MODEL OF DEVELOPMENT OF MODEL COMPETENCES OF A FUTURE TEACHER OF INFORMATICS

Yusupova Gulchekhra Yuldashevna
Lecturer of the Department of Informatics and Methodology
Tashkent State Pedagogical University named after Nizami
Republic of Uzbekistan

Abstract. *This article discusses the Competence Learning System, which provides an internationally significant tool for describing competencies. This competency-based approach is well suited for building a learning environment and will assist program developers in solving the problem of developing, describing and including competencies related to computer and IT professionals, and most importantly, future computer science teachers.*

Key words: *professional competence, computing competence; competence, competency curricula, computational thinking, inclusiveness, teaching standards, computer science.*

How can we describe and analyze the content and results of higher education programs in order to understand how they are structured and function? To answer this question, we are developing a framework for modeling the competencies of graduates associated with higher education programs in computer disciplines. Although our main focus is on computing, the structure is applicable to education in a broader sense.

The American social philosopher and educator, the theorist of pragmatism - John Dewey and his compatriots suggested that the main goal of higher education is "to help people develop their abilities to realize their vocation (that is, to be effective in their favorite profession)".

To achieve this goal, it is necessary to establish, develop and evaluate the educational process by which students studying in computer engineering programs turn into professionals in the field of computer technology. Historically, computer education has relied on knowledge about the content, defining the totality of knowledge and results of the program, which are focused on knowledge about the content of the educational program. However, such an emphasis on knowledge is problematic in the context of 21st century computing, where the boundaries between knowledge-based descriptions of computational disciplines and the broad computer science profession are becoming increasingly blurred. In computing and IT, problems also arise due to the complex dependencies inherent in the deep integration of these disciplines into almost all aspects of human life.

This article develops an empirically controlled framework (SOC) for determining competencies in computer disciplines in higher education. To develop the SOC (Competence training system), we applied a multi-faceted approach that combines a comprehensive synthesis of literature with a structured identification of the competencies of graduates from key groups of stakeholders. In particular, we studied the student discourse related to professional competencies and the development of concepts of professional competencies over time. As a theoretical starting point, we study the literature devoted to the concept of competence as a means of describing computer programs and exchanging information between various stakeholders. Based on this analysis, we propose a working definition of competencies and a competency learning model through which students develop the competencies of their degree program.

The goal is to provide a promising and sustainable approach to the definition of disciplinary competencies. We propose a shift in the approach to graduate learning outcomes based on the body of knowledge (SZ) of

disciplinary areas. Instead, we propose to apply a structured analysis to the expectations of graduates caused by stakeholders in computer education. These stakeholders include teachers, students, industry representatives and other employers of computer graduates, policy makers, professional communities, etc.To help develop competencies that express the expectations of graduates of educational programs when they start a professional career and participate in the civic aspects of their lives, we offer a theoretical model and methodology for formulating competencies based on data obtained from a number of interested communities identified by us.

Defining a competency - based description of a computer degree program using the competency model proposed here involves collecting empirical data through surveys and interviews with stakeholders. The data sets are then systematically examined using the proposed model and analytical methodology to obtain a set of competencies in which increasingly abstract competencies describe the computational tasks of the degree program and the graduate's profile in terms of what his graduates are ready to do in the workplace. and society as a whole.

The application of the model is demonstrated on two data sets collected from academic and student stakeholder groups, which are analyzed to determine competencies, which are a concrete example of how the model and methodology are applied.

Motivation - The educational needs of students in the field of computer technology are developing in accordance with the development of the intellectual and practical areas that make up the profession. Among the many issues raised is the emergence of a more general understanding of what constitutes computing as a discipline, and how computer education is described and transmitted between various stakeholders. The answer to these questions is crucial both for determining which new developments further expand the depth and breadth of the discipline, and those that are moving into other intellectual

and professional fields. In computer education, this is especially important, since there are significant differences in what a specific computer term means in various computer engineering disciplines and in various educational programs around the world. Thus, there is an urgent need for a" common system " for a reasonable description of computer education programs and their respective goals.

Similarly, computing is more accurately described as a family of disciplines based on three interrelated intellectual traditions: the mathematical (or analytical, theoretical or formalistic) tradition, the scientific (or empirical) tradition, and the engineering (or technological) tradition. Within the framework of all three of these intellectual traditions, the general trend was the development of competence models and ontologies focused primarily on cognitive development and, consequently, on the predominance of the knowledge dimension. Therefore, one of the motivations for this work is to offer a model and methodology that will allow the goals of higher education programs to go "beyond the cognitive" and more clearly formulate the skills, knowledge, attitudes and professional values expected from a graduate. The next motivation is to encourage tertiary computing programs to explicitly expand their focus "beyond technical". Numerous professional, educational programs and disciplinary documents strongly suggest that computer science students should demonstrate professional competence in many ways, in addition to their technical knowledge. Expanding the field of discipline, for example, by focusing on social aspects, can lead to a greater diversity of people engaged in computer science, and thus to a more democratic promotion of technological development. Thus, a convincing competence model offers a means of more explicit integration of the expectations of computer graduates who go beyond the technical field.

The normative solution to questions concerning meaning consists in developing an ontology that creates a consistent structure of the language and

defines an area for common use, so that this language then becomes a "common system" for establishing a common meaning. Various attempts to develop ontologies of computer education have proved useful, but they are also incomplete and cannot be compared with different levels of education. The reasoning of the curriculum in the direction of using computer competencies as a means of describing computer degree programs in such a way that they can be meaningfully compared by nationality, languages, geographical locations and, possibly, by computer disciplines. The works that have been studied present a scientifically based definition of IT competence as a triad of interrelated parameters of knowledge, skills and predispositions related to the professional context.

Our goal is not to create an ontology of computer education, but rather to present a model and method of competencies that can be used to describe various computer disciplines in general and computational degree programs in particular. Using a more extensive approach to competence makes it possible to mint new currency, new means of describing and comparing computer degree programs and their components around the world.

This article is a methodological contribution to modulating the competencies of a future computer science teacher and includes an analysis and formulation of sets of disciplinary competencies used in computer education. The aim of this article is to develop a comprehensive, evidence - based competency framework, as well as guidelines for modeling competencies in computer-based education, suitable for comparing degree programs by nationality and discipline, allowing you to compare the competencies provided in each degree program.

The objectives of the work include the development of a better conceptual framework for explaining computer education and its relationship with quality and innovation. Therefore, in this article, the SOC model is developed as a method that helps to describe the relations between

competencies, knowledge sets, professional profiles, educational contexts and degree programs.

The competence model focuses on the meaning and use of competencies in the educational structure. Using this approach, it is possible to further describe the patterns of how to formulate a competence and illustrate its structure. Descriptions of the disciplinary areas of computing and other training programs that are used in education need to standardize all terminology and suggest ways to harmonize terminology over time.

The SOC provides for the development of an online comparison tool with open access. It is expected that the tool will use this and other scientific works so that interested parties (for example, computer science teachers, administrators, etc.) can use it to develop curricula and course descriptions. For example, they can use a comparison tool to inspire or motivate changes to an existing curriculum, correct or evaluate a given curriculum, compare one curriculum with another, or contrast one computer discipline with another.

One of the advantages of this study is to offer a more complete and practical set of evidence-based definitions of the term "competence". This job specifically represents an individual competence, not just a sum of knowledge, skills, and predispositions. Instead, he suggests that a well-formulated statement of competence should require all the components (potentially many of each component category) and a process that integrates them in a meaningful way in a given context.

This statement, although based on existing literature, asserts this, recognizing that the term "competence" has different and often contradictory definitions. We will make three main comments on this issue. First, competence is the development of skills in a particular field of work. Second, a competence is structured and combines knowledge, skills, and aptitudes. Third, competencies in the learning environment are not self-contained, but

demonstrate dependency relationships to describe different stages of learning in the degree program or academic unit in which learning takes place.

The literature justifiably asserts the notion that competencies are based on demonstrated performance in the context of work. Competence is understood in certain conditions and when performing purposeful specific tasks. While some work-related expectations may be ambitious, they are ultimately performative in nature and can be evaluated, as discussed in the literature on performance evaluation.

The second key understanding of competence concerns the internal structure of competence. This is a response to cognitive-oriented models that are common to many (most?)people. Computer programs, as well as knowledge, skills, abilities, and similar statements. In this sense, we argue that the proposed model of integrated knowledge, skills, and predispositions fits better with a more holistic approach to education and assessment, in the sense that current research in behavioral science "shows very clearly that each individual reacts as a 'holistic organism'. "or' the whole being'."

In this sense, the paper is an extension of the existing literature on competence modeling, as he suggests that a competence is not the sum of its parts, but rather a contextually related synthesis of these parts, extending the "pooling" approach. Understanding predisposition and understanding how and why it is important for the effective application of competence education (for example, is one of the main intellectual contributions of this work.

For the main purpose of developing tools for describing contextualized competencies, the approach used in this study was mainly twofold:

1) study the theory of competencies and

2) conduct a series of case studies to demonstrate potential applications of the study.

Here, the theoretical work was intended to provide information and reinforce the model, while the various retrospectives were intended to help

understand the problems associated with different approaches and help inform how to develop such models for use in education.

An important contribution to the development of the model was a thorough study of educational knowledge related to competencies, modeling of competencies and their use in various educational institutions.

Other important ways to explore our understanding of the concept of competencies were through data-driven case studies from the perspective of faculty and students. The purpose of several case studies was primarily to understand the perspectives of key stakeholders in the field of education, and secondly, to inform both the model being developed and the methods for developing competence descriptions in practice. They are reflected in the two lower rectangles in Figure 1.

We argue that most of the previous work on developing guidelines for computer science training has used the "unit of knowledge plus time" approach to create collections of the body of knowledge-the sum of knowledge (SP), which are contained in various disciplinary disciplines and are important sources of information for our work. The aim of these areas of research was to develop a theoretical framework for teaching competencies that could be applied to create descriptions of competencies located in different contexts.

In this illustration, an example of the use of this work is shown in Figure 1. The context is a degree program at a hypothetical university, which was originally defined based on a traditional approach based on a unit of knowledge and time. The blue thin arrow indicates one route from these NW (Sum of Knowledge) collections and their time measures related to the units of knowledge using the proposed theoretical framework to arrive at a description of the contextualized set of competencies defining the degree curriculum in terms of competencies within our Competence Learning Framework (SOC).

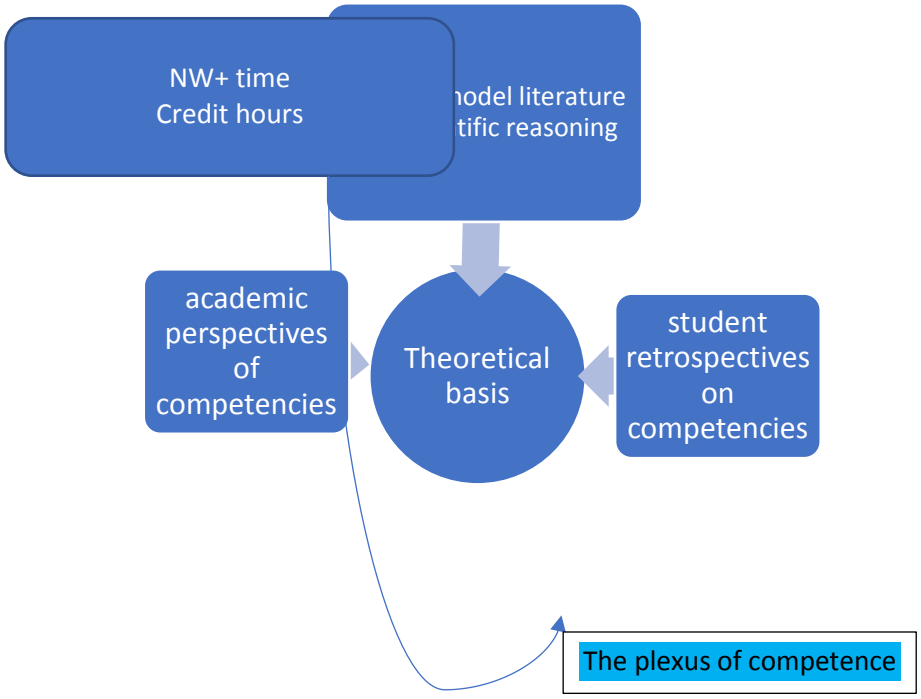

Figure 1. Combined theoretical and retrospective approach.

The educational literature on competencies and their role in structuring the learning process is extensive and includes insights on epistemology, agency, skill acquisition, and comparative statements of various competence structures. This has led to a variety of terminology, some of which are contradictory and almost all of which are confusing when trying to define the scope of the main definitions of the theory. Indeed, some researchers have stated that it is no longer possible to effectively coordinate the various uses of the terms under consideration and that the use of competence should be completely abandoned:

Winterton et al. wrote that put it this way: "There is such confusion and controversy about the concept of 'competence' that it is impossible to identify or attribute a coherent theory or arrive at a definition capable of accounting for and reconciling all the different uses of the term."

Van der Klink and Boon argue for the popularity of the concept, ironically, by the lack of clarity regarding the term "competence" and argue that the number of definitions "probably cannot be calculated". A literary study

conducted by Stouf, Martens and Van Merrienboer places this word in the category of "evil words", which means that its limits are difficult to determine, which makes full agreement on its meaning illusory. Despite the continuing vagueness, this term promises to be useful for bridging the gap between educational results and work requirements. In part, this confusion arises from the failure to disambiguate the fundamental terms associated with competence, which are often used synonymously in everyday language, in particular the words "competence", "competence, ability, ability, ability". Moreover, it sometimes happened that the plural numbers "competence «and»" competence " were not defined as a simple plural extending the singular.

In addition, words that have come to denote components of competence, such as knowledge, cognitive abilities, and skills, have also been ambiguously defined, again leading to confusion. For example, are we talking about being able to play the piano, or being proficient at playing the piano, or being able to play the piano in concert?

Competencies as a conceptual basis for evaluating the results of higher education can be traced back to the 1970s, when legal training programs for nurses and teachers were conducted in the United States. In these programs, special attention was paid to the acquisition of behaviors demonstrated by outstanding specialists in order to study and develop the desired set of skills. The resulting approach to studying the skills of copying behavior did not lead to the emergence of the intended competencies, and, consequently, the experiments did not attract many followers. Although there was renewed interest in this concept from trade unions and vocational education, it was only in the late 2009s that higher education began to show interest and resume its participation. And today, the following factors can be distinguished::

1) a shift in the labor market towards increasing career and professional mobility;

2) the emergence of "knowledge workers" and "knowledge economy", in which the application of knowledge and skills and "motivation to continue learning" are important for personal and professional growth; 3) new trends in higher education in response to an increasingly dynamic and complex world in which the acquisition of technical knowledge alone is not enough;

4) innovations in the study of science and education, such as collaborative learning, deep learning and contextualization, have caused a switch "from knowledge to learning".

In conclusion, it should be noted that the ever-pressing problem of transferring learning to new situations, combined with the transition from knowledge to learning, has created favorable conditions for the popularity of the terms "competence" and "competence", despite ongoing discussions about their meaning and use in curriculum development. As a reminder of this section, we provide some hints on the range of meanings inherited by these terms and the historical context in which they were used. Our study of the relevant literature also provides a working definition of competence, which we present in this document. Based on this definition, we propose two models, the Competency Model (SOC) and the Competency Learning model, to assist in the design of curricula and implementation of degree programs.

Competence/Competence. In general, we understand by "competence" the state of an ability or a general ability that is a necessary requirement for performance, or a set of characteristics that ensure performance. Some authors distinguish between the concept of competence and competence, with competence usually referring to functional areas, and competence to behavioral areas. In relation to professional and vocational education, this concept can also be defined in other words: professional competence is considered as a general, integrated and internal ability to provide sustainable effective (decent) work (including problem solving, implementing innovations and creating transformations) in a certain professional field, work, role, organizational

context and task. For example Armstrong sought to distinguish between competence and competence:

* competence describes what people should be able to do in order to do a good job; the emphasis is perhaps on achieving the desired result.

* competence is defined in terms of those aspects of behavior that underlie competent work. They are often called behavioral competencies, because they are designed to describe the behavior of people when doing their work.

Competent is an adjective denoting adequacy or qualification, as well as the ability or qualities to function and develop.

Competence can be used in different contexts:

* Competence as a prerequisite, for example, specific educational and training requirements necessary to obtain a permit to practice within a certain profession;

* Competence as a result, that is, the implementation of the specified standards;

* Competence as an ability shown when performing specific work tasks, i.e. competence as a practical achievement.

Woodruff [11] suggested that the term competence was used to refer to two factors:

* proven ability to perform the work competently, i.e. in accordance with the standards required when applying for a job;

* sets of behaviors that a person must demonstrate in order to competently perform the tasks and functions of the work.

Passow defines competence as " knowledge, skills, abilities, attitudes and other characteristics that allow a person to act skillfully (i.e. make informed decisions and take effective actions) in complex and uncertain situations, such as professional work, civic engagement and personal life."

The traditional dimensions of competence: knowledge, skills and relationships - or head, hand and heart-can now be seen and restructured ... to

better understand the integrity of the competence. Relationships, skills, and knowledge are not separate competencies or areas of competence, but rather components in the same holistic competence. We can say that skills without knowledge are blind, knowledge without skills is empty, and knowledge and skills without attitude are inert and ineffective. This point of view emphasizes that knowledge and cognition as a cognitive action is really an action that requires skills and attitude, like any material action. The latter, accordingly, requires and formats knowledge and skills and will not happen at all without the right attitude, i.e. the desire and need to do. The meaning of these definitions. We note that there is no consistent distinction between the terms "competence "and" competence", and that in some languages there is a single word for this construction. We decided to choose the English word " competence "to model this" general system " that will help computer education stakeholders to describe, compare and report on computer degree programs.

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