephrasing to address 'new guidelines' or explore the gap between recent research and its implementation in clinical practice for the benefit of patients and society."* ***(Participant* 11)**
Theme 4: Adequacy of Content	Coverage of Aspects	"*The questionnaire covers all aspects of professional identity formation effectively.*"**(Participant 12)**
	Language and Target Population	"*The language used was academic and appropriate for the target population, allowing readers to grasp the researchers' intentions clearly.*"**(Participant 12)**

Table 3 Demographic characteristics of participants

	Category	Number	Percentage
Gender distribution	Male	205	40.0%
	Female	308	60.0%
Respondent Age	25 years and below	272	53.0%
	26 to 35 years	164	32.0%
	36 to 45 years	27	5.3%
	46 to 55 years	9	1.8%
	56 years and above	41	8.0%
Qualification distribution	M.Sc	19	3.7%
	MHPE scholars	137	26.7%
	MPhil scholars	241	47%
	PhD	62	12.1%
	MHR	54	10.5%
Profession distribution	Demonstrator/lecturer	126	24.6%
	Registrar	21	4.1%
	Assistant professor	115	22.4%
	Associate professor	74	14.4%
	Not working	113	22.0%
	Professor	64	12.5%

The response rate for this phase in the pilot testing was 95% (n 470/500). The Kaiser- Meyer Olkin Measure of Sampling adequacy (KMO) yielded a value of 0.9954, indicating a high level of adequacy. Additionally, the results were found to be statistically significant result (approximately chi-square = 17799.554; degrees of freedom = 1225; $p = 0.000 < 0.05$) from Bartlett's test of sphericity, the sample size was acceptable for factor analysis. According to the scree-plot graphic, four is the ideal number of PIF scale variables, as shown in Figure 2.

EFA model for the PIF-Scale

The five elements reserved in the PIF scale was intended for 99.99% of the variance (Additional file#1: annex V). All the factor loadings were higher than 0.400, between 0.51 and 0.84. The EFA was done by extracting factors with eigenvalues more than 1.0, using the basic component of the analysis, and then rotating the factors using the varimax rotation [35]. The Varimax technique identified five factors with acceptable loading values. The rotational component matrix helps analyze how distinct items group together depending on underlying variables and provides insight into the latent constructs in the data.

Confirmatory Factor Analysis (CFA)

Goodness of fit of the CFA model for the PIF-Scale

The CFA model generated 14 items associated with the five elements of PIF "Commitment to Professional Identity, belonging and Values" (15 items; factor loadings: 0.436–0.757), "Pursuit of Knowledge and Excellence," (8 items; factor loadings: 0.499–0.646), "Professional Growth and Collaboration," (7 items; factor loadings: 0.486–0.707), "Personal Growth and Reflection," (for those six items; the factor loadings: 0.461–0.767), "Confidence and Impact" (6 - items; factor loadings: 0.425–0.552). The CFA model is shown in Figure 3, which shows 42 items on the scale formed. The results of the fit indices of the tool specify that the values of absolute and incremental fit indices resemble a good fit model (Table 4).

Reliability for a CFA model

The correlation between the studied constructs was statistically significant ($p< .01$). The Cronbach's Alpha coefficient ranged from 0.84 to 0.97, indicating a high level of internal consistency for the tool. The initial exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) models for the Professional Identity Formation (PIF) scale are deemed to be reliable in assessing participants' professional identity since they demonstrate satisfactory levels of reliability.

Discussion

Measuring professional identity is challenging due to the lack of well-developed assessment methods and the constructs' complexity. So, for basic health sciences postgraduate trainees PIF, we modified a validated survey by PIS, PSIQ [36], and Tagawa [37]. The study found recurring themes in participants' perceptions of PIF, offering insights into personal growth, values, ethics, and collaboration. This study aimed to examine how PIF develops during different stages of basic health sciences education and explore the factors contributing to or inhibiting its development. It involved developing the PIF scale through a multidimensional, multi-phased, rigorous methodology comprising a theoretical framework, a

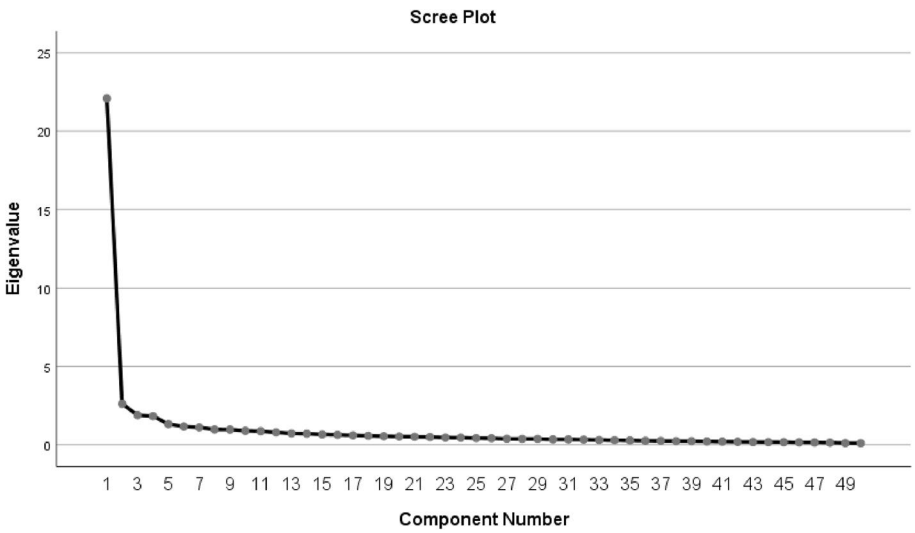

Fig. 2 Scree plot for PIF scale (factor analysis)

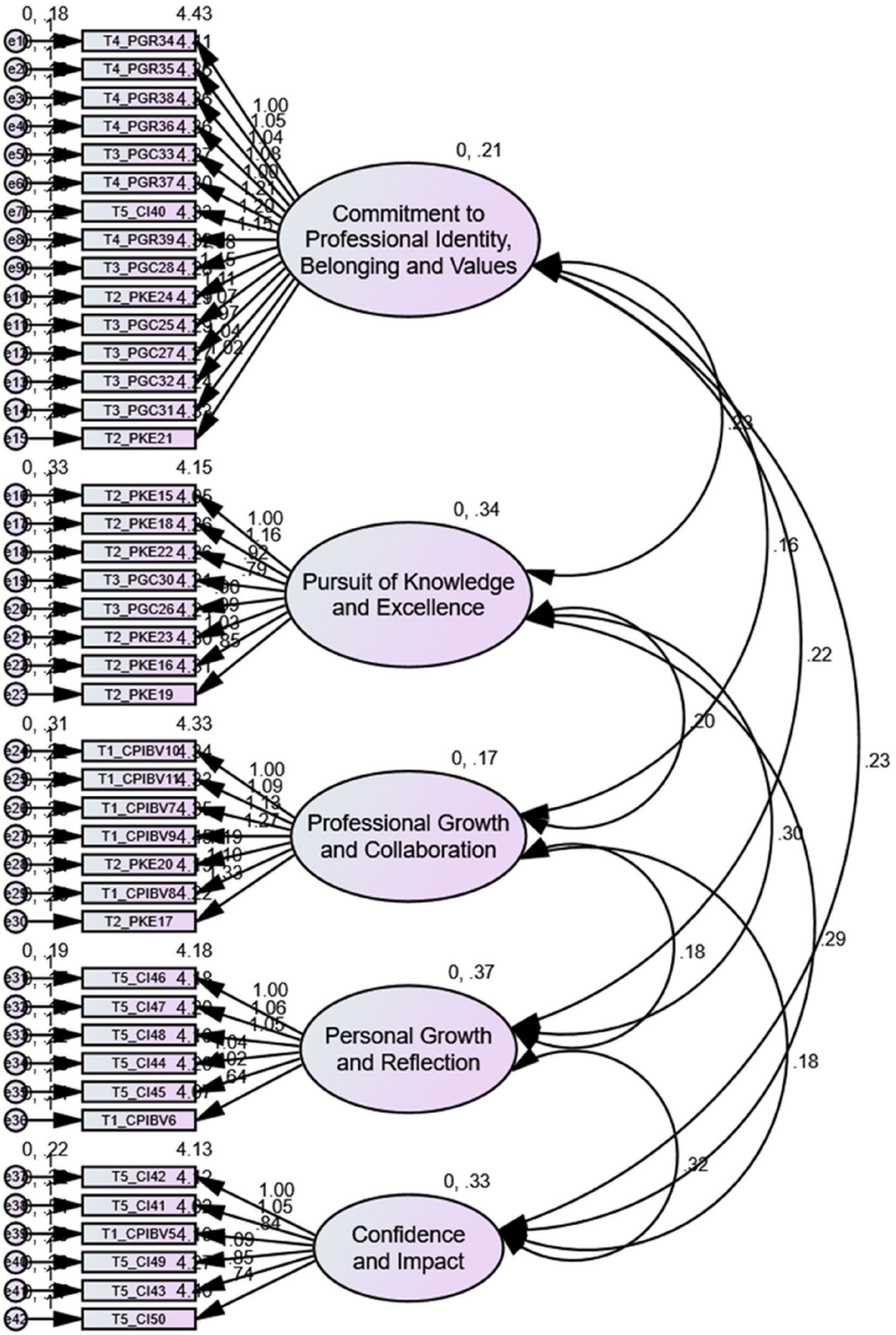

Fig. 3 Confirmatory factor analysis of professional identity formation scale for basic health science postgraduate trainees

Table 4 Results of confirmatory factor analysis of the 50-item instrument (Phase-3) (n 500/500)

Fit Indices	Cut-off values	Measured values
Absolute fit measures Observed normed χ 2/df	< 5 The smaller, the better	4.707
Root mean square error of approximation (RMSEA)	0.08 to 0.1 (0.05 is cut off for a good fit model)	0.082
Incremental Fit measures Tucker-Lewis Index (TLI)	Adjacent to 1 (Higher the better) (0.9 is cut off value)	0.75
Comparative fit index (CFI)	Near to 1 (Higher the better) (0.9 is cut off value	0.78

Delphi technique, exploratory factor analysis followed by confirmatory factor analysis, and pilot testing.

To evaluate the scale's content validity, we have used I- CVI and S-CVI to make up for the skewness by eccentricity in the S-CVI [28]. The I-CVIs and CVR scores showed that the items were meaningful and pertinent to determining the PIF for postgraduate students in basic health sciences. Low CVRs were found for some items. However, it's possible that experts didn't understand what they were measuring. Two more studies aimed to measure professional identity among medical students using valid and reliable instruments [38]. The first study utilized Brown et al.'s Professional Identity Questionnaire, identifying two factors: PIF-attachment and detachment, while the second study, using Tagawa's scale, identified five factors related to basic health science postgraduates. The first study assessed content validity through item-level CVI and CVR and examined correlations with the Academic Self-Regulation Scale [37].

The second study evaluated content validity using the Content Validity Index (I-CVI) and reported a low response rate. Both studies provide useful insights for improving measurement tools in medical education. The CFA and Cronbach's alpha values indicate high internal consistency, showing that each component of the CFA model effectively represents the variable [21, 17]. A 2024 study highlighted that the IPE aid helped graduates enhance responsibility, communication skills, collaboration across fields, and trust among coworkers [39]. A 2020 study identified trustworthiness as a key aspect of professionalism that dentists, nurses, and physicians emphasized during training [37]. Another study found that the average medical student was at stage 3, ranging from stages 2 to 4, while instructors averaged at stage 4 or higher. Haruta et al. [40] reported the questionnaire's internal consistency yielded Cronbach's alpha scores of 0.932, 0.936, and 0.939 for phases 1, 2, and 3, respectively [40].

The EFA model shows that the PIF scale has a reliable factor structure and good model fit. The CFA model's validity was evaluated using Cronbach's alpha and composite reliability statistics [41]. All Cronbach's alpha values were more significant than 0.70, some even exceeding 0.90, showing high internal reliability [42].

In this study, five factors related to professional identity formation were identified: "Commitment to Professional Identity, Belonging, and Values," "Pursuit of Knowledge and Excellence," "Professional Growth and Collaboration," "Personal Growth and Reflection," and "Confidence and Impact." The modified Professional Identity Formation (PIF) scale demonstrated strong psychometric properties, including a well-defined factor structure, high reliability (Cronbach's alpha of 0.97), and comprehensive representation of professional identity dimensions, accounting for 99.99% of the variance.

Commitment to professional identity, belonging, and values

This factor is grounded in Social Identity Theory and Professional Socialization [10]. This theory suggests that self-concept comes from perceived social group membership, which in health sciences means integrating into the professional community and adopting its values. Professional Socialization involves acquiring the necessary values, attitudes, and behaviors for professional performance, aided by mentoring, role modeling, and organizational culture.

Pursuit of knowledge and excellence

This factor emphasizes Self-Determination Theory and Lifelong Learning. Self-determination focuses on intrinsic motivation, encouraging health science professionals to excel. Lifelong Learning is essential for ongoing professional development in a rapidly changing field [43].

Professional growth and collaboration

This factor is based on Communities of Practice [44] and Interprofessional Education (IPE). Communities of Practice theory suggests that learning happens within social groups that share a common practice, enhancing

professional growth in health sciences through collaboration. IPE encourages learning alongside diverse healthcare professionals, promoting collaboration, mutual respect, and a comprehensive understanding of patient care, essential for developing a collaborative professional identity.

Personal growth and reflection

Reflective Practice and Transformative Learning underpin this factor. Reflective Practice involves critical self-reflection on experiences to improve practice, integrating experiences for personal and professional growth. Transformative Learning describes how individuals change their frames of reference through critical reflection, leading to a deeper understanding of their professional role and identity [45].

Confidence and impact

This factor is founded on the Self-Efficacy Theory [11]. Bandura and Leadership Development. Self-efficacy theory emphasizes that confidence in one's abilities impacts professional behavior and performance, with high self-efficacy being crucial for effective practice in health sciences. Leadership Development focuses on cultivating leadership skills, decision-making, and influence, which are integral to professional identity and impact in the field.

These findings highlight the importance of professional identity formation in basic health sciences education and support the development of targeted training programs for postgraduate trainees. The study introduces a validated five-dimensional framework for enhancing professional commitment and personal growth, advocating for a shift from traditional technical training. Understanding the factors affecting PIF across multiple domains can enhance prospective respondents' skills, behavior, and personal values.

The implications of professional identity formation in health professions education are significant. Integrating experiential learning, reflective practices, and mentorship is essential for developing strong professional identities that shape future healthcare professionals' communication, decision-making, and ethical standards. This identity greatly influences patient care, impacting empathy, collaboration, clinical competence, and lifelong learning commitment. Key development occurs during medical school, residency, and early practice due to clinical experiences and mentorship. Recommendations include incorporating experiential learning and reflective practice into the curriculum and establishing mentorship programs to support learning. Additionally, assessment instruments can help institutions monitor professional development and improve program quality.

Conclusions

The study successfully developed and validated a Professional Identity Formation scale for postgraduate health sciences trainees, demonstrating exceptional statistical validity (S-CVI/Ave: 0.83; KMO: 0.9954) and reliability (Cronbach's alpha: 0.84–0.97). The instrument identifies five key dimensions of professional identity: Commitment to Professional Identity, Pursuit of Knowledge, Professional Growth, Personal Growth, and Confidence and Impact, with factor analysis accounting for 99.99% of variance. Despite a 20–30-minute completion time, the scale offers valuable insights for educational interventions and professional development in healthcare settings.

Future directions

Future research on professional identity formation should incorporate larger samples and longitudinal designs to identify critical intervention periods in this dynamic process. Cross-cultural validation efforts, like those conducted in Pakistan, reveal important contextual variations that must be considered when developing assessment tools. Technology-enhanced approaches and interdisciplinary collaboration will be essential for creating evidence-based interventions that remain relevant across educational settings and healthcare environments.

Strengths and limitations

The PIF scale demonstrated high consistency and reliability in assessing professional identity in medical education, with implications for institutions and healthcare workers. However, it has limitations: the questionnaire may not suit other clinical populations, outcomes could be influenced by recall bias, and it takes 20–30 minutes to complete. Its effectiveness in different contexts is uncertain, as it has only been evaluated with basic health science trainees in Pakistan.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-025-07025-w.

Supplementary Material 1
Supplementary Material 2
Supplementary Material 3
Supplementary Material 4

Authors' contributions

US designed the study, collected data, and analyzed the data. UM conceptually designed the study, revised the manuscript, and gave final approval of the manuscript. NM Analysed the data and revised the manuscript. BM Substantially reviewed and revised the manuscript. ASA Substantially reviewed and

revised the manuscript. MB revised the manuscript and reviewed the draft. All the authors have read and approved the final manuscript.

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Not Applicable.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was conducted six months after authorization of the synopsis from the Advanced Study and Research Board (ASRB), Khyber Medical University (KMU) Peshawar (ASRB002059/AM/IHPE) obtained in 135th meeting of the KMU AS&RB held online on 31st/05/2023, along with ethical clearance certificate. All methods were carried out according to relevant guidelines and regulations, and informed consent was obtained from all participants.

Competing interests
The authors declare no competing interests.

Consent for publication
The author took permission from the participant about the publication.

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