Scoping Review of Instruments for Measuring Doctoral Students' Mentoring Relationships with Advisors or Mentors

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Abstract

Objectives: *This scoping review aims to provide a comprehensive overview of instruments used to measure mentoring relationships between doctoral students and their advisors or mentors. The review spans from 1983 to 2023, encompassing a wide array of studies conducted in university settings and published in academic journals, reports, dissertations, and conference materials.*

Methods &Result: *The study reveals a multifaceted definition of effective mentorship, highlighting both formal structured programs and informal, spontaneous connections between mentors and mentees. Drawing from established theories like Kram's mentorship theory and Edmondson's psychological safety concept, the instruments analyzed demonstrate a diverse conceptual foundation rooted in higher education. Over 40 years, 47 unique instruments were identified, reflecting a global interest in doctoral education research, with the USA leading in the number of studies. While many instruments exhibit high internal consistency reliability and validity, some lack detailed psychometric properties, emphasizing the need for further validation studies to enhance the quality of measurement tools in doctoral education.*

Conclusions*: This scoping review not only identifies validated instruments but also underscores the importance of rigorous validation protocols and transparent reporting of psychometric properties for ensuring the credibility and replicability of research findings in this critical area. Future research should prioritize the development of instruments tailored to the unique dynamics of doctoral mentoring relationships***.**

1. INTRODUCTION

1.1 Importance of Effective Mentorship in Doctoral Education

In doctorate education, a mentor's ability to effectively shape a student's experiences and outcomes is critical. A mentor is a capable or experienced individual who provides direction, encouragement, and advice to a less seasoned individual [1]. Accordingly, mentoring is characterized as a developmental connection in which a more knowledgeable or experienced individual provides guidance, support, and help to a less knowledgeable one [2]. Additionally, Toma [3] highlights that the purpose of mentoring is to provide a framework for teaching and modeling values and life skills, as well as to encourage personal growth through the sharing of experiences and insights. Positive outcomes including skill improvement, career aspirations, and general program satisfaction have been linked to effective mentoring, especially in the early stages of the mentoring relationship. [4]. This positive impact extends to various groups of doctoral students, including women, minority students [5], and first-generation students [6]. For instance, mentorship has been shown by Graham & McClain [7] to influence doctoral students' career aspirations and pursuit of academic degrees, highlighting its significance in shaping students' professional trajectories. Negative graduate advising experiences can have a big impact on students' academic careers and general well-being. Studies in engineering education have indicated that negative advising experiences can have a lasting psychological and health impact in addition to lowering students' motivation and increasing the likelihood of school dropout [8]. This emphasizes how crucial it is to provide encouraging and productive advising procedures to guarantee the achievement and well-being of graduate engineering students.

1.2 Multifaceted definition of effective mentorship

The concept of mentorship has evolved, with contemporary definitions emphasizing the multifaceted nature of the mentor's role. According to Hirsch et al. [9], mentoring takes place when experienced workers, or mentors, aid less seasoned workers, or protégés, in achieving a shared objective. This is consistent with the idea of providing guidance and support. According to Johnson [10], a mentor can also be a teacher, adviser, sponsor, counselor, or role model. Mullen & Klimaitis [4] provide more support for the diverse nature of mentoring. They address the issues posed by alternative mentoring theories and the importance of maintaining transparency on the definitions of mentoring. Further highlighting the differences between formal and informal mentoring relationships, Mellon & Murdoch-Eaton [11] stress that mentoring is a diverse position with varied behaviors expected of mentors and supervisors.

Furthermore, the literature distinguishes between formal and informal mentoring relationships, recognizing the diverse forms and functions of mentorship [12]. Formal mentoring is defined as a structured program initiated by an organization to facilitate the development and advancement of individuals, where protégés and mentors are linked in some way [1]. Kakyo et al. [13] describe formal mentoring as a program started by an organization to enable a less experienced person to obtain support for transitioning into a specific practice from an experienced mentor. This definition further supports the structured character of formal mentoring. Conversely, informal mentoring is more unstructured and spontaneous, with no formal program framework; instead, the mentor-mentee connection grows organically (O'Donnell et al., 2019). This is further supported by [14], who emphasize the distinction between formal mentorship programs and informal mentorship programs, indicating that informal mentoring lacks the structured framework of formal programs.

1.2 Measuring Effective Mentorship in Doctoral Education

The quality of mentoring relationships is a critical aspect of doctoral education, as highlighted by Anderson et al. [15], who emphasized the importance of internal relationship quality characterized by mentors' and mentees' perceptions of the relationship, encompassing relational and instrumental quality.

The process of measuring mentorship in doctorate education is intricate and multidimensional. The selection and development of these tools require a robust theoretical framework and rigorous psychometric properties. The success of these tools in evaluating the mentorship experience is determined by their psychometric features. This scoping review aims to provide an update on mentoring relationships specifically for doctoral education, spanning from 1983 to 2023. It is noted that there are numerous instruments available for evaluating mentoring relationships, but the quality of these instruments beyond the work done by the authors is not well-evaluated [16], [17]. This review is also crucial for researchers seeking interventions and faculty aiming to evaluate the mentoring relationships of advisors and doctoral students [18]. Notably, a similar review was conducted by Chen et al. [16] on mentoring measurement tools, but it was focused on mentoring generally and was conducted between 1985 to 2015, making the current review unique in its focus on doctoral education which aims to systematically identify, evaluate, and synthesize the available instruments for measuring doctoral students' mentoring relationships with advisors or mentors. Future research and instrument development in this field

would be guided by a thorough grasp of the current instruments, their psychometric qualities, and the gaps in the literature that such a review would provide.

2.0 METHODS

2.1 Protocol

The best practice guidelines and reporting items for the establishment of scoping review protocols by Peters et al. [19] will be followed in the construction of the scoping review procedure. The methodical and reporting quality of scoping reviews depend on a systematic approach to searching, screening, and reporting, which is emphasized in this guidance.

2.2 Eligibility Criteria

1. Studies with doctoral students as major participants regardless their professional domains
2. The review will encompass studies that investigate mentoring relations between doctoral students and their advisors or mentors. This includes examination into the nature of the relationships, the impact of mentoring relationships on student outcomes, and mentoring process dynamics.
3. Studies conducted in university settings.
4. Studies publishes in academic journals, reports, dissertations, and conferences materials. The sources will provide a comprehensive understanding of the instruments used to measure mentoring relationships among doctoral students.
5. Studies published in English language.

2.3 Exclusion Criteria

1. Studies not focused on doctoral students or mentoring relationships.
2. Studies did not use any instrument to measure mentoring relationships.
3. Reject papers of qualitative or theoretical review or discussion
4. 4. non-English language studies
5. Non- Academic sources such as, E-books, books, magazines, and news articles

2.4 Search Terms Strategy

The search strategy involved using keywords such as "Ph.D. students," "doctoral students," "graduate students," "mentoring," "mentorship," "advisors," "supervisors," and "instruments," "inventories," "surveys," "scales," "measures," and "tools" to identify relevant literature. The time limiting was set from January 1983 to November 2023 since mentorship was at its height during this period and the earliest tool was produced at the same time. The language was restricted to English, and age group limiters (adult, over 18) were applied in various databases as adult groups applied doctoral mentoring.

2.5 Data management

2.5.1 *Citation Management*

All citations were imported into a web-based citation manager Zotero where duplicates were further removed if found in the process. Citations were later imported to Excel for the subsequent screening of titles and abstracts to ensure relevance and the characterization of full articles based on data.

2.6 Selection process

2.6.1 Title and abstract relevance screening

The scoping review aims to comprehensively explore the instruments used for measuring mentoring relationships between doctoral students and their advisors or mentors. To ensure the relevance of the included studies, a rigorous screening process was conducted. Two doctoral students independently evaluated 20 citations to assess reviewer agreement, and the kappa statistic was calculated to measure inter-rater reliability.

The screening process involved a meticulous assessment of the title and abstract of each study to determine its alignment with the review's focus. The studies were carefully examined as part of the relevant screening procedure to make sure they satisfied the predetermined eligibility requirements. All disagreements among the reviewers were settled by consensus and discussion. Through the screening process, pertinent studies were found and included in the scoping review. This will guarantee that the studies that are chosen are in line with the review's goal of looking at instruments that measure the mentoring relationships between doctorate students and their advisors or mentors. This thorough screening procedure improves the scoping review's quality and comprehensiveness and offers a solid basis for the upcoming review stages.

2.7 Data collection process

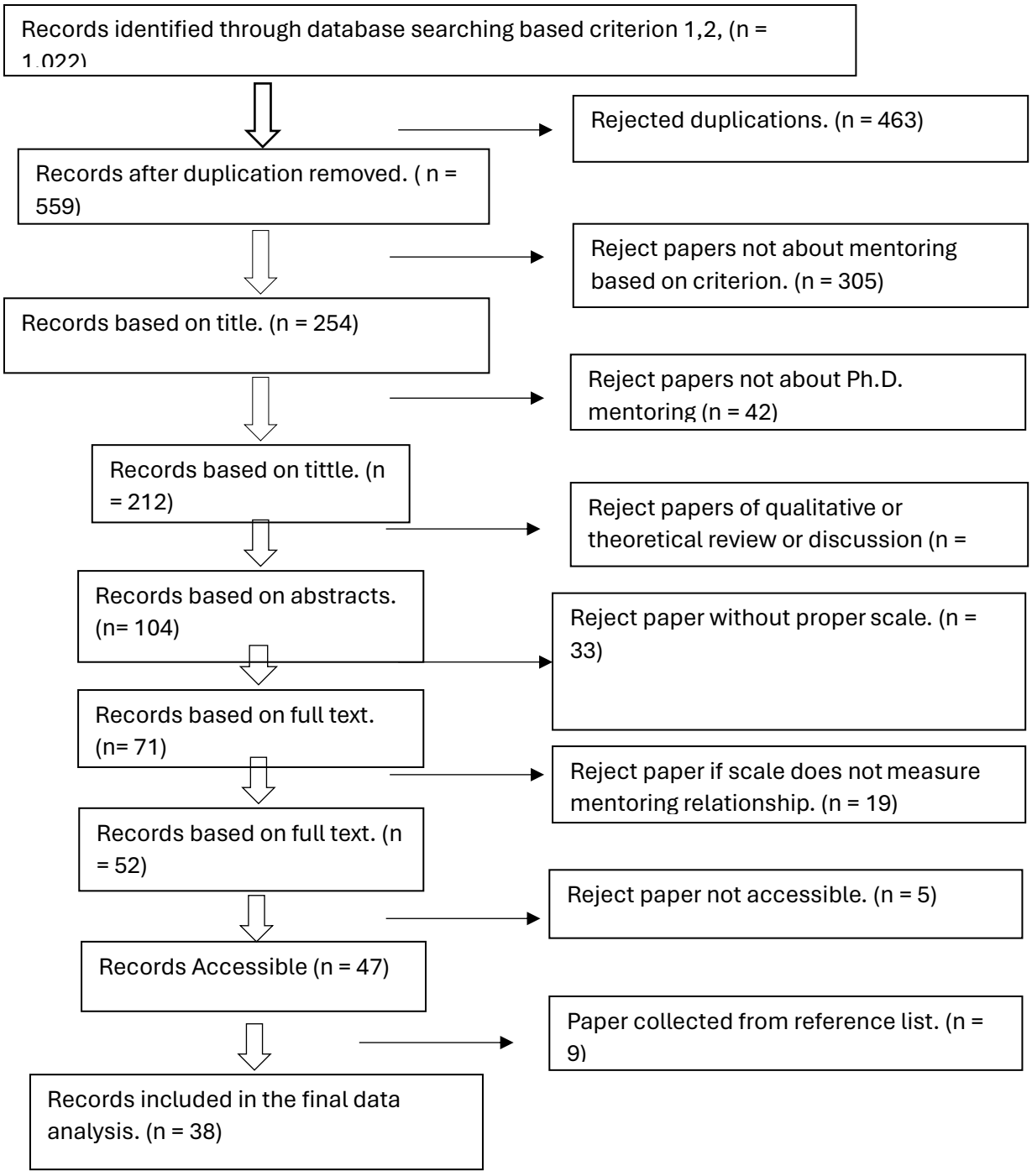
2.7.1 Data characterization

Following the title and abstract screening, all relevant citations were obtained for further review of the full-text papers. For articles that could not be accessed through institutional holdings available to the authors, efforts were made to contact the source author or journal for assistance in getting the article. This approach ensured that the scoping review encompassed a comprehensive inclusion of literature relevant to the topic of instruments for measuring mentoring relationships between doctoral students and their advisors or mentors.
The authors devised a coding sheet to confirm relevance and extract study characteristics from the found publications. The coding sheet facilitated the systematic extraction of pertinent information, including study topics, publication types, thematic analyses, theoretical frameworks, reliability, and validity measures. This systematic approach allowed for the comprehensive characterization of the data, ensuring that the scoping review was underpinned by a robust and methodical process.

4. RESULTS

Based on the search conducted on November 17th, 2023, 1022 articles were first found across various sources, including academic journals, reports, dissertations, e-books, books, conference materials, magazines, news, and electronic sources. After limiting the search to academic journals, reports, dissertations, and conference materials in English, 936 articles were identified. The search covered several databases, with the following distribution of papers: Eric (400), Academic Search Premier (133), Complementary Index (120), Medline (95), CINAHL Plus (68), Gale Academic Onfile (54), JSTOR Journals (38), IEEE Xplore Digital Library (6), Supplementary Index (21), and Gale Health and Wellness (7). The search period ranged from 1983 to November 2023. During the process of importing the articles into our reference manager, duplicates were automatically removed leaving 559 articles.

Figure 1. Flow diagram of the scoping review



Our research questions for this work were to determine (i) What underlying attributes (Theoretical frameworks, the geographic distribution of instrument usage in applied articles, and

the methods of adaptation, adoption, or self-development), characterize available doctoral students mentoring relationship instruments for diverse populations in higher education? (ii) What are the psychometric properties of instruments for measuring doctoral students' mentoring relationship with their advisors in higher education?

Characteristics and Evolution of Doctoral Student Mentoring Relationship Instrument

The doctoral student mentoring relationship instruments analyzed in Table 1 exhibit a diverse array of attributes that characterize their conceptual foundations in higher education. These instruments demonstrate a blend of adaptation and development, with a strong emphasis on doctoral students and a global representation of sources. The theoretical foundations of these instruments are rooted in established theories such as Edmondson's psychological safety concept [20], Graen and Uhl-Bien's Leader-Member Exchange theory [21], and Kram's mentorship theory [22], Thomas Joiner's Interpersonal Psychological Theory of Suicide (IPTS [1] provides a solid conceptual basis for understanding mentorship dynamics. The instruments vary in whether they are adapted from existing tools or newly developed, with a focus on doctoral students and the perspectives of advisors, reflecting a comprehensive approach to evaluating mentoring relationships.

Over the 40 years, as shown in Figure 1, 47 unique instruments were identified in 38 studies, ranging from scales and surveys to questionnaires, designed to assess various aspects of doctoral education and supervision. The USA leads with the highest number of studies (23), indicating a significant focus on doctoral education research in this region. China followed with 7 studies Australia with 3, and the rest of the countries shared the remaining 5, showcasing an international interest in the topic. Cultural sensitivity is also evident in some instruments [21], [23], which adapt measures to specific cultural contexts to ensure relevance and validity across diverse populations.

Out of the 47 instruments, 22 were adapted, 10 were adopted from existing tools, and 15 were developed specifically for the studies they were used in as displayed in Table 2. This indicates a balanced approach to research methodology in this field, with researchers both building on existing instruments to ensure comparability and creating new ones to address specific research questions or contexts. The temporal scope from 1983 to 2023 highlights the evolving nature of doctoral education and the diverse methodologies and instruments developed or adapted to study it over time. The range of publication years spans from 2000 to 2023, suggesting ongoing interest in the field.

The distribution of research instruments across doctoral education studies, with a substantial focus on doctoral students (36 instruments), a targeted exploration of advisors (5 instruments), and a noteworthy emphasis on both parties involved (6 instruments), signifies a comprehensive approach to understanding the intricate dynamics within the mentor-mentee relationship in doctoral education. The prevalence of instruments tailored specifically for doctoral students reflects a commitment to unraveling the multifaceted challenges and experiences unique to their academic journeys. Simultaneously, the dedicated attention to advisors underscores the acknowledgment of mentors' pivotal roles in shaping the academic and

professional trajectories of their mentees. The existence of instruments targeting both doctoral students and advisors further underscores a recognition of the interdependence and bidirectional influence within these relationships. This review demonstrates the dynamic and international nature of research into doctoral education, supervision, and the student-advisor relationship, highlighting the ongoing efforts to enhance doctoral training and experiences worldwide.

Instrument validation analysis

In Table 2, the validation status of instruments for measuring doctoral students' mentoring relationships with their advisors in higher education is highlighted. These instruments cover various dimensions and utilize different measurement scales, with reliability assessments ranging from $\alpha = 0.70$ to 0.97, indicating good internal consistency reliability. According to Fitzner [24], reliability refers to the consistency in measurement, whereas validity pertains to the accuracy of measurement. Cronbach's alpha is commonly used to assess reliability, with values of 0.7 or higher suggesting satisfactory internal consistency [25]. Validation methods included confirmatory factor analysis (CFA), exploratory factor analysis (EFA), and content validity (CVI). The instruments consisted of multiple subscales or dimensions to capture different facets of mentorship experiences, such as psychosocial support, career development, trustworthiness, and communication competence. Our analysis revealed a range of instruments with varying degrees of validation status: Several instruments, such as the Supervisory Inventory Styles (SSI), Supervisory Working Alliance Inventory (SWAI), and The Supervisee Level Questionnaire-Revised (SLQ-R), demonstrated high internal consistency reliability (ICR) and validity, supported by exploratory factor analysis (EFA) and content validity index (CVI).

Several instruments in Table 2 lack detailed psychometric properties, making it challenging to assess their reliability and validity accurately. The Perceived Abused Supervision instrument, Abusive Supervision (Chinese Version), Survey to Assess the Concept of Mentoring of Students in the Psychology Doctoral Program, Survey on the Social Support, Science Identity, and Persistence, Students' Perceptions of Doctoral Supervision, Supervisory Support and Doctoral Learning, and Research Student Feedback Survey (RSFS) all suffer from a lack of specific reliability and validity measures. Without this essential information, the effectiveness and suitability of these instruments in assessing mentoring relationships in doctoral education remain uncertain, highlighting the need for further research to establish their psychometric properties. While many instruments have undergone rigorous validation processes, some lacked detailed reliability and validity information, emphasizing the need for further validation studies to enhance the quality of measurement tools in doctoral education.

Conclusion

The findings of this scoping review highlight both the presence of validated instruments and the gaps in the validation status of others used to measure doctoral mentoring relationships in higher education. Validated instruments provide researchers with confidence in the reliability and validity of their findings, ensuring robust measurement of key constructs. However, the lack of validation details for some instruments raises concerns about their psychometric properties and the accuracy of the data they produce.

Future research in this area should prioritize the development and validation of instruments tailored specifically to the unique dynamics of doctoral mentoring relationships. Additionally, researchers should adhere to rigorous validation protocols and transparently report the psychometric properties of the instruments they use to ensure the credibility and replicability of their findings.

Table 1

Authors	Publishing Year	Name of Journal	Focus/Target respondents	Country of study	Instrument Name	Instrument Status	Source of the Instrument
Kong, L., Ma, Z., Li, X., & Kim, H. (2023)	2023	International Journal of Intercultural Relations	Doctoral students	China	Intercultural student-advisor interaction	Adapted	Kong et al. (2022)
					Psychological Safety	Adapted	Edmondson (1999) & Liang et al. (2012)
					Interaction Engagement	Developed	-
Yao, Y., Dong, F., & Qiao, Z. (2023)	2023	BMC psychology.	Doctoral students	China	Perceived abused supervision	Adapted for Chinese language	Tepper's (2000)
Li, D. (2022)	2022	Professional Counselor	Doctoral students	USA	Supervisory Inventory Styles (SSI)	Adopted	Friedlander & Ward (1984)
			Doctoral students		Supervisory Working Alliance Inventory (SWAI)	Adopted	Efstation et al. (1990)
			Doctoral students		The Supervisee Level Questionnaire-Revised (SLQ-R)	Adopted	McNeill et al. (1992)
Sherman, D. K., Ortosky, L., Leong, S., Kello, C., & Hegarty, M. (2021)	2021	Frontiers in Psychology	Doctoral students	USA	Perceived Social support	Adapted	Zimet et al. (1988)

Smith, A. B., Umberfield, E., Granner, J. R., Harris, M., Liestenfeltz, B., Shuman, C., & Smith, E. M. L. (2021	2021	Nurse education today	Doctoral students	USA	Collaboration of Leadership and Innovation in Mentoring (CLIM) - an instrument for nursing PhD mentorship	Developed	
Yue, J. J., & Chen, G. (2020)	2020	BMC Medical Education	Advisor & Doctoral student	China	Research on the competence of pharmacy professional mentors in Chinese universities"	Developed	
Butz, A. R., & Branchaw, J. L. (2020)	2020	CBE—Life Sciences Education	Doctoral students	USA	Entering Research Learning Assessment (ERLA)	Developed	
Roberts, L. (2020)	2020	International Journal of Doctoral Studies.	Advisors	USA	Mentor Integrity and Trustworthiness (MIT)	Developed	
Nnadozie, E. E., Ugwu, L. E., Enwereuzor, I. K., Anozie, E. U., & Albi-Oparaocha, F. C. (2019)	2019	Journal of Psychology in Africa	Advisors	Nigeria	The Mentoring Effectiveness Scale (MES)	Adopted	Berk, Berg, Mortimer, Walton-Moss, & Yeo (2005)

German, K. T., Sweeny, K., & Robbins, M. L. (2019)	2019	Professional Development in Education.	Doctoral students	USA	Mentoring Functions Scale	Adopted	Scandura and Ragins (1993)
Estrada, M., Zhi, Q., Nwankwo, E., & Gershon, R. (2019)	2019	Professional Development in Education.	Doctoral students	USA	Multiple Scales	Developed and adapted	
Nersesian, P. V., Starbird, L. E., Wilson, D. M., Marea, C. X., Uveges, M. K., Choi, S. S. W., ... & Cajita, M. I. (2019)	2019	CBE—Life Sciences Education	Doctoral students	USA	Mentorship Effectiveness Scale (MES)	Adopted	Berk, Berg, Mortimer, Walton-Moss, & Yeo (2005)
					Mentoring Practices Questionaire	Adopted	Ynalvez et al. (2014)
Nersesian, P. V., Starbird, L. E., Wilson, D. M., Marea, C. X., Uveges, M. K., Choi, S. S. W., ... & Cajita, M. I. (2019)	2019	Journal of Professional Nursing.	Doctoral students	USA	Islamic Mentoring Questionnaires	Developed	

Muñoz, K., Landon, T., & Corbin-Lewis, K. (2018)	2018	Korean journal of medical education.	Advisors	USA	Survey to explore supervisors' perspectives and practice	Developed	
Mangione, L., Borden, K. A., Nadkarni, L., Evarts, K., & Hyde, K. (2018).	2018	Journal of the American Academy of Audiology.	Doctoral students	USA	Survey to assess the concept of mentoring of students in the psychology doctoral program	Developed	
Taylor, R. T., Vitale, T., Tapoler, C., & Whaley, K. (2018)	2018	Training and Education in Professional Psychology	Advisors & Doctoral students	USA	Students' Perceptions of Doctoral Supervision	Developed	
		Training and Education in Professional Psychology.	Advisors & Doctoral students	USA	Advisors' Perceptions of Doctoral Supervision	Developed	
Goldman, Z. W., & Goodboy, A. K. (2017)	2017	Communication Education.	Doctoral students	USA	The advisee Relational Maintenace Scale	Adapted to reflect the advisor-advisee relationship	Mansson&Myers (2012)
		Communication Education.	Doctoral students	USA	The Student Communication Satisfaction Scale	Adapted to reflect the advisor-advisee relationship	Goodboy,Martin,&Bolkan (2009)
Harris, R., Birk, S. B., &	2016	Journal of Nursing Education.	Advisors & Doctoral students	USA	The Ideal Mentors' Scales	Adapted	Rose (1999, 2003)

Sherman, J. (2016)							
Meng, Y., Tan, J., & Li, J. (2017)	2017	International Journal of leadership in education.	Doctoral students	China	Abusive Supervision (Chinese version)	Adapted for Chinese language	Tepper's (2000)
Meng, Y., Tan, J., & Li, J. (2017)	2017	International Journal of leadership in education, 20(5), 605-617.	Doctoral students	USA	Leader-member exchange (LMX) - Chinese version	Adapted for Chinese language	Graen and Uhl-Bien (1995)
Comer, K., & Brogt, E. (2016).	2016	International Journal of Doctoral Studies, 11, 185-203.	Doctoral students	Australia	The University of Canterbury Postgraduate Experience Survey (UCPEQ)	Developed	Graduate Careers Council of Australia (2002) and Ainley (2000)
Welton, A. D., Mansfield, K. C., Lee, P. L., & Young, M. D. (2015).	2015	International Journal of Educational Leadership Preparation.	Doctoral students	USA	Mentor-Mentee Relationship	Developed	
Satariyan, A., Getenet, S., Gube, J., & Muhammad, Y. (2015)	2015	Journal of the Australia and New Zealand Student Services Association.	Doctoral student	Australia	Supervisory Support and Doctoral learning	Developed	Lee, A. (2008)
Reedy, K., & Taylor-Dunlop, K. (2015).	2015	Journal for Leadership and Instruction.	Doctoral students	USA			
Welton, A.D., Mansfield, K.C., & Lee, P.L. (2014).	2014	Partnership in Learning.	Doctoral students	USA	Students' Perspectives of Quality Mentorship		

Elizabeth Anne Erichsen, Doris U. Bolliger & Colleen Halupa (2014)	2014	Studies in Higher Education.	Doctoral students	USA	Student Satisfaction.	Developed	
Graham, E., & Gadbois, S. (2013).	2013	Canadian Journal of Educational Administration and Policy.	Doctoral students	Canada	Perceptions of Graduate supervision	Developed	Rose's (2003) conception of an ideal mentor
Mansson,D.H.,& Myers, S.A (2013)	2013	NACADA Journal.	Doctoral students	USA	Mentoring Support and Relational Uncertainty in the Advisor-Advisee Relationship	Adopted	(Schrodt et al., 2003),(Hill et al., 1989),(Knobloch & Solomon, 1999)
Moxham, L., Dwyer, T., & Reid-Searl, K. (2013)	2013	Journal of Higher Education Policy and Manageme	Doctoral students	Australia	Supervisor-Student Best Fit	Developed	
Bégin, C., & Géarard, L. (2013).		Policy Futures in Education	Doctoral students	France	Metaphor; Role of Supervisors survey	Developed	(Boulaire, 2004)
Noy, S., & Ray, R. (2012).	2012	The Journal of Higher Education	Doctoral students	USA	from the Survey on Doctoral Education and Career Preparation.	Adapted	(Golde & Dor, 2001)
Marinette Bahtilla (2022)	2022	Innovations in Education and Teaching International.	Advisors	Cameroun	supervisor and supervisee's perceptions of the quality of	Developed	Kam(1997).

					research supervision		
Pyhältö, K., Keskinen, J. (2012).	2012	International Journal of doctoral studies.	Advsisors & Doctoral Students	Finland	Satisfaction with supervisory support	Developed	(Pyhältö et al., 2009)
Lunsford, L. (2012).	2012	Partnership in Learning.	Doctoral students	USA	Advisor Working Alliance Inventory (AWAI), Measure of Ego Identity (OMEIS).	Developed	
Lee, Alison; McKenzie, Jo (2011).	2011	Innovations in Education and Teaching International.	Doctoral students	Australia	Research Student Feedback Survey (RSFS)	Adapted	Moses (1985)
Barnes, B. J., Williams, E. A., & Archer, S. A. (2010).	2011	Nacada Journal.	Doctoral students	USA	variety of facets of the doctoral student-advisor relationship	Adapted	
Marie Taylor, J., & Neimeyer, G. J. (2009).	2009	Counselling Psychology Quarterly.	Doctoral students	USA	Graduate student's perceived relationship with his or her mentor	Adapted	Tenenbaum, Crosby, and Gliner (2001).

Zhao, C. M., Golde, C. M., & McCormick, A. C. (2007).	2007	Journal of further and higher education.	Doctoral students	USA	Advisor Choice and Advisor Behaviors	Adopted	Survey on Doctoral Education and Career Preparation, the results of which were published in 2001 (Golde & Dore, 2001); see www.phd-survey.org for details
Dickinson, S. C., & Johnson, W. B. (2000).	2000	The Clinical Supervisor.	Advisors	USA	The Mentor Relationship Survey for Training Directors.'	Developed	
Clark, R. A., Harden, S. L., & Johnson, W. B. (2000).	2000	Teaching of psychology	Advisors	USA	Mentor Relationship Survey	Developed	Kram (1988)

Table 2

Summary of the Existing Literature on Measurement Instruments Scales and Psychometric Properties of Doctoral Mentoring Relationship

S/N	Instrument (Abbreviation)	Source of the Instrument	Number of Items	Corresponding Response Options	Reliability & Validity	Theoretical Framework	Focus/Target respondents
1	Perceived Abused Supervision	Edmondson (1999) & Liang et al. (2012)	15	1 = "I cannot remember him/her ever using this behavior with me"; and 5 = "He/she uses this behavior very often with me"	N/A	Thomas Joiner (2005) The Interpersonal Psychological Theory of Suicide (IPTS)	Doctoral students
2	Supervisory Inventory styles (SSI)		25	1 = not very to 7 = very	ICR: α (4 studies) = 0.82 - 0.91 (total scale), α = 0.82- 0.93 (Attractive), α = 0.70 - 0.88 (Interpersonally Sensitive), α = 0.80 - 0.85 (Task Oriented); Test-retest = 0.92 (total scale), 0.94 (Atrractive), 0.91 (Interpersonally Sensitive), 0.78 (Task Oriented) CV: EFA	Parker et al. (2010) The model of proactive motivation	

4	Supervisory Working Alliance Inventory (SWAI) - Supervisor scale	Tepper's (2000)	23	1 = almost never to 7 = almost always	ICR: α = 0.71 (Client focus), α = 0.73 (Rapport), α = 0.77 (Identification). CV: EFA	N/A	
	Supervisory Working Alliance Inventory (SWAI) - Trainee scale	Friedlander & Ward (1984)	19	1 = almost never to 7 = almost always	ICR: α = 0.77 (Client focus), α = 0.90 (Rapport). CV: EFA	N/A	Doctoral students
5	The Supervisee Level Questionnaire-Revised (SLQ-R)	Efstation et al. (1990)	30	1 = never to 7 = always	ICR: α = 0.88 (total scale), α = 0.83 (Self and other awareness), α = 0.74 (Motivation), α = 0.64 (Dependency-Authonomy).CV: EFA	N/A	Doctoral students
6	Multidimensional Scale of Perceived social support (MSPSS)	McNeill et al. (1992)	12	1 = strongly dissagree to 5 = strongly agree	ICR: α = 0.88 (total scale), α = 0.91 (Significant other), α = 0.87 (Family), α = 0.85 (Friends).CV: EFA, CVI		
7	Collaboration of Leadership and Innovation in Mentoring (CLIM)	Zimet et al. (1988)	41	1 = strongly disagree to 6 = strongly agree	ICR: α = 0.95, Test-retest = 0.69. .CV: EFA, CVI(0.57-10)	N/A	
8	Research on the competence of pharmacy professional mentors in		37	1 = not important to 7 = very important	ICR: (reporting α from expert panel only) α = 0.83 - 0.92 for 6 subscales. .CV: EFA, CVI		Doctoral students

	Chinese universities				
9	Entering Research Learning Assessment (ERLA) - Trainee scale	53	1 = no gain to 5 = great gain	ICR: α = 0.95 (research comprehension and communication skills), α = 0.92 (practical research skills), α = 0.86 (research ethics), α = 0.091 (research identity), α = 0.91 (research confidence and independence), α = 0.92 (equity and inclusion awareness and skills), α = 0.90 (professional and career development skills).CV: EFA; CFA: $\chi 2$=3333.766,CFI>0.957, RMSEA=0.056)	Doctoral students

10	Entering Research Learning Assessment (ERLA) - Mentor scale		48	6-point Likert scale (1 = no gain to 5 = great gain, and 6= not applicable - for mentees) (1=	ICR: α = 0.95 (research comprehension and communication skills), α = 0.92 (practical research skills), α = 0.86 (research ethics), α = 0.091 (research identity), α = 0.91 (research confidence and independence), α = 0.81 (equity and inclusion awareness and skills), α = 0.90 (professional and career development skills).CV: EFA; CFA: χ2=2306.844, CFI=0.949, RMSEA=0.064	Branchaw et al. (2020)Entering Research curriculum and conceptual framework	Advisor & Doctoral student
11	Mentor Integrity and Trustworthiness (MIT)		14	1 = strongly disagree to 6 = strongly agree	IRC: α = 0.81 (Trustworthiness - all scale), α = 0.33 (Benevolence), α = 0.71 (honesty and reliability), α = 0.82 (competence)	Moran and Hoy (1998, 2000) Kram's mentor relations, Mentor Integrity and Trustworthiness (MIT) theory - Tschannen-	Doctoral students
12	Mentors' Perceptios of Protégé's Independence (MPPI)	Berk, Berg, Mortimer, Walton-Moss, & Yeo (2005)	8	1 = strongly disagree to 6 = strongly agree	ICR: α = 0.89		Advisors

13	The Mentoring Effectiveness Scale (MES)	Scandura and Ragins (1993)	12	0 = strongly disagree to 5 = strongly agree	N/A		Advisors
14	Mentoring Functions Scale		15	1 = strongly disagree to 5 = strongly agree	ICR: α = 0.81 (Psychosocial support), α = 0.75 (Career development), α = 0.70 (Role-modeling).CV: EFA	Charles Horton Cooleysocializati on theory was	Doctoral students
15	Survey on the social support, science identity and persistance	Berk, Berg, Mortimer, Walton-Moss, & Yeo (2005)	11	1 = strongly dissagree to 5 = strongly agree	ICR: α = 0.89 (Instrumental support), α = 0.88 (Psychosocial support), α = 0.83 (Professional network support), α = 0.69 (Friend and family support)	N/A	Doctoral students
16	Doctoral Mentoring Practices	Ynalvez et al. (2014)	11	4-point Likert scale (1 = never, 2 = rarely, 3 = often, 4 = very often)	CV: EFA	N/A	Doctoral students

17	Islamic Mentoring Questionnaires	70	1 = never, to 5 = always	ICR: α = 0.97 (full scales), α = 0.79 (Role modeling), α = 0.90 (challenging); α = 0.94 (coaching), α = 0.91 (encouraging), α = 0.89 (consulting), α = 0.89 (protection), α = 0.88 (care and reverence), α = 0.81 (good behavior and facilitating), α = 0.89 (scientific networking).CV: EFA, CFA: $\chi 2$=1660.17, RMSEA = 0.057		
19	Survey to explore supervisors' perspectives and practice	34	1 = not confident to 5 = extremely confident	ICR: α = 0.83 (importance), α = 0.87 (teaching confidence), and α = 0.93 (self-efficacy in supporting student learning)	N/A	Doctoral students
20	Survey to assess the concept of mentoring of students in the psychology doctoral program	31	open-ended and forced-choiced questions	N/A	N/A	Advisors

21	Students' Perceptions of Doctoral Supervision		46	1= strongly agree to 5= not Agree	N/A	N/A	Doctoral students
22							Advisors & Doctoral students
22	The advisee Relational Maintenace Scale	Mansson&Myers (2012)	25	1= Strongly disagree to 7= strongly agree	Cronbach alpha ranges from 0.70 to 0.94.CV. EFA	Chickering and Reisser's(1993) Vectors of Identity Development	Advisors & Doctoral students
23	The Student Communication Satisfaction Scale	Goodboy,Martin,&Bolkan (2009)	8	1= Strongly disagree to 5= strongly agree	Cronbach alpha ranges from 0.70 to 0.98.CV. EFA	N/A	Doctoral students
24	The ideal Mentors' Scales	Rose (1999, 2003)	34	1= Not at all important to 5= extremely important	Cronbach alpha ranges from 0.77 to 0.8.CV. EFA		Doctoral students
25	Abusive supervision (chinese version)	Tepper's (2000)	15	1 = never to 5 = very often.	(αp = .984; α = .979).CV. EFA	Thomas Joiner (2005) The Interpersonal Psychological Theory of Suicide (IPTS)	Advisors & Doctoral students

26	Leader-member exchange (LMX) - Chinese version	Graen and Uhl-Bien (1995)	7	1 = extremely ineffective to 5 = extremely effective.	e (αp = .918; α = .884).CFA	N/A	Doctoral students
27	The University of Canterbury Postgraduate Experience Survey (UCPEQ)	Graduate Careers Council of Australia (2002) and Ainley (2000)	14	1=Very satisfied to 7= very dissatisfied	alpha = 0.96 CFA	N/A	Doctoral students
							Doctoral students
28	Mentor-Mentee Relationship	Lee, A. (2008)	8	3= strongly agree to 0= strongly disagree	N/A	N/A	Doctoral students
29	Supervisory Support and Doctoral Learning		7	1= strongly disagree to 5= strongly agree	N/A	N/A	Doctoral student
							Doctoral students
30	Students' Perspectives of Quality Mentorship		28	3= strongly disagree to 0= strongly agree	N/A	N/A	Doctoral students
31	Student Satisfaction.		51	1 = strongly disagree to 5 =strongly agree)	ALPHA=0.96 for its 2 subscales (a) functions (a = .93) and (b) behaviors (a = .94)		Doctoral students
33							

32	Mentoring Support and Relational Uncertainty in the Advisor-Advisee Relationship					N/A	Doctoral students
33	Supervisor-student best fit	(Boulaire, 2004)	12	1 = strongly disagree to 5 = strongly agree.	N/A	N/A	Doctoral students
34	Metaphor; Role of Supervisors survey	(Golde & Dor, 2001)	4	n/a	N/A	The Metaphor as a Methodological Tool	Doctoral students
39		Kam(1997).					Doctoral students
35	Doctoral Education and Career Preparation.	(Pyhältö et al., 2009)	24	1 = strongly disagree to 4 = strongly agree	N/A	Framework of the Job Demands–Resources Model,(Demerouti, Bakker, Nachreiner, & Schaufeli, 2001)	Advisors
36	Satisfaction with Supervisory Support		6	1= fully disagree, 5= fully agree	α =0.9. CFA	psychosocial developmental Theory (Forehand, 2008	Doctoral students
37	Advisor Working Alliance Inventory (AWAI),	Tenenbaum, Crosby, and Gliner (2001).	14	1 =strongly disagree to 5 strongly agree	0.77.(CFA) for the AWAI-r (α = .91)	N/A	Doctoral students

	Measure of Ego Identity (OMEIS).						
38	Research Student Feedback Survey (RSFS)	Survey on Doctoral Education and Career Preparation, the results of which were published in 2001 (Golde & Dore, 2001); see www.phd-survey.org for details	4	1 = strongly disagree to 5 = strongly agree	N/A	N/A	Doctoral students
39	Variety of facets of the doctoral Student-Advisor Relationship	Kram(1997).	58	1= very satisfied to 7 =very dissatisfied	N/A	N/A	Doctoral students
40	Mentor Relationship Survey	(Pyhältö et al., 2009)	24	1 = strongly disagree to 5 = strongly agree	N/A	N/A	Doctoral students
41	Measure of Ego Identity (OMEIS).		24	1= strongly disagree to 6 =strongly agree	α= .71 to .92 .CFA (α = .74)2	N/A	Doctoral students

42	Academic Mentoring Behaviors Scale (AMBS).	Moses (1985)	15	1= to strongly agree =5.	α= .65 to .82. CFA (α = .74)2	N/A	Doctoral students
43	15	1= to strongly agree =5.	α=.65 to .86. CFA	N/A	Doctoral students		
44	Relational Uncertainty Scale (RUS)		16	6 = completely or almost completely certain (1) to completely or almost completely uncertain (6).	α= .73 to .89. CFA	N/A	Doctoral students
45	The Mentor Relationship survey		13	1 = strongly disagree to 5 = strongly agree	N/A	N/A	Advisors
46	graduate student's perceived relationship with his or her mentor	Tenenbaum, Crosby, and Gliner (2001).	19	1 = strongly disagree to 5 = strongly agree	α= 0.91. CFA	N/A	Advisors
47	Mentor relationship Survey	Kram (1988)	9	1 = strongly disagree to 5 = strongly agree	N/A	N/A	Advisors

Note. α = Cronbach's alpha, CFA: Confirmatory Factor Analysis, CV: Construct Validity, EFA: Exploratory Factor Analysis.

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