



# Defining Cognitive, Higher Order Thinking, and Psychomotor Meta-Skills: Three-Curricular Content Concept Analysis

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## Abstract

Rapid technological changes, reduced job security, the need for developing professional skills, and the urgent need for capable and adaptable physicians are the important issues that medical, educational systems must pay more attention to. Based on existing evidence, outcome-based education is the best approach for facing this situation, and competency-based education is a preferred strategy for planning and quality assurance of medical education. CanMED in 2015 claimed that competency-based education is known as the preferred educational approach and developed a framework consisting of seven competency groups. Graham Cheetham and Chivers denoted that professional competencies included a set of skills. Also, ACGME provided six main capabilities for the physician in which a variety of skills were required for carrying out professional tasks. One of the important dimensions of these skills is general skills that play an important role in the ability of the individual to apply his/her learning and can be used generally in all activities. In this study, this part of skills is conceptualized as “meta-skills” because the ability to build and develop other skills in individuals is formed through the acquisition of these meta-skills. We divided meta-skills into three groups, including psychomotor meta-skills, basic cognitive meta-skills, and higher-order thinking meta-skills, and developed an analytical definition for each group with certain defining attributes.

**Keywords:** Defining, Cognitive Skills, Higher Order Thinking Skills, Psychomotor Skills, Meta-Skills, Medical Education, Concept

## 1. Context

Nowadays, very rapid changes are observed in the world of work. Reduced job security, rapid technological changes, and increased individual responsibility for keeping pace with the growth of the body of knowledge related to professional expertise and keeping the skills up to date are among the challenges faced by professionals (1). De La Harpe et al. (2) acknowledged that graduates entering the work environment do not possess some skills and have weaknesses in other skills. Fallows and Steven (3) emphasize the important role of higher education institutions, as they are responsible for developing professional skills in their learners and create job opportunities for their graduates. They should help their learners to manage and improve their capabilities (3). In the recent UK statement related to the national leadership and labor force federation in the National Health System (NHS), a question is raised: What kind of education and training can help the NHS achieve its goal of providing more efficient services? (4).

Based on available documents, it can be said that in

the best conditions, education considered so far by the medical science education system is outcome-based education, and the competency-based approach is considered as the preferred curriculum approach and is one of the important strategies for the quality development of medical science education (5, 6). The concept of competence is too complex and controversial. Newble (7) defined competence as “the mastery of a body of relevant knowledge and the acquisition of a range of relevant skills”. Therefore, skill is an essential component of the concept of competence.

By paying a little attention to the literature and documents related to the medical curriculum, it is found that a lot of skills have been neglected and there is no special planning for fostering such skills in medical students, and students do not acquire these skills during the years of studying (8, 9). Since technology is advancing quickly, the pattern of diseases is constantly changing, and workplaces are undergoing various changes, training students on all the required skills according to ongoing changes is beyond the capacity of the educational system, and facilities of the

educational system are not adequate for such a condition. Moreover, teaching a fixed set of skills does not meet the ever-changing needs of medical care systems. Therefore, teaching a series of general and basic skills that help one to get and learn other specialized skills is very important, through which one can develop the ability to learn and upgrade his/her required specialized skills independently (10-12).

These sets of skills are called meta-skills by nature because other skills require applying these skills; they are generally used in all tasks, and the ability to build and develop other skills is formed in individuals through the acquisition of these meta-skills. Since meta-skills have different types and they have not been carefully reviewed in the relevant literature on medical education, this research attempted to determine different types of meta-skills required for doing duties of the physician and present an analytical definition for each meta-skill based on concept analysis.

### 1.1. Literature Review

CanMED in 2015 claimed that competency-based education is known as the preferred educational approach, and developed a framework consisting of seven competency groups including medical expert competency, professional competency, communicator competency, collaborator competency, scholar competency, health advocate competency, and manager competency. Among these seven competencies, the area of medical expert competency is the most important area located at the center of the CanMED model, where the physician combines all other areas and uses his medical knowledge and learned skills with his professional values to provide high-quality patient-centered care to patients. To perform, promote, and complete professional tasks, the acquisition of some skills seems necessary, which are manifested in these seven areas. Some of these skills are specific to certain tasks, and others are general and used in most tasks (13).

Miller considered competence in the form of a pyramidal hierarchy in which the learner starts learning from the very first levels of knowledge- knows- and reaches knows how and then learns shows how, and finally reaches does where the learner conducts affairs independently. Miller's assumption about the concept of competency levels is proficiency, which can be displayed as a range from safe/functionally adequate to skill mastery, and where individuals are placed depends on several factors. Some factors are related to the individual, and some factors to the structured methods of education and learning (14).

By reviewing the relevant literature on outcome-based education, some models have been presented for the development of skills in which a variety of skills were considered, including the comprehensive capability model of Graham Cheetham and Chivers. Four key components of professional competencies are presented in this model, each of which includes a set of skills:

**Functional Competency:** The ability to perform some job-based tasks that effectively address specific outcomes. This competency has separate skills and emphasizes their use to achieve specific outcomes.

**Personal Competency:** The ability to adapt appropriately and do observable behaviors in work-related situations.

**Cognitive Competency:** Knowledge about the proper work and the ability to effectively apply this knowledge in practice.

**Ethical Competency:** Proper professional and personal values and the ability to judge correctly based on them in different situations in the workplace.

The generic level of these four main components filling by meta-competencies that include skills of communication, problem-solving, creativity, analysis, and self-promotion (15).

In an article published in 2007 entitled "what is competence?", Winterton and Delamare claimed the development of a comprehensive model of professional capability containing four sets of capabilities and competencies related to each other. This framework contains cognitive ability, functional competency, social competency, and meta-competencies in which each component comprises several skills (16). ACGME also provided six main capabilities for the physician in which a variety of skills required for carrying out professional tasks include:

- Patient care;
- Medical knowledge;
- practice-based learning;
- System-based practice;
- Professionalism or professional commitment;
- Interpersonal and communication skills.

However, they were not explicitly examined and emphasized (17).

Some institutions, including the Committee of University of British Columbia (UBC) Faculty of Medicine (18), the postgraduate office of the University of Saskatchewan College of Medicine (19), the Council of Ontario Faculties of Medicine (20), and many other universities also set up a set of skills required for their general medical graduates, categorized into five areas.

Observation;  
 Communication;  
 Dexterity/motor skills and procedural skills;  
 Intellectual, conceptual, integrative, and quantitative abilities;  
 Behavioral and social attributes.

In Australia, emphasizing the importance of general skills in professional development, a series of efforts were made to clarify and apply these skills in educational and workplace systems, including the KARMEL Committee's effort in 1985 to assess the quality of education in Australia, emphasizing the importance of global labor force competition, arguing that educational outcomes would ultimately enhance the competitive advantage of Australia. The committee suggested that learners should be prepared for both training and employment accomplished by acquiring some skills such as access to information, communication skills, and teamwork (21). Then, in 1991, the FINN Australian Education Assessment Committee understood the importance of developing key competencies in their learners by examining post-graduate students after compulsory education. Due to the advancement of technology and changing the economic conditions of the educational system, the committee should emphasize both the acquisition of technical and job-specific skills and the adaptability with the prerequisite of acquiring general and transferable skills (22).

In 1992, based on the suggestion of the FINN Committee, the MAYER Committee developed a set of key competencies essential for the preparation of individuals for employment (23). In 1999, the Australian Industrial Group presented a report and brought attention to hard skills including information technology and soft skills including problem-solving, teamwork, and desire for adaptability, claiming that all these skills should be developed in the individual before being prepared for work (24). Also, in 2002, the Australian Chamber of Commerce and Industry, along with the Australian Business Council, conducted a study on employees' opinions on general skills and developed a very comprehensive list of basic employment skills, including necessary skills for different stages of working life. The report emphasized that a combination of these skills would lead to a high level of professional performance, and their integration into real life should not be discarded, but the development and assessment of these skills should be considered (25). In the same year, the Australian National Board of Education examined the development of employment skills in the veterinary sector, including a pilot test on different approaches for building and upgrad-

ing these skills in training packages and found that success in teaching and learning these skills depends on determining and clarifying them accurately (26). In 2000, the board of directors of Canada said that employment skills are the skills we need to enter, stay and progress in the world of work, and acquiring these skills becomes necessary when we want to work individually or as part of a group. These skills can be used outside of the work environment in a wide range of daily activities. Some of these skills include problem-solving, positive attitude and behavior, adaptability, work with others, technology, and math skills (27).

Given that in recent classifications, skills have received more attention, but meta-skills are interwoven with other skills, it is necessary that "meta-skills" as the basic skills enabling people to build, maintain, and upgrade other skills be identified and studied more profoundly. Thus, the present study provided a comprehensive classification of meta-skills in the medical education system, presented an analytical definition for each group in which the boundary between each meta-skill is distinguished, and provided some cases for each group. In this research, according to Walker and Avant's belief in the dynamic nature of concept analysis and its desire for the evolution of definitions given to concepts, a concept analysis method was used based on the Walker and Avant method so that the concept of "meta-skill" was examined with a comprehensive and applied approach.

## 2. Methods

Walker and Avant define the concept analysis as a strategy for measuring the characteristics or attributes of a concept. They emphasize that concept analysis should never be regarded as an end product, and the purpose is to achieve the existing definitions. This process is goal-oriented and methodological and seeks to clarify features related to the concept. The stages of the concept analysis defined by Walker and Avant are as follows:

- Choosing a concept;
- Determining the purpose of analysis;
- Identifying all uses of the concept;
- Defining attributes;
- Identifying a model case;
- Identifying antecedents and consequences;
- Defining empirical referents (28).

In this study, based on Walker and Avant's belief in the dynamic nature of the concept analysis and its desire to evolve the definitions of concepts, the Walker and Avant

(28) approach to concept analysis was used to review the concept of competence with a more holistic and practical approach.

### 2.1. Data Selection

We searched databases including SCOPUS, MEDLINE, Google Scholar, Web of Science, and ERIC using keywords:

(Overarching OR meta OR comprehensive OR general OR generic OR core OR common OR key OR basic) AND (skills OR abilities OR competencies), file type: pdf.

(Overarching OR meta OR comprehensive OR general OR generic core OR common OR key OR basic) AND (skills OR abilities OR competencies) AND (medicine OR medical OR physician), file type: pdf.

Thus, 778 documents were selected by reviewing the titles. In the next round, 64 documents were selected for further studies according to the abstracts of the articles, among which 14 documents were selected by removing duplicates and reviewing the entire text. Other 12 documents were added to the list of texts used in this study by applying the backward search method. Finally, a total of 26 documents were used as a base for the analysis.

## 3. Results

Descriptions were presented based on the steps in the Walker and Avant (28) analysis method.

Choosing the concept: According to the information emphasized so far, the concept of “meta-skill” was considered as the focal concept.

### 3.1. Determining the Purpose of the Analysis

The purpose of this concept analysis was to analyze various aspects of “meta-skill”, determine its general types, and provide an analytical definition for each meta-skill in the general medical profession.

### 3.2. Identifying All Uses of the Concept That can Be Found

Meta-skills are one of the foundations of academic achievement during studying and performing efficient and effective professional tasks in the workplace. Determining these basic skills in organizing curricula and methods of teaching and learning is very important and, subsequently, can help determine methods of assessment and evaluation (29, 30). Meta-skills also play a major role in fostering graduate students to become lifelong learners, be adaptable to changes in the workplace, and enhance their capabilities (11).

### 3.3. Determining Defining Attributes

Since there were many proposed substructures for each of the three main concepts and they might be mixed together, we considered some areas in terms of nature and function of the concepts to establish a distinct boundary between the main concepts. These areas are as follows (for ease of understanding of the nature of areas, each area was defined in terms of the concept of “cognitive meta-skill”, given that definitions and related areas can apply to the other two concepts):

**Character:** Known as an attribute to identity; a description of how we identify an identity as a cognitive meta-skill.

**Content:** What constitutes “cognitive meta-skills” by bringing together, known as its components; their accumulation must necessarily build “cognitive meta-skill”.

**Result:** By applying “cognitive meta-skills” in action, basically, something is achieved that is the result we are looking for.

**Development:** The methods by which “cognitive meta-skills” can be developed in individuals.

Accordingly, the information was grouped and the boundary between the concepts was determined. The defining attributes are shown in [Table 1](#).

### 3.4. Identifying a Model Case

A model case represents an example of the desired concept, which includes all the defining attributes. The sample case and the mentioned defining attributes are shown in [Table 2](#).

Identifying antecedents and consequences: To perceive and understand the circumstances and outcomes related to the concept of meta-skill, [Figures 1](#) and [2](#) are used.

It is evident that all basic cognitive functions, including perceiving, memorizing, comprehending (understanding), applying, analyzing, and synthesizing are based on executive functions of the brain and they together provide the possibility of thinking at high levels, which includes the ability to develop critical thinking, creative thinking, and caring thinking, through which complex cognitive processes can be provided to the individual.

Also, performing psychomotor skills involving work with people, work with the equipment, and work with the in-virtual world requires one to acquire basic communication skills and basic physical skills, and use equipment and programs, through which a reliable relationship can be established between the doctor and the patient, the power of management and teamwork can be improved, clinical effectiveness can be enhanced, and patient satisfaction can be achieved.

**Table 1.** Defining Attributes

Overarching Curricular Concepts	Definitional Areas			
	Characteristics	Content	Results	Development
<b>Meta-skills</b>				
<b>Cognitive Meta-skills</b>	Overarching, basic, and intellectual	Remembering, understanding, applying, analyzing, evaluating, and creating	Decision making, problem solving, judgment, and learning	Dialogic teaching, thinking-based classrooms, teaching philosophy and logic, and cognitive training
<b>HOTS</b>	Overarching, higher order, and intellectual	Critical thinking, creative thinking, system thinking, and strategic thinking	Complex decision making, complex problem solving, complex judgment, and deep understanding	Ask, listen, reflect: questions that probe assumptions, questions of clarification, questions that probe reasons and evidence, questions about viewpoints or perspectives, questions that probe implications and consequences
<b>Psychomotor Meta-skills</b>	Overarching, professional, and psychomotor	Physical examination, and history taking	Realization of professional decisions	Demonstration, simulation, virtual reality, and supervised skill practice

**Table 2.** Sample Case and Defining Attributes<sup>a</sup>

Defining Attributes	Sample Case
<b>Work with people</b>	A doctor is working at a rural health services center. Today, after visiting her first patient, she found that a young girl living with her 75-year-old mother has come with a bunch of flowers. Recently, her mother has suffered from bedsores due to long sleep and inactivity due to aging. They had visited the doctor one month ago and now the patient's wounds have been treated.
<b>Caring thinking</b>	The patient's daughter was a flight attendant. She didn't have the time to take care of her mom at the moment, and because of financial constraints, she couldn't hire a nurse for her mother. It created a complicated condition for the doctor because the sleep position of the patient needed to be changed regularly and continuously, and wound dressing should be changed every day.
<b>Creative thinking</b>	The doctor had to find a solution to this problem. By analyzing the situation, she came to the conclusion that she should talk with the central emergency staff regarding the assistance to the patient, and ultimately, it was decided that the medical emergency practitioner be discharged one hour earlier to go to the patient's home for changing her wound dressing.
<b>Work with people</b>	In return, a free training course will be provided by the doctor in her spare time for the practitioner to familiarize her with one of the databases publishing credible articles on emergency medicine.
<b>Caring thinking</b>	The doctor, with the agreement of the patient's daughter, ordered a wavy mattress for the patient from the center contract party's medical equipment, so that patient's family can pay the price in installments and thereby, the problem of patient regular relocation is resolved.
<b>Work with equipment</b>	Then, the doctor taught the patient and her daughter how to work with wavy mattresses and observe the safety precautions.
<b>Work with in virtual world/perceiving/memorizing/comprehending</b>	In order to fulfill her commitment to the practitioner, the doctor first studied the resources on the main databases of emergency medicine and tried to understand and learn how to apply one of the databases.
<b>Critical thinking/analyzing/synthesizing</b>	Then, the doctor analyzed the database and listed its strengths and weaknesses and ultimately, for optimal use of the database, planned how to access the resources in the shortest possible time and with the utmost accuracy by applying the correct filters.
<b>Applying</b>	Then, the doctor presented what she had learned to the medical emergency practitioner on a day off.

<sup>a</sup>And now, after one month, wounds had been healed, the patient's daughter had brought the doctor a bunch of flowers to thank her.

### 3.5. Analytical Definition of Concepts

#### 3.5.1. Cognitive Meta-Skill

It is "A comprehensive, basic, and rational skill of requirements involved in remembering, understanding, applying, analyzing, evaluating, and creating. It provides a basis for decision-making, problem-solving, judgment, and learning, and is developed through dialogic teaching, thinking-based classrooms, teaching philosophy, and logic and cognitive training".

#### 3.5.2. Higher-Order Thinking Meta-Skill

It is "A comprehensive, higher-order, and rational skill of requirements involved in critical thinking, creative thinking, and caring thinking. It provides a basis for complex decision-making, complex problem-solving, complex judgment, and deep understanding, and is developed through education based on asking questions that probe assumptions, questions about viewpoints or perspectives, and probe reasons and evidence, as well as questions of clarification, in line with the implementation and

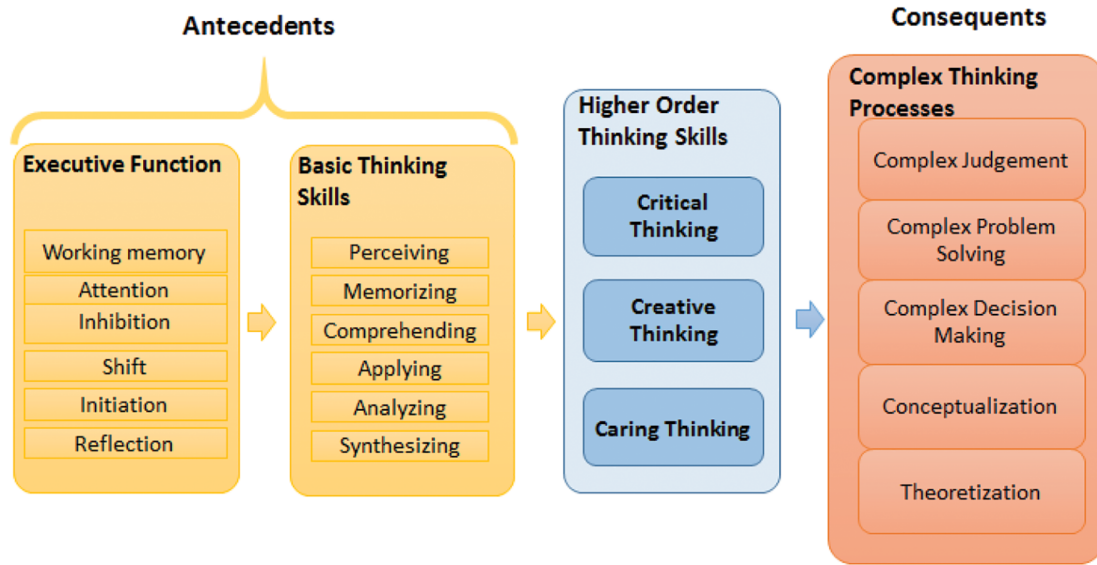


Figure 1. Antecedents and consequences of higher-order thinking skills

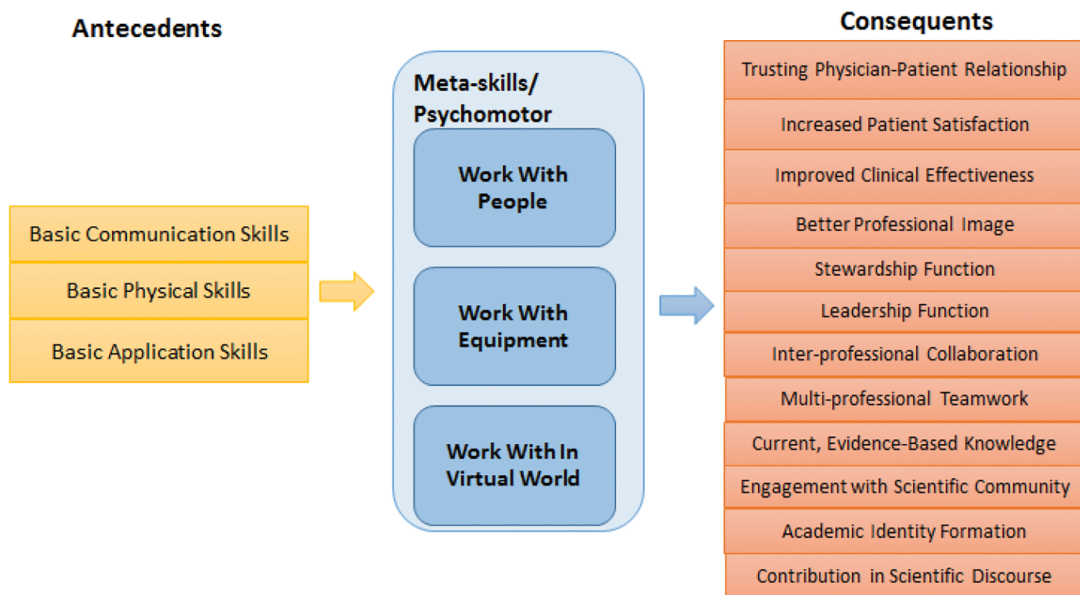


Figure 2. Antecedents and consequences of psychomotor meta-skills

final consequences, along with reflecting on what’s being heard”.

### 3.5.3. Psychomotor Meta-Skills

“A comprehensive, occupational (job-related), and psychomotor skill of requirements involved in work with peo-

ple, work with the equipment, and work with the in-virtual world. It provides a basis for the realization of professional decisions and is developed through education based on demonstration, simulation, virtual reality, and supervised skill practice”.

#### 4. Conclusions

The concept of meta-skill is one of the basic concepts in the outcome-based education system and one of the main categories in the workplace, which recognizing its types and planning to foster it requires many studies. In this research, we tried to introduce and define types of meta-skills having a curricular structure. Further studies are needed to better understand the cases related to meta-skills in the medical field. To this end and for releasing a complete draft of the cases, in the forthcoming research, we will try to present the taxonomy of meta-skills to provide an inclusive and comprehensive list through which all medical disciplines can select the cases and prepare appropriate educational programs based on their interest and needs.

#### Footnotes

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