

Table S1. Definitions of Clinical Competence in Nursing Education

No	Ref	Author, Year	Country	Desain	Sample/Population	Dicipline	Definition
1	[7]	Jarva et al., 2023	Finland (9 organisations)	Instrument development & psychometric testing	Face validity: n=20; main data: n=817 professionals	Digital health	Analogous to general definitions of competence, <i>digital competence</i> is a broad construct encompassing technical skills; the ability to use and apply digital technologies meaningfully in everyday life; an understanding of digital technological phenomena; and the motivation to participate in digital culture.
2	[5]	Egilsdottir et al., 2023	Iceland (nursing education setting)	Quantitative cohort study	Second-year n=72; third-year n=99 (total n=171)	Nursing	Nursing competence is a multidimensional, dynamic construct that encompasses nurses' knowledge, understanding, judgment, and cognitive, technical, psychomotor, and interpersonal skills. A systematic and structured health assessment is a core element of nursing competence, essential to clinical reasoning capacity and to delivering holistic, person-centred care.
3	[15]	Lau et al., 2019	Singapore	Instrument development (cross-sectional psychometric evaluation)	n=283 (response rate 87%)	Community nursing	The integrated combination of an individual's knowledge, skills, and abilities (KSAs) to perform specific tasks.
4	[16]	Firoozehchian et al., 2022	Iran	Qualitative content analysis	n=34 students	Midwifery	Competence means possessing sufficient information, psychomotor skills, communication skills, decision-making capacity, and the appropriate attitude to perform specific tasks. Core reproductive and sexual health competencies in primary health care include appropriate attitudes, knowledge, and ethics; respect for human rights; the ability to lead; teamwork; the capacity to engage in social activities; and the ability to provide education, counselling, and clinical services.
5	[11]	Feng et al., 2023	China (Beijing)	Qualitative comparative study (BEI + csQCA)	n=23 pediatric residents	Medical	<i>Health competence</i> is the capacity, in day-to-day medical practice, to skillfully deploy clinical skills, medical knowledge, interpersonal communication, clinical reasoning, empathy, and accumulated clinical experience in diagnosis and patient care.

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6	[17]	Javed et al., 2023	Pakistan	National cross-sectional survey	n=862 responses (27 dental schools)	Dentistry	Beyond clinical operative procedures, dental graduates are expected to demonstrate competence in soft skills, including time management, critical thinking, problem-solving, professionalism, leadership, teamwork, and interprofessional collaborative practice.
7	[18]	Yu et al., 2021	China (Anhui; 5 medical colleges)	Cross-sectional descriptive correlational study	n=1518 students	Nursing education	Clinical competence is defined as students' ability to integrate knowledge, skills, attitudes, and values into specific nursing practice.
8	[19]	Vincent et al., 2022	Multiple (systematic review)	Systematic review (PRISMA)	n=14 studies	Nursing education	Educators often use assessments to determine their students' levels of knowledge and skills, and can use the results to inform improvement efforts that support student learning.
9	[1]	Faraji et al., 2019	Iran (Kermanshah)	Cross-sectional study	n=155 nurses	Nursing	Competence is the set of knowledge, skills, attitudes, values, and abilities that enhance efficiency and effectiveness in professional work environments. Clinical competence encompasses general competencies (e.g., management and communication skills, professional skills, team performance, and the ability to deliver primary and specialised health services) and specific competencies (e.g., quality-of-care assessment, implementation of specific processes, performance monitoring, and the capacity to monitor health and disease).
10	[4]	Nabizadeh-Gharghozari et al., 2021	Iran (hybrid concept analysis)	Hybrid concept analysis (theoretical + fieldwork)	Theoretical phase: 42 articles; fieldwork: 18 interviews	Nursing	Competence in nursing is a complex, relative, variable, and context-bound concept comprising knowledge, skills, attitudes, and logical, scientific, and behavioural attributes, on the basis of which a professional can practice competently and independently in accordance with standards and make accurate clinical judgments across diverse situations.
11	[20]	Dehnavi et al., 2022	Iran (Tehran)	Cross-sectional correlational study	n=200 nurses	Nursing	Competence is the set of knowledge, skills, and attitudes required for safe and effective performance without the need for direct supervision.
12	[21]	Falk & Lindström	Sweden	Cross-sectional survey	Participants: n=32 (prehospital) + n=30	Nursing	"General clinical competence" is described as "the ability to perform tasks to the desired outcome across diverse real-world conditions."

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		om, 2022			(acute); admitted n=45 + n=42		
13	[22]	Azimira d et al., 2022	United Kingdom & Finland (2 acute hospitals)	Comparative cross-sectional correlational study	388 nurses	Nursing	Nurses' clinical competence in recognising and responding to patient deterioration depends on their knowledge, skills, and attitudes, as well as their level of expertise (novice versus expert).
14	[23]	MacKay et al., 2023	Multiple (scoping review)	Scoping review + thematic analysis	n=13 articles included	Health professions	Competence has been identified as encompassing knowledge, skills, attitudes, values, and performance, all of which can be enhanced through education, training, and professional development.
15	[12]	Charette et al., 2020	Not applicable (systematic review)	Systematic review of psychometric properties	10 competence scales (evidence synthesis)	Nursing	Competence is a holistic, complex, and evolving combination of knowledge, skills, attitudes, and values that is bound to the context of practice.
16	[24]	Motoya et al., 2020	Japan	Single-institution observational assessment (OSCE-based)	n=12 PT + n=4 OT (total n=16)	Physical therapy	Competence is the acquisition of knowledge, basic techniques, and actual patient care."
17	[25]	Leonard sen et al., 2021	Norway (ICU context)	Cross-sectional study (education effect described)	164 nurses	Nursing	Competence has been described as "a combination of knowledge, skills, personal qualities, and understanding that are applied effectively not only in predictable specialist contexts but also in unexpected and unstable circumstances."
18	[26]	Lew et al., 2020	Singapore	Propective study (CUSUM analysis)	n=24 junior residents (no prior epidural experience)	Medical obstetrics	Compared with other technical skills, a higher minimum case volume is required to demonstrate competence.

Table S1 summarizes definitions of clinical competence across disciplines. Overall, clinical competence is consistently described as a multidimensional construct integrating knowledge, skills, and performance in practice.

Table S2. Full Attribute and Cluster Mapping By Source

Attribute	n	%	Cluster
Knowledge [1], [4], [5], [12], [15], [16], [18]–[20], [22], [24], [25]	12	66.7	Cognitive Capability
Cognitive skills [5],	1	5.6	
Understanding [5], [23]	2	11.1	
Critical thinking; Problem-solving [17]	1	5.6	
Sufficient information [16],	1	5.6	
Medical knowledge [11]	1	5.6	
Thinking/reasoning skills [11]	1	5.6	
Logical and scientific attributes [4]	1	5.6	
Judgment [5],	1	5.6	Affective capability
Values [1], [18], [22]	3	16.7	
Attitudes [1], [4], [12], [16], [18], [20], [22]	7	38.9	
Systematic, structured health assessment [5]	1	5.6	
Interpersonal orientation [5]	1	5.6	
Task-oriented attitude [16]	1	5.6	
Ethics [16]	1	5.6	
Holistic, complex, evolving, and context-bound values [12]	1	5.6	
Personal qualities [25]	1	5.6	Psychomotor capability
Skills [1], [4], [12], [15], [18]–[20], [22], [25]	9	50.0	
Technical skills [1], [23], [26]	3	16.7	
Ability to perform specific tasks [1], [15]	2	11.1	
Basic techniques [5], [24]	2	11.1	
Psychomotor, Psychomotor skills [5], [16]	2	11.1	
Ability to apply skills in everyday life [23]	1	5.6	
Clinical skills [11]	1	5.6	
Counselling ability and clinical services [16]	1	5.6	Advanced nursing skill
Ability to provide counselling and clinical services [16]	1	5.6	
Actual patient care [24]	1	5.6	
Empathy [11]	1	5.6	Soft skill
Interpersonal skills [11]	1	5.6	
Communication skills [16]	1	5.6	
Capacity for social engagement [16]	1	5.6	
Appropriate ethics [16]	1	5.6	
Respect for human rights [16]	1	5.6	
Decision-making ability [16]	1	5.6	Leadership
Leadership/ability to lead [16], [17]	2	11.1	
Teamwork [16], [17]	2	11.1	
Interprofessional collaborative practice [17]	1	5.6	
Professionalism [4], [17]	2	11.1	Professionalism
Performance [22]	1	5.6	
Works without direct supervision [20]; role autonomy [4]	2	11.1	
Ability to perform across diverse real-world conditions [21] [25]	2	11.1	
Time management [17]	1	5.6	
Personal qualities [25]	1	5.6	

Table S2 presents the detailed mapping of identified terms into seven domains of CC based on frequency analysis and thematic clustering. The domains include cognitive, affective, and psychomotor capabilities; soft skills; leadership; professionalism; and advanced nursing skills.

Table S3. Empirical Referents/Instruments Inventory and Domain Mappings

Category	Measure / instrument	Assessment mode	Typical target	Indicative cluster coverage (7 clusters)	Source	Notes (use in Step 8)
Performance-based assessment	Direct observation + checklist	Observed performance	Students / new graduates	COG; PSY; PROF	[34]	Used to document task execution, safety, and supervision needs.
Performance-based assessment	OSCE (Objective Structured Clinical Examination)	Observed performance (standardized stations)	Students	COG; PSY; SOFT; PROF (and sometimes LEAD/ADV by station design)	[34]	Can be blueprint-mapped to 7 clusters by station objectives.
Simulation-based performance	Creighton Simulation Evaluation Instrument (C-SEI)	Observed simulation performance	Students	COG; PSY; SOFT; PROF	[37]	Useful when clinical exposure is limited; scenario-driven.
Simulation-based performance	Creighton Competency Evaluation Instrument (C-CEI)	Observed competency/performance	Students	COG; PSY; SOFT; PROF	[37]	Often paired with simulation; supports standardized rating.
Self-report / competence scale	Nursing Professional Competence Scale–Short Form (NPCS-SF)	Self-report competence rating	Nurses / students	COG; AFF; PSY; PROF (may include SOFT/LEAD depending on subscales)	[38]–[39]	Validated/adapted in multiple contexts (as cited).
Self-report / competence scale	Nurse Competence Scale (NCS)	Self-report competence rating	Nurses	COG; PSY; PROF	[40]	Listed in Yilmaz review (as cited).
Self-report / competence scale	Holistic Nursing Competence Scale (HNCS)	Self-report competence rating	Nurses	COG; AFF; PSY; PROF	[40]	Emphasizes holistic nursing competence domains.
Self-report / competence scale	Intensive & Critical Care Nursing Competence Scale	Self-report competence rating	Nurses (ICU/critical care)	COG; PSY; PROF	[40]	Context-specific for critical care practice.
Self-report / competence scale	Self-Evaluated Core Competencies Scale	Self-report competence rating	Nurses / students	COG; AFF; PSY; PROF	[40]	Core competency framing; can be mapped to clusters.
Self-report / competence scale	Competency Inventory of Nursing Students (CINS)	Self-report competence rating	Students	COG; AFF; PSY; PROF (may include SOFT)	[40]	Student-focused; supports formative monitoring.

Category	Measure / instrument	Assessment mode	Typical target	Indicative cluster coverage (7 clusters)	Source	Notes (use in Step 8)
Self-report / competence scale	Nursing Students Core Competencies Scale (NSCC)	Self-report competence rating	Students	COG; AFF; PSY; PROF (may include SOFT/LEAD)	[40], [41]	Appears both as a general instrument and a student tool (as cited).
Self-report / competence scale	Nursing Students Competence Instrument (NSCI)	Self-report competence rating	Students	COG; AFF; PSY; PROF	[40]	Student competence profile complements the OSCE.
Self-report / competence scale	Ambulance Nurse Competence Scale (ANC)	Self-report competence rating	Ambulance nurses	COG; PSY; PROF	[40]	Prehospital-specific; included as an example instrument.
Competency-based assessment	Nurse Practitioner Student Competency Scale	Competency attainment rating	NP students	COG; PSY; PROF; LEAD (program-dependent)	[42]	Role-based competency tracking.
Competency-based assessment	Capstone Core Competency Scale	Competency attainment rating	Students / capstone	COG; AFF; PSY; PROF (may include SOFT/LEAD)	[43]	Useful for end-of-program summative evaluation.
Non-technical skills	NTS-Nursing Scale	Rating of non-technical skills	Students / nurses	SOFT; COG (situational); PROF	[44]	Aligns strongly with soft-skill emphasis and safety behaviours.
Learning capability (supporting indicator)	Self-Directed Learning Instrument (SDLI)	Self-report learning capability	Students	(Antecedent indicator; supports COG/AFF/PROF development)	[45]	Better positioned as an antecedent-related indicator, not CC itself.
Proxy academic indicators	Graduate Record Examination (GRE)	Academic score	Applicants / students	COG (proxy only)	[46]	Indirect indicator; use cautiously as CC referent.
Proxy academic indicators	Grade Point Average (GPA)	Academic performance	Students	COG (proxy only)	[47]	Indirect indicator; does not capture clinical performance alone.

Table S3 summarizes empirical referents and measurement instruments for CC, including performance-based assessments, simulation tools, self-report competence scales, and competency-based evaluations. These instruments collectively map across the seven identified domains, with varying coverage depending on the assessment approach and context.