Structural Components Of The Digital Competence Of The Master Of Production Training Of The Agricultural Profile

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Summary
With the rapid development and introduction of digital technologies, both everyday human life and technological processes of any production are changing, which stimulates the transformation of the economy and education. Digital technologies are not only a tool, but also a living environment of modern human, which opens up new opportunities: learning at any convenient time, continuing education, the ability to form individual educational learning trajectories and more. However, the digital environment requires teachers to take a modern approach to the organization of the educational process, the formation of new skills and abilities to work in the digital educational environment. As a result of the study, it was found that the system of vocational education should provide training for masters of industrial training who have a high level of digital competence. The purpose of the article is to single out, theoretically substantiate and determine the level of formation of structural components of digital competence of future masters of agricultural training. The structure of digital competence of agricultural master was analyzed on the basis of domestic and foreign scientists researches. Systematized research results indicate that digital competence consists of four components: motivational-value (combination of internal and external motives for the use of digital technologies in future professional activities), cognitive (a set of theoretical knowledge, skills and abilities of future master of industrial training to effectively build educational process with the use of digital technologies), activity-professional (expansion and deepening of knowledge, skills, necessary skills for effective implementation of digital technologies in the educational process) and evaluative-reflexive (ability to analyze and self-analyze own activities and its results taking into account professional characteristics, self-realization in professional activities through the use of digital technologies). These components are comparable with the indicators that describe the knowledge, skills and abilities needed by the future master of industrial training to organize the modern educational process. A questionnaire was conducted to determine the levels of this competence formation, which allows us to conclude that it is necessary to increase the level of formation of all components of digital competence of future masters of industrial training in agriculture. The results of the study can be used as a basis for the development of disciplines that form the special competencies of masters of industrial training in agriculture and programs of advanced training of teachers.

Keywords:
Agricultural profile, Digital competence, Digital technologies, Digitalization of education, Master of industrial training

1. Introduction

Digital technologies have become an integral part of everyday human life, and the use of digital technologies in the educational process has made it possible to effectively organize distance learning during the COVID-19 pandemic. They have become the tool that has ensured the preservation of the continuity of the educational process, while the forced transition to distance learning has revealed the problems that exist in this area.

Digitization is currently the main trend in education, which primarily involves the intensification of the educational process, the introduction of adaptive learning, improving the forms and methods of organizing the educational process, creating a systematic education focused on the constant use of modern digital technologies. The "Concept of digital transformation of education and science for the period up to 2026" [[20]] presents a comprehensive systemic strategic vision of digital transformation of education and science of Ukraine, which meets the principles of implementation of executive principles of state policy of digital development, approved by the Cabinet of Ministers on January, 30 2019 № 56 [[25]], as well as priority areas and tasks (projects) of digital transformation for the period up to 2023, approved by the order of the Cabinet of Ministers of Ukraine dated February 17, 2021 № 365-p. [[15]]. The main condition for such development is the modernization of the

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education system, aimed at preparing the graduate who is able to live and carry out their professional activities in a digital environment, taking into account the requirements for new professions and changing values of society.

Confident, critical and responsible use and interaction with digital technologies for learning, employment, work, leisure and participation in public life is called digital competence. Today, digital competence is one of the key competences for lifelong learning and the main competence of any specialist in the fourth industrial revolution [[24]].

It should be noted that the enterprises of the agricultural sector of Ukraine are already actively using a wide range of modern special equipment equipped with digital technologies, which allows to effectively cultivate large areas and serve "smart" farms. Therefore, the formation of digital competence is important in the training of agricultural specialists, and the ability to use digital technologies is a guarantee that students after graduation will be prepared for the modern labor market and able to contribute to society. In particular, state standards in the field of vocational education already set a number of requirements for the use of digital technologies by teachers, and digital competence is defined as an important component of professional competence [[14]].

In this regard, the issues of professional training of future masters of industrial training in agriculture, who have the skills and abilities to organize the educational process in the digital environment, systematically use digital technology in their professional activities and know the features of the "digital generation" are extremely relevant.

2. Theoretical Consideration

2.1 Analysis of recent research and publications

The strengthening of the role of digital technologies in society is reflected in international instruments such as the Incheon Declaration: Education 2030 [[18]] and in the Framework Program of Updated Key Competences for Lifelong Learning [[2]], in which digital competence is identified as one of the eight key competences for life and activities of EU citizens.

The specificity of pedagogical education at the present stage of development of society is the fact that the future teacher will teach the "digital generation" of students who have certain features of perception, memory, thinking, motivation, behavior and more. Thus, there will be a change in the principles, approaches to the formation of the content of education, forms and methods of educational activities, which is impossible without digital competence of the teacher.

The concept of "digital competence of the teacher" is actively studied by foreign scientists. The study of the structure of professional competence of teachers in the context of digitalization of education is conducted under the guidance of the Committee on Education of the European Union [[8]], where in 2017 a profile of digital competencies of teachers was proposed Digital Competence of Educators (DigCompEdu). It has a recommendatory character and describes 22 competencies, in which the main focus is not on technical skills, but on the teacher's ability to use digital technologies to improve the efficiency of the educational process [[4]].

Foreign scholars S. Kluzer, S. Carretero, M. Giraldes, W. Okeeffe in their study describe the practice of implementing the European system of digital competencies (DigComp) in the educational process, consisting of 50 case studies and tools [오류! 참조 원본을 찾을 수 없습니다.].

G. Ottestad, M. Kelentrić [[7]] define the digital competence of the teacher in the form of a set of components: general (general knowledge and skills that teachers must have to function as "digital teachers"); didactic (reflects the digital specifics of the discipline) and professionally oriented (describes the features of the use of digital technologies in education).

K. Zierer and N. Seel [[10]] emphasize that the introduction of digital technologies in education will be effective if the key place is not technology, but the teacher and pedagogy: "The main focus of educational responsibility has always been human development. Man in pedagogy is both the starting point and the end result. This approach should be applied to the digitization of education. Digital technologies cannot replace the pedagogical component of the educational process. Moreover, digitalization must be subordinated to pedagogy".

E. Meyers [[3]] believes that the development of digital technologies and tools requires new knowledge and skills from the teacher: the teacher must provide students with the development of digital tools for advanced development of the younger generation and help him learn the necessary skills to increase access to new knowledge.

In Oxford University a study of pedagogical support systems for students in digital education was taking place, and it showed that teachers play a leading role in the development of new skills by their students. J. Yarbro emphasizes that in the digital space it is "the teacher who determines the pace of learning, the order of obtaining subject knowledge. The teacher is responsible for the progress of the student" [[9]].

Domestic scientists I. Vorotnikov, M. Zhaldak, S. Ivanova, N. Morse, O. Ovcharuk, T. Panina, N. Pakhotina, L. Popova, A. Semenov consider digital competence as a component of professional competence of a teacher and understand it as the ability specialist to navigate in the digital space, extract data and operate them in accordance with their own needs and requirements of modern digital society [[22]].

V. Kovalchuk and V. Soroka [[5]] in their study emphasize that the skills of digital technology, a generation ago were not in demand in many areas of economics, and today is a key competence necessary for the successful operation of a highly qualified specialist in any field. Scientists note that the digital competence of the pedagogical worker should ensure the formation of all its components: knowledge of the general principles, mechanisms and logic that underlie the creation of digital technologies; understanding of the principles of digital communication and cooperation; awareness of the functional features of digital technologies, the consequences and risks of their use.

Ukrainian researchers have revealed the content of digital competence of a teacher in the document "Description of digital competence of a pedagogical worker" [[21]]. Components of digital competence include the ability to navigate in the information space, receive information and operate it in accordance with their own needs and requirements of the modern high-tech information society.

Thus, a review of works of foreign and domestic scientists shows that the description and structuring of digital competence of a teacher is a priority area of research and shows the expansion of the content of its activities, changing training requirements and conditions of professional development of teachers. It should be noted that the qualification of a master of industrial training belongs to the group of professional qualifications in which two systems operate simultaneously, in addition to readiness for teaching, the master of industrial training must have appropriate competencies in industry or economy in which he trains future professionals.

The purpose of the article is to single out, theoretically substantiate and determine the level of formation of structural components of digital competence of future masters of industrial training of agricultural profile.

2.2 Research methodology

The research method used a system of methods, which contained an analysis of scientific works of domestic and foreign researchers on the formation of digital competence of future teachers and the use of digital technologies in education, taking into account the agricultural profile. Methods of mass collection of information to determine the level of formation of the components of the studied competence, comparative methods, quantitative and qualitative analysis in order to process the results.

Measures to implement a competency - based approach were identified basing on the analysis of the current state of the domestic system of vocational education, which is the methodological basis of state standards of vocational education and is a necessary condition for modernizing the vocational education system of Ukraine in accordance with global trends in vocational education institutions.

Analysis of research results on the training of future agricultural professionals to the requirements of the modern labor market, including work with digital equipment and consideration of the concept of "digital competence of the teacher" from the standpoint of the competence approach allowed to draw conclusions about the structural components of digital competence.

We developed a questionnaire in order to determine the level of formation the components of digital competence of future masters of industrial training of agricultural profile. It is based on the knowledge, skills and abilities necessary for a modern master of industrial training, taking into account the professional direction.

3. Experimental Consideration

Agriculture has become a data-intensive sector. The information comes from various devices and sensors located on special equipment, in the fields or on a "smart" farm, namely: agricultural machinery, meteorological stations, drones, satellites, external control systems, online agricultural platforms, suppliers or customers of raw materials. Data received from various devices allow to conduct agriculture effectively taking into account modern requirements of economy.

This requires the vocational education system of Ukraine to organize an appropriate level of training of highly qualified specialists through the formation of digital competence in future masters of industrial training of agricultural profile who directly train future professionals to work with modern equipment using digital technologies.

Today the problem of training future specialists in the agricultural sector to the requirements of the modern labor market, including work with digital equipment, has not been fully resolved in Ukrainian system of vocational education. The main problem is the lack of modern methods of training masters of industrial training with the use of digital technologies, which ensures the formation of professional competence at a high level [19].

The professional competence of the master of industrial training is considered as a reflection of the level of professional knowledge, skills, abilities, experience, sufficient to achieve the goal of professional activity. An important component of the professional competence of the master of industrial training in today's digital society is his digital competence [[6]].

The Law of Ukraine "On Higher Education" states that "competence is a person's ability to successfully socialize, learn, conduct professional activities, which arises on the basis of a dynamic combination of knowledge, skills, ways of thinking, views, values, and other personal qualities" [[16]].

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"competence is a dynamic combination of knowledge, skills, abilities, ways of thinking, views, values, and other personal qualities that determine a person's ability to successfully socialize, conduct professional and / or further educational activities" [[17]].

The methodological recommendations for the development of standards of professional (vocational) education according to the competence approach emphasize that the competence approach is the direction of the educational process to achieve learning outcomes and acquisition of competencies necessary for self-realization, personal development, successful professional, social and further educational activities [[13]].

I. Rozhenko, substantiating the importance of acquiring competence in the training of future specialists, emphasizes that competence is formed gradually, and the level of competence formation at different stages of training will differ. Applicants must have a clear idea of the structural components of the formed competence or its main elements that are necessary for the formation of a certain level [[27]].

According to I. Vorotnikova, digital competence requires the applicant to have certain skills and abilities that provide use of digital technologies in professional activities and in own needs. In the structure of digital competence the author identifies the motivational component, cognitive component, practical-activity component [[11]].

In the study of N. Morse and I. Vorotnikova, researchers describe three components of digital competence of the teacher − technical literacy, deepening knowledge and knowledge creation. Scientists also distinguish three components: cognitive (knowledge), operational (methods of activity and readiness to carry out activities), axiological (the presence of certain values) [[23]].

S. Prokhorov identifies four components of digital competence of the teacher: personal (expressed in the context of reflective skills and abilities of the teacher), motivational (responsible for a positive attitude to the use of digital technologies in education), cognitive (responsible for the necessary knowledge in digital technology) and activity (characterized by the formation of skills and abilities to work with electronic educational resources) [[26]].

According to researcher G. Genseruk the process of formation of digital competence of scientific and pedagogical workers should be built on the basis of actualization of motivational (awareness of the future teacher's need to master digital technologies), cognitive (future teacher's knowledge of digital technologies), activity (teacher's knowledge of digital technologies in future professional development), and reflexive (the ability of the future teacher to independently model the educational process using digital technologies) [[12]].

Based on the research of scientists and taking into account the peculiarities of training masters of industrial training, the specifics of the use of digital technologies in the educational process, we have identified the following structural components of digital competence of future masters of industrial training: motivational-value, cognitive, activity-professional, *evaluative-reflexive.*

Motivational and value component of digital competence of the future master of industrial training in modern conditions is of particular interest because it reflects the perceived need of the individual in the application of digital technologies in professional activities.

The importance of the cognitive component is noted by many scientists and characterized as a set of relevant integrated knowledge that combines knowledge in the field of digital technology and pedagogical knowledge to use in solving professional problems, the ability to constantly improve, willingness to be creative, flexible and critical thinking.

The activity − professional component consists in the formation of intellectual, cognitive, technical, technological skills, necessary skills for effective implementation of digital technologies in the educational process, for informed choice of digital content, digital security (sanitary norms and rules of digital devices) and skills in own digital content.

Assessing-reflexive component of digital competence includes the ability to analyze and self-analyze activities, agree on goals, methods and results, awareness of their own style of activity, willingness to self-improvement and self-development, skills and abilities of self-control, self-regulation, self-awareness and self-realization. The teacher's ability to reflect largely determines the success of his professional activities in modern conditions. Therefore, the importance of pedagogical reflection is especially growing in innovation.

Thus, in accordance with the essence of the concept and its structure, the components and indicators of digital competence of the master of industrial training of agricultural profile are determined.

Table 1: Components and indicators of digital competence of future masters of industrial training of agricultural profile

Component	Indicator
Motivational and value	1) Professional and personal position on professional activity in the context of digitalization of education. 2) Interest in the problems of education digitalization. 3) Psychological comfort in the process of mastering digital technologies. 4) Personal motives for the development of digital technologies in the agricultural sector and the use of digital educational resources. 5) The need to achieve results in the development of digital technologies, the use of digital resources.

Cognitive	1) Knowledge of the legal framework of their professional activities and requirements for the design of modern and safe digital educational environment. 2) Knowledge of the features of the "digital generation" and approaches to organizing the process of their education and upbringing. 3) Knowledge of the capabilities of basic digital educational tools, resources and platforms for organizing the educational process. 4) Knowledge of the features and capabilities of digital technologies used in agriculture.
Activity-professional	1) Ability to predict and predict the outcome of their professional activities using digital technologies and educational platforms. 2) Ability to design and plan the educational process using digital technologies and platforms using health technologies. 3) Ability to distinguish the main types of digital educational resources and use them at the appropriate stages of the lesson to increase its effectiveness. 4) Ability to organize production practices using modern digital technologies used in agriculture. 5) Ability to build communication, interaction and relationships in the digital environment, etc.
Evaluative and reflexive	1) Ability to evaluate personal results of mastering digital technologies. 2) Ability to make creative responsible decisions during the development of digital technologies, the use of digital educational resources. 3) Ability to understand the professional difficulties that arise in the process of using digital educational resources and mastering digital technologies in agriculture. 4) Self-control in professional activities for the implementation of digital technologies. 5) Ability to carry out control and evaluation activities aimed at themselves, summarizing their professional activities using digital technologies of digital platforms, etc.

To establish the level of digital competence of future masters of industrial training of agricultural profile on certain components and indicators, we have developed a questionnaire: "Comprehensive questionnaire to assess the level of digital competence of future masters of industrial training of agricultural profile". On its basis a survey was conducted with 226 applicants for professional higher education in the specialty 015 Vocational Education (Agricultural production, processing of agricultural products and food technology).

All questions are divided into 4 blocks, for which you can get 100 points. Each block of questions corresponds to the component of formation of digital competence of future masters of industrial training of agricultural profile:

Block 1 corresponds to the study of the motivational and value component of the digital competence of future masters of industrial training in agriculture. It is possible to get maximum of 40 points for 10 questions, which is interpreted by the appropriate levels: high − 27-40 points, medium − 13-26 points, low − 0-12 points.

Block 2 determines the level of the cognitive component of digital competence of future masters of industrial training in agriculture. For the correct answer to each question 1 point is assigned, maximum possible to receive 28 points for 28 questions. Interpretation of the points scored by the respondent by levels: high − 20-28 points, medium − 10-19 points, low − 0-9 points.

Block 3 explores the operational and operational component of the digital competence of future masters of industrial training in agriculture. For the correct answer on each question 1 point is assigned. Therefore, it is possible to get maximum 16 points for 16 questions. Interpretation of the points scored by the respondent by levels: high − 11-16 points, medium − 6-10 points, low − 0-5 points.

Block 4 determines the level of evaluative-reflective component of digital competence of future masters of industrial training of agricultural profile. It is possible to get maximum 16 points for 16 questions. Interpretation of the points scored by the respondent by levels: high − 11-16 points, medium − 6-10 points, low − 0-5 points.

The analysis of the obtained survey results showed that the majority of future masters of industrial training of agricultural profile assessed their general level of digital competence as medium (Table 2). Having systematized the results by components and levels of formation of digital competence of future masters of industrial training of agricultural profile, we obtained the following general result: high level − 19.5%, medium − 63.8%, low − 16.7% of students, respectively.

Table 2: The results of the analysis of the questionnaire of self-assessment of students according to the criteria of formation of digital competence of future masters of industrial training of agricultural profile

Levels of formation	**Digital competence**				
	Motivational and value	**Cognitive**	**Operational activity**	**Evaluative and reflexive**	**Everything**
	%	%	%	%	%
High	22	23	17	16	19.5
Medium	64	65	62	64	63.8
Low	14	12	21	20	16.7

Lets learn the data in more details.

The results of the study show (Fig.1) that at a high level the formation of the motivational-value component is demonstrated by 22% of respondents, the vast majority of

respondents (64%) has an medium level of formation of the motivational-value component, low levels of respondents Lets learn the data in more details 14.0%.

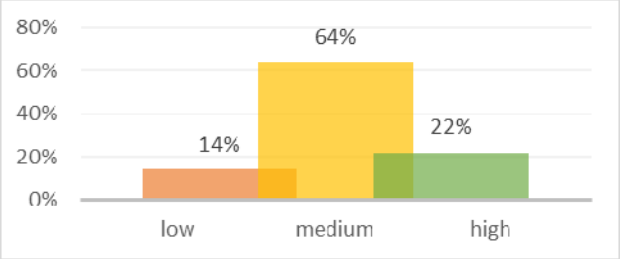

Fig.1 Distribution of future masters in industrial training of agricultural profile by levels of formation of motivational and value component of digital competence.

Analyzing the obtained data, it can be stated that the motivation is at an medium level and needs to be strengthened, because this is the first and key step towards the systematic formation of digital competence.

The analysis of the respondents' answers to the questions of Block 2 shows (Fig.2) that the level of formation of the cognitive component of digital competence in future masters of industrial training is mostly medium (65%). The cognitive component of digital competence was identified at a high level Lets learn the data in more details 23%, and the lowest level was found in the smallest number of respondents Lets learn the data in more details 12%.

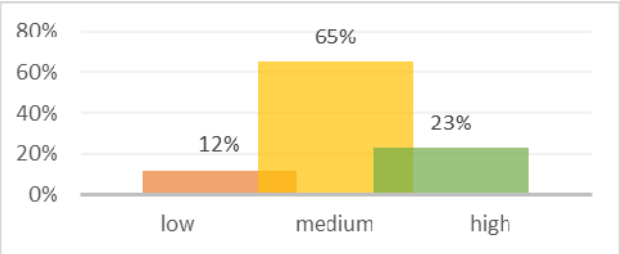

Fig.2 Distribution of future masters of industrial training of agricultural profile by levels of formation of the cognitive component of digital competence.

Thus, we observe for the most part the medium level of formation of the cognitive component of digital competence in future masters of industrial training in agriculture.

The answers on the questions of Block 3 reflect (Fig.3) the skills of future professionals in the application of digital technologies in future professional activities. Insufficient level of formation of activity-professional component of digital competence of future masters of industrial training of agricultural profile is revealed. Low level was demonstrated by 21%. The medium level of formation of the activity-professional component of digital competence of future masters of industrial training is set at − 62%, and the high level is recorded at the smallest number of respondents − 17.0%.

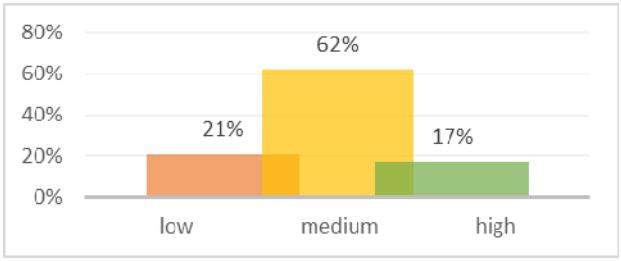

Fig.3 Distribution of future masters of industrial training of agricultural profile by levels of formation of activity-professional component of digital competence.

The results indicate that most students, despite the fact that they seek to use digital technology in the classroom, do not have enough knowledge, skills and abilities to implement them in practice, because they do not have the appropriate level of knowledge.

The results of determining the formation of the evaluative-reflexive component of digital competence are presented (Fig.4) by the following distribution by levels: high level − 16 %; medium level − 64%; low level − 20%.

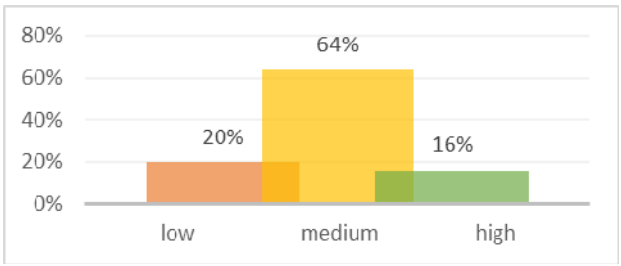

Fig.4 Distribution of future masters of industrial training of agricultural profile according to the levels of formation of the evaluative-reflexive component of digital competence.

Analyzing the obtained data, we came to the conclusion that although the respondents have an medium level, the lowest level has a high level − 16%. This is primarily due to the low ability to self-control, self-assessment and self-analysis of their own activities, ways and opportunities to assess digital resources, self-analysis and self-assessment of their knowledge and skills in the application of digital technologies in professional activities.

Thus, achieving the level of digital competence required for professional activity implies not only the acquisition of skills and abilities to organize the educational process in the digital educational environment, but also the achievement of personal knowledge and skills of working with digital technologies actively used in agriculture, development of motivation for further study of digital technologies. It is important that the professional training of future masters of

industrial training of agricultural profile contributes to the development of their readiness to carry out various types of amateur activities: self-motivation, self-education, self-development, self-determination and so on.

4. Conclusions

Analysis of the works of foreign and domestic scientists shows active changes in the digital society, in particular the state of modern Ukrainian society requires a change in the requirements for professional competence of future professionals, including agriculture. At the same time, the quality of their professional training is important, in particular the formation of their digital competence.

Based on the theoretical analysis of the concept of "digital competence" and its structure, it is established that the problem of formation of digital competence of future teachers is considered by some scientists, but the masters of industrial training of agricultural profile and features of formation of digital competence in professional training is staying without attention. A small amount of research concerns the content, structure of digital competence, methods of its formation in future teachers, as well as pedagogical conditions to ensure the effectiveness of the educational process.

Thus, the above analysis allowed to clarify the structural components of the digital competence of the future master of industrial training of agricultural profile, justify the introduction of motivational-value, cognitive, operational-activity and evaluative-reflexive component and propose indicators of digital competence of future masters of industrial training.

In view of this, diagnostics was developed to determine the levels of formation of the specified competence and the state of formation of the defined components of digital competence of future masters of industrial training of agricultural profile.

Analysis of the results of the questionnaire allows us to conclude that it is necessary to increase the level of formation of all components of digital competence of future masters of industrial training in agriculture.

As a result, this study opens wide opportunities for further research in determining the structure of digital competence of the master of industrial training, which is one of the components of professionalism of a modern teacher who meets the requirements of society in a digital economy. The results of the research can be used in the development of academic disciplines that form the special competencies of masters of industrial training of agricultural profile and training programs for teachers.

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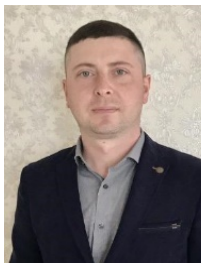

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