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Professional Competencies of a Higher Education Teacher in an Information Educational Environment

Lavina T.A.* Zakharova A.N. Aleksandrov A.H. Talanova T.V.

Chuvash State University, Cheboksary, Russia
**Corresponding author. E-mail: tlavina@mail.ru*

ABSTRACT
The digitalization of all spheres of modern society has led to the widespread use of information and communication technologies in the professional activities of university teachers, which is currently one of the priorities for modernizing Russian education. In this regard, the role of purposeful training and advanced training, which should be based on a thorough knowledge of the whole system of the main factors in the informatization of education, has sharply increased in the system of higher education. This is due to the fact that at present the activities of a teacher of higher education include both activities to build competencies among students and activities to create educational resources placed in the information educational environment, new ways of interacting with students, and the use of information technologies in scientific and research work.
The article considers the psychological and pedagogical aspects of the professional activity of a teacher of higher education and advanced training. The article highlights the experience of the Russian regional university in building a system of continuing education for a university teacher in the field of information and communication technologies in professional pedagogical activity in the conditions of an information educational environment. On the basis of an empirical study, in which 1003 teachers of various faculties have taken part (a representative sample was 300 people), it is concluded that targeted training in the field of education informatization affects the motivation and sustained interest in the use of information and communication technologies significantly. At the same time, a high level of cognitive and activity components can be formed only if there is a combination of continuing education courses, high motivation, independent knowledge acquisition in this area, as well as individual additional consultations and targeted support of motivation from the administration.
Keywords: *Russian higher education system, higher education institution, professional competence, information and communication technologies, informatization of education, competence in the field of information and communication technologies*

1. INTRODUCTION

At the present stage of development of Russian society, digital technologies are strengthening their influence on all areas of the economy, including the development of higher education. In Russia, federal regulatory legal documents have been adopted for strategic planning (the Strategy for the Scientific and Technological Development of the Russian Federation [1], the Strategy for the Development of the Information Society in the Russian Federation for 2017–2030 [2], etc.). Following this, a program (Program "Digital Economy of the Russian Federation") was developed and adopted to evolve the economy of a new technological generation - the digital economy, in the implementation of which the role of the higher education system is significant.

In order to digitalize higher education, it is planned to use and further develop the information educational environment - a network of open educational systems that ensure the safety and unity of the educational space of the Russian Federation, its integration into the global educational space, intended for planning, organizing and managing the educational process at all levels of continuing education , the interaction of all participants in educational relations.
At the same time, it is necessary to understand that the digitalization of higher education is not only equipping an educational institution with information and communication technology (ICT) means, but also a new understanding of the role and place of a higher education teacher working in a digital educational environment. In modern conditions, it can be stated that digital technologies are a mechanism for the development of

higher education institutions and higher education in general.

In a situation where a higher education becomes one of the leading links in the digital economy, a university teacher must have competencies that ensure, on the one hand, high-quality training of students for professional activities in the digital economy, and on the other, professional competencies must be formed that allow to fulfill his professional pedagogical activity in the conditions of the educational information environment.

The problems of the application of information and communication technologies in the professional activities of a teacher of higher education are reflected in many modern studies [3-8]. The introduction of information and communication technologies in the professional activities of teachers is a priority in modernizing Russian education today.

The analysis of the main risk groups that accompany the transition to universal digitalization, characteristic of the entire world, allowed scientists [9] to identify sources of additional problems - factors inherent only in Russian society. According to the authors, the education system is one of the key areas in Russia that generate a whole range of various risks. The authors describe seven types of competencies most relevant for Russia's transition to a digital economy.

Consideration of the structure of competence in the field of information and communication technologies, as well as the mechanisms and methods for developing this competency among teachers of humanitarian specialties in the framework of continuing education courses are considered in the work of Titova S. V. [10].

Kondrasheva N. N. concludes that in order to increase the level of professional competence of a university teacher, in the context of the transition to the concept of "digital economy", basic informational competencies should be initially formed, such as: the ability to work with text editors, spreadsheets, e-mail and browsers; ability to keep documentation on electronic media; conducting regular cognitive activities in the professional field; readiness for distance learning for retraining and advanced training; the use of computer and multimedia technologies in the educational processes of training specialists [11].

Andreev A. A. notes the great importance of online learning for the educational process of the university [12], has conducted a detailed analysis of the role and competence of university teachers in an educational environment saturated with information and communication technologies.

The expansion of online formats for higher education is noted by Galikhanov M. F., Khasanova G. F. [13], which shows that an important trend in higher education is the increasing use of digital technology in education. Universities are forced to expand their educational activities in the online environment, and an increasing number of teachers are involved in the development and conduct of online courses. We agree with their opinion that not all teachers have the necessary skills and competencies and have sufficient experience in the application of digital technologies.

The "Professional Standard. Teacher (pedagogical activity in preschool, primary general, basic general, secondary general education)", which states that the teacher must have ICT competencies "necessary and sufficient for the planning, implementation and evaluation of educational work" was approved in 2013 and entered into force on January 1, 2017 in the Russian Federation [14]. According to this standard, the teacher is required to possess three levels of ICT competence: general user; general pedagogical and subject-pedagogical, reflecting the professional ICT competence of the corresponding field of human activity. The teacher should: be able to work with text editors, spreadsheets, e-mail and browsers, multimedia equipment; be able to apply modern educational technologies, including information, as well as digital educational resources; together with students to use foreign sources of information, translation tools, pronunciation; be able to use modern assessment methods in the context of ICT (maintaining electronic forms of documentation, including an electronic journal and student documents). Requirements for teachers are spelled out in detail not only at the level of skills, but also at the level of labor activities and labor functions aimed at "forming the attitude of students in communication in the broadest possible context, including in a hypermedia format" and "developing skills related to information and communication technologies "[C. 4-19]

In 2015, the Ministry of Labor and Social Protection of the Russian Federation adopted the professional standard "Teacher of vocational training, vocational education and additional professional education", which reflects the requirements, including for the university teacher. In particular, ICT competency was described as part of the professional competence of a university teacher, which should include the following skills: apply modern technical teaching aids and educational technologies, including, if necessary, carry out e-learning; use distance educational technologies, information and communication technologies, electronic educational and information resources "[15].

Of interest is the experience of UNESCO, which, at the initiative of the United Nations, developed the requirements for teaching staff in the field of ICT use [16]. In the structure of UNESCO competencies, 6 modules of pedagogical activity related to the use of ICT are distinguished: understanding of the role of ICT in education; curriculum and assessment; teaching practices; ICT hardware and software; organization and management of the educational process; professional development [16].

The above allows us to conclude that the need for the formation of ICT competence of a teacher of higher education is due to both external (in relation to the higher education system) and internal prerequisites (existing within the educational system of higher education). The main of the external (socio-economic) prerequisites is the development of scientific -technical progress associated with the constant updating of knowledge in the field of informatics and ICT, digitalization of all sectors of the economy, therefore, knowledge in the field of informatization One of the internal (psychological and

pedagogical) prerequisites is the identification of didactic opportunities of ICT (I. V. Robert), a change in the structure of informational educational interaction (I. V. Robert, V. A. Kastornova, L. L. Bosova) between the teacher and the student, changing the forms, structure, educational environment of the university.

In this regard, it is necessary to purposefully build up the ICT competence of a teacher of higher education, since currently the activities of a teacher of a higher school are a combination of activities to build competencies among students, create educational resources hosted in the information educational environment, new ways of communicating with students, scientific and research work in line with the scientific agenda that is in demand in Russia. Requirements for the level of formation of competence in the field of information and communication technologies for teachers in both the natural sciences, technology and the humanities will increase in the near future. Analysis of works in the field of competency-based approach (V.I. Baidenko, Yu.A. Vardanyan, I.A. Zimnyaya and others), educational and professional standards of university and school teachers, author's definition of ICT competency of teachers (Lavina T.A.), as well as an analysis of the didactic capabilities of ICT (Robert I.V.) made it possible to determine the ICT competence of a higher education teacher as an integrative personality profile that provides the teacher's flexibility and willingness to adapt to changes in teaching activity in the context of digitalization of economics, informatization of education, information educational environment of the university, namely:

- the need to use and master new means of informatization of education in accordance with the current stage of ICT development and the level of digitalization of the economy;
- understanding of the laws and characteristics of the flow of information processes of the university teacher's professional activity, focused on the development of the student's intellectual potential, on the formation of the ability to acquire and integrate new knowledge independently, to meet the needs of the individual in intellectual, cultural and moral development, knowledge of the didactic capabilities of ICT used in education;
- abilities and skills of using ICTs for collecting, processing professionally significant information, selecting digital educational resources, online courses, mastering pedagogical technologies of working with them, abilities and skills of information interaction, including in the educational environment of the university, and educational automation skills.

Thus, the ICT competence of a higher education teacher can be considered as an interconnected and interdependent complex of motivational, cognitive and activity components. To diagnose the level of mastery of pedagogical activity in the conditions of an information educational environment that is adequate to the above-described components, the degree of independence and awareness of actions (V.P. Bespalko) was selected as a criterion, which made it possible to distinguish reproductive, adaptive, heuristic, and creative levels of development. At the reproductive level, the teacher performs his professional tasks according to a given algorithm, motives for working in the information educational environment are absent or weakly expressed. Upon reaching the heuristic level, the teacher independently chooses the software for using and creating his digital educational resources, as well as the forms and methods of their application, can adapt them to solve a specific pedagogical problem, independently master new ICT tools, he has developed a focus on working in information educational environment, on self-education in the field of ICT. The creative level is characterized by the fact that the teacher is able to independently set the pedagogical task, choose methods and means to solve it, evaluate the results of applying the chosen methods, develop the teaching methodology in the digital information educational environment independently, develop a focus on creative activity, receive new information in the field of informatization of education.

Many academic teachers addressed the issue of building competency in the field of information and communication technologies for university teachers. The result of the Monitoring of qualified scientific personnel conducted by the Institute of Statistical Studies and Economics of Knowledge at the Higher School of Economics in 2019 was of interest. 1700 Russian Candidates and Doctors of Science took part in a survey aimed at assessing their level in basic and advanced digital competencies, as well as ways to master specialized information technologies. Employees of research institutes and universities, as well as industrial and service organizations were interviewed. As a result of monitoring, it was concluded that the bulk of Russian scientists –

Doctors and Candidates of Sciences - believe that their level of basic digital skills corresponds to the requirements of the place of work, but not everyone knows specialized information technologies, but they want to master them [17]. However, it should be noted that the use of standard software can also be used to create digital educational resources, however, this requires special knowledge, as well as knowledge of the methods for their creation and application, which need to be purposefully studied. We agree with the authors of the monitoring that "given that the main way to get advanced digital skills is self-study, personal interest and motivation of scientists is needed here."

2. RESEARCH METHODS

1003 university professors from various facultiesof the Chuvash State University named after I.N. Ulyanova, Cheboksary took part in a study. Among them were representatives of the humanities faculties - 264 people, representatives of natural science and technical faculties - 739. A representative sample was 300 people.

The following methods were used in the study:

To diagnose the level of mastery of pedagogical activity in the conditions of the information educational environment, adequately allocated components, the degree of

independence and awareness of actions was chosen as a criterion (Bespalko V.P.) [18].
To assess the motivational and cognitive component of the formation of ICT competence, statistical methods are used in the work: comparing indicators and correlation-regression analysis of the influence of independent parameters on the effective indicator [19].

3. RESULTS AND DISCUSSION

In order to develop the ICT competence of teachers of the Chuvash State University advanced training courses "Information and communication technologies in the activities of a teacher of a higher school in the information educational environment of the university" are organized. The purpose of continuing education courses: improving the professional competencies of the faculty necessary for practical work on the creation and use of the educational information environment of the university as a whole of its didactic, psychological, technological components. Within the framework of this program, the following issues were considered: informatization of education in the digital economy - the main directions, didactic opportunities of ICT, the educational information environment as a pedagogical system of a new level, the components of the educational information environment and their characteristics, the online course as an element of the educational information environment of the university, digital educational resources, automation of the educational process, Dean's OfficeSystem, Department System, etc. In the period from 2018 to 2019 more than 1000 university professors and employer representatives improved their qualifications.
In order to assess the formation of the motivational component of the ICT competency of the teacher, an entrance survey of students of continuing education courses was carried out. The questionnaire also included diagnostic questions along with traditional ones (name, year of birth, education, etc.). For example, “Rate on a scale of 0, 1, 2 (0 - is a mediocre level; 1 - is a level of “confident” user; 2 - is the highest “advanced” level) your level of ability to work with the basic application package (MS Word, MS Excel, MS PowerPoint). And also - “What is your level of ability to work with specialized software (R-studio, SPSS, MS Access, Google Web services)?”. The results of processing the questionnaires are shown in Fig. 1.

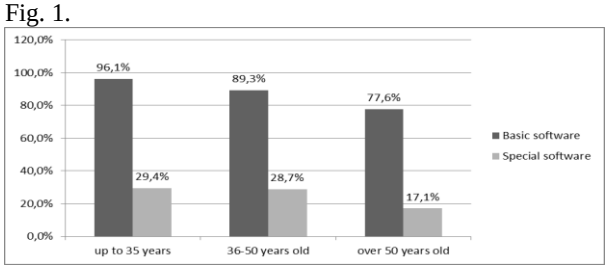

Figure 1 The proportion of respondents who consider themselves to be “confident” and “advanced” users of software applications by age groups.

To identify the motivation of students of continuing education courses for further self-development, the following questions are presented in the questionnaire: 1) “Would you like to improve your skills as a user of a basic software package (MS Word, MS Excel, MS PowerPoint)? Answer Yes / No”; and 2) “Would you like to improve your skills as a user of specialized software packages (R-studio, SPSS, MS Access, MS SQL Server)? Answer Yes / No.”

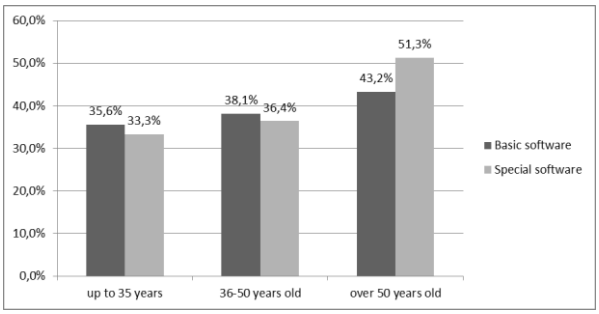

Figure 2 The proportion of respondents who wished to improve their skills as a user of basic and specialized software applications by age groups.

An analysis of the results gives reason to believe that university teachers for the most part quite successfully use office applications in everyday practice. First of all, it is a text editor MS Word. At the same time, the level of development of specialized applications leaves much to be desired, although the software products proposed in the questionnaire are universal in nature and can be useful to researchers of any scientific specialty.
If we consider the data obtained in the context of age groups, we can clearly see the inversely proportional nature of the change in the share of “confident” and “advanced” users from one age group to the next, which is predictable. However, if you pay attention to Fig. 2, it is possible to find a rather significant share (51.3%) of senior citizens from the number of respondents who wished to improve their skills in ICT in terms of mastering specialized packages, compared with a similar share in youth (33.3%) and average (36.4%) groups. Perhaps this is due to the fact that the older generation is more "burdened" in the field of manual calculation of statistical indicators, and therefore shows a natural desire to master the automation tools for such calculations, clearly recognizing the expected benefits and emerging prospects in the scientific research and educational process . In general, the level of motivation for learning and mastering professional techniques for applying software applications of a basic and specialized type is at an acceptable level.
In order to assess the formation of the cognitive component of ICT competency and the didactic effectiveness of the continuing education course “Information and Communication Technologies in the Activities of a Higher School Teacher in the Information Educational Environment of a University”, participants were asked to answer the entrance test questions at the

initial stage of training, and at the final stage of training to answer control test questions. The processing results of these materials are given in table. 1. To analyze the test results, a sample set was determined that met the requirements of representativeness. The estimated sample size (out of 1000 people in the general population who have undergone training) was 298 people (we took a sample of 300 people.) In the Table 1 the results of passing tests by participants before and after training are shown.

Table 1 Test results by participants before and after training

Age group	Total people	Before the course		At the end of the course	
		9 and 10 points people (in%)	*6 or more points people (in%)*	*9 and 10 points people (in%)*	*9 и 10 баллов чел. (в %)*
Under 35 years old	75	69 (92.0%)	39 (52.0%)	75 (100.0%)	57 (76.0%)
36-50 years old	120	75 (62.5%)	-	90 (75.0%)	9 (7.5%)
Over 50 years old	105	72 (68.6%)	3 (2.86%)	105 (100.0%)	3 (2.86%)
In the whole sample	300	216 (72.0%)	42 (14.0%)	270 (90.0%)	69 (23.0%)

According to the Table 1, you can clearly trace the progress in the of knowledge by participants the course before and after completing advanced training. So, in the "Up to 35 years old" age group, at the end of the course, the number of successfully (6 or more points out of 10 possible) who passed the test increased only by 6 people, but the contingent of "excellent students" (9 and 10 points) increased by 18 people and amounted to 57 people. In the middle age group, there is also an increase in successfully passing the control test (for 15 people), and at the same time, "excellent students" appeared in this group in the amount of 9 people who were not at the initial stage. In the older age group, the number of successfully passed the control test increased to 100% (105 people), and the number of "excellent students" did not decrease. On the whole, we can observe the growth trend of those who have successfully mastered the continuing education program. So, the number of successfully passed the control test was 270 people, the growth of successfully passed the control test was 25%, or in absolute terms - 54 people. in relation to the base level (216 people). The number of "excellent students" also increased by 27 people. In relation to the base level (42 people), the increase was 64.3%.

The test results are encouraging, despite a certain share of the error present in the test control. In order not to stop there, you should carefully consider the content of the course program. Perhaps there is a need to review individual sections of the program, its structure, the duration of the study of individual topics. Hypothetically, the perception of complex information most likely varies depending on education (technical or non-technical), gender (male or female), age (young, middle-aged, elderly). Indirectly we may assess the influence of these factors on the effectiveness of perception of information using the model of multiple regression of the form [7]:

$$y = b_0 + b_1 \cdot x_1 + b_2 \cdot x_2 + \ldots + b_p \cdot x_p + \varepsilon, \quad (1)$$

where y - is a dependent variable (productive attribute); b_0 – is a free term; x_1, x_2, …, x_p – independent variables (factors); ε - is a random term.

To estimate the parameters b_0, b_1, …, b_p using the least squares method, the initial information from the above questionnaires and tests was used. The following parameters were introduced into the specification of the model: y – effective attribute - level of self-assessment of ICT competence of students on a five-point scale; x_1 - age of students, years; x_2 – the result of the input and control (output) tests, score; x_3 – the first higher (full-time full-time) education (1 - technical, 0 - non-technical); x_4 gender attribute (1 - male, 0 - female).

The calculations were performed using the "Regression" tool of the "Analysis Package" add-in, which is included in the MS Excel office. The calculation results are given in Table 2.

Table 2 Multiple Regression Model Parameters

Parameters	Before the course			At the end of the course		
	b_i	*t- criterion*	*P- value*	*bi*	*t- criterion*	*P- value*
b_0	3,3788	7,0963	2,292E-10	3,9115	8,1308	1,5949E-12
x_1	-0,0385	-5,7226	1,2171E-07	-0,0386	-6,4286	5,1368E-09
x_2	0,1063	2,2685	0,0256	0,1713	4,1871	6,3152E-05
x_3	1,1655	9,0399	1,8632E-14	0,5005	5,5851	2,2149E-07
x_4	0,1920	1,8287	0,0706	0,1057	1,2714	0,2067

In the Table 2 the values of the coefficients b_0, b_1, …, b_4, are shown, as well as their estimates by t – the Student criterion. As can be seen from the Table 2, all coefficients are significant except b_4, for which the P-value exceeds the permissible 5% threshold, both before the start of the advanced training course (7.06%) and after passing them (20.67%). This means that the value of b_4 was generated randomly, and the variable x_4 should be excluded from further consideration. A check was also made for the presence of multicollinearity, which showed satisfactory results for both models - the inter-factor correlation is weak, which indicates the independence of factor variables. In addition, in Table 3 the values of the coefficients of determination of R^2 and their estimated parameters – F - the Fisher criterion and the F significance are shown. These values indicate the significance of both models of multiple regression and the correlation and determination coefficients calculated from them.

Table 3 Parameters of the multiple regression estimation model

Parameters	Before the course	At the end of the course.
Determination coefficient R^2	0,7322	0,7829
Fisher criterion F	64,9492	85,6585
F Significance	2,3522E-26	1,1777E-30

As a rule, regression models are used for predictive purposes. In this case, the constructed model has poor predictive capabilities, since the variability of the effective indicator is limited by the rigid framework of a five-point rating scale. The purpose of this approach is different. It consists in comparing the weight coefficients of the selected factor characteristics, since it is their value that determines the strength of the influence of the corresponding parameter on the effective indicator.

In the case under consideration, parameter x_1 – the age of the course participants - has a negative coefficient b_1 = -0,0385 for the regression equation, which characterizes the influence of factors on the level of self-assessment of ICT competence at the initial stage of the course participants. It should be noted that the value of this coefficient remained practically unchanged after passing the final control test (b_1 = -0,0386). A negative value of this coefficient also indicates the inversely proportional nature of the relationship of this factor with an effective attribute. In other words, the self-esteem of ICT competency decreases with age, which does not contradict practice.

Parameter x_2 – the results of the input and control (output) tests are included in the specification of the multiple regression model in order to determine indirectly the quality of the tests used: do they confirm the level of participants' self-esteem. The small value of coefficient b_2 is due to the need to change a ten-point test score into a five-point self-assessment scale. In general, a slightly increased indicator at the final stage of the final control test is evidence of higher scores received by participants during the test.

Parameter x_3 – the first higher education (full-time full-time), (1 - technical, 0 - non-technical) was chosen consciously. It is known that in Russia higher technical education is a systemic education that disciplines the work of the brain and makes it think systematically. Therefore, if the listener has an engineering education as his first education, then he, as a rule, is easier to master innovations. In our model, for the initial stage of the course, the coefficient b_3 – - is of decisive importance (b_3 = 1,1655), which indicates the validity of the proposed hypothesis about the systemic nature of engineering education. At the same time, the value of this coefficient at the final stage of the course is significantly reduced (b_3 = 0,5005), which can indicate a weakening of the importance of this factor for the effective indicator due to the high efficiency of the continuing education program.

Parameter x_4 – gender attribute (1 - male, 0 - female) is excluded from consideration due to the statistical insignificance of the calculated coefficients.

Thus, the experience of conducting a continuing education course “Information and communication technologies in the activities of a university teacher in the information educational environment of a university” for teachers of Chuvash State University showed the effectiveness in the aspect of the development of ICT competency, course participants, regardless of gender, increased their level of knowledge of both basic and specialized software, a comparison of data by age groups showed an inversely proportional relationship between the level of formation of ICT competency and age. The results of the input control testify to the validity of the proposed hypothesis about a higher level of ICT competence of teachers of a technical orientation, however, the availability of technical education at the final stage of the course did not have such a clear advantage on the results of the final test. This allows us to conclude that the course materials are accessible in presentation form and that all participants are highly motivated.

4. CONCLUSION

1. One of the professional competencies of a teacher of higher education in demand in the digital economy is ICT competency, which can be considered as an interconnected and interdependent complex of motivational, cognitive and activity components. The degree of independence and awareness of actions was selected as a criterion to diagnose the level of ICT competence, which allowed us to distinguish reproductive, adaptive, heuristic and creative levels of development.
2. In order to identify difficulties encountered by higher education teachers when working in the digital educational environment, a survey was conducted that showed that 96.1% of teachers under 35 years old, 89.3% aged 36-50 years old, 77.6% older than 50 years consider themselves confident and “advanced” users of the basic software. At the same time, 29.4% of teachers under 35 years old, 28.7% aged 36-50 years old, 17.1% older than 50 years old consider themselves confident and "advanced" users of special software. The results of the analysis made it possible to highlight the substantive directions of the continuing education course “Information and communication technologies in the activities of a higher school teacher in the information educational environment of the university”.
3. The study showed that a significant proportion of the older age group of the teachers surveyed who wished to improve their skills in ICT in terms of mastering specialized packages, compared with a similar share in the youth and middle groups of respondents.
4. Course participants, regardless of gender, increased their level of knowledge of both basic and specialized software, a comparison of data by age groups showed an inversely proportional relationship between the level of formation of ICT competence and age.
5. The results of the input control testify to the validity of the proposed hypothesis about a higher level of ICT competence of teachers of a technical orientation, however, the availability of technical education at the final stage of the course did not have such a clear advantage on the results of the final test. This allows us to conclude about the effectiveness of the proposed continuing education program, an accessible form for presenting course materials and the high motivation of all students.

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