

## Digital Literacy and Digital Didactics as the Basis for New Learning Models Development

<https://doi.org/10.3991/ijet.v15i14.14669>

Zhi-Jiang Liu (✉)

GuangXi Normal University, Guilin, China  
51995812@qq.com

Natalia Tretyakova, Vladimir Fedorov, Marina Kharakhordina  
Russian State Vocational Pedagogical University, Ekaterinburg, Russia

**Abstract**—An efficient organization of the educational process within rapid acceleration of the society digitization is impossible without increasing its digital literacy, if the latter is really estimated and new models of digital learning didactics are developed respectively. So, it is necessary to study an actual state of digital literacy, as well as to search for and introduce new learning models in the educational system based on the use of modern innovative technologies and digital learning methods. The objective of the research is to examine the level of the digital literacy of teachers, and also opportunities and promising trends within the digital didactics for the formation of competencies as the basis of a new model for the development of a new learning model in the context of the formation of the digital knowledge society. Two main methods have been used – elaboration of the abstract and logical model and a survey. In the research the data obtained as a result of the survey conducted in 2018 by NAFI Analytical Centre related to the measurement of the digital literacy level of teachers and lecturers in Russia were used. The number of respondents made up 634 lecturers (higher education) as well as 555 teachers (general education). The digital literacy formation model was developed based on the didactic learning triangle taking into account the synthesis of three learning environments – real, virtual and neurocognitive. The analysis of the survey data demonstrated that in the aggregate of the compared indices for different social groups of the population, school teachers and lecturers of higher educational institutions have reached the higher level of the digital literacy, which significantly exceeds the average Russian level. So, in Russia as a whole the index of the digital literacy of the adult population by a similar measurement method makes up 52% out of 100% possible ones, school teachers – 87%, lecturers of higher educational institutions – 88%. The use of research results in practice is possible with the improvement of training programs, the exchange of international experience and further researches.

**Keywords**—Digital technologies; educational process; emerging technologies in learning; model.

## **1 Introduction**

At the beginning of the 21st century there have been disruptive changes related to intensive application of new technologies in education. The global network is stronger affecting the daily lives of people and society. According to some estimates, now hundreds of millions of personal computers and other mobile devices (for example, personal digital equipment, mobile phones) are connected to the global network. We are witnesses of the appearance of a new phenomenon, that is the global virtual educational community, which comprises more than a billion people, and the number is continuing rigorously to increase [1].

Nowadays the digital literacy has become very popular in educational institutions and among students. A huge leap in technologies has made significant changes to our daily lives, one aspect of which allows us to strive for digital citizenship. Thus, the gap as for the availability of digital devices should be narrowed, and is necessary to expand an access to technologies for creation of the equality. When students can extensively use the media and technologies to interact with their environment, students' personal environment is greatly enhancing and helps them uniting. They gain the competence during the research, study and creation of their own digital works using modern, affordable tools. This expands the knowledge in order to facilitate a lifelong learning in the digital learning environment [2].

Due to the opportunities provided by information and communication technologies (ICTs) in the contemporary education, many multimedia and interactive educational products are being developed in campus or online education (e-learning) [3].

Up-to-date information technologies are becoming one of the most important tools for modernizing a school. They make the work of teachers and learners easier, reduce the loading on students in the classroom, diversify teaching forms and methods, organize the learning process taking into account the personal characteristics of the student, as well as track definite learning outcomes [4]. In didactic cyberspace you can obtain an access to various learning environments: get digitized video lessons, multimedia and hypertext links to books, texts, selected bibliographic links, lists of websites and virtual laboratories. In the virtual classroom teachers of each subject interact with students and support their learning processes. Through forums and chats intellectuals have become interconnected and share knowledge [5].

Didactics is used at planning and the description of the process of learning individual lessons by the help of information and communication technologies (ICT). The didactics or learning scenario is an accompanying document, from which it should be read: student's age (grade level), learning subject, learning package, training plan, description of the objectives of fast learning, methods and forms of the work, learning materials and instruments, definition and content of time phases, generalization, lesson mark [6].

Computer-based literacy, media literacy, digital literacy and digital competence are the concepts that focus on the necessity of the use of technologies in digital era [7].

Nowadays the digital literacy is necessary for all aspects of human life, especially in the field of education [8]. Researches carried out for last 40 years refer to the impact of computer and digital technologies on the processes of training and education,

and achievements of learners in the training, affirm their positive influence on different aspects of education [9].

The changes caused by technological, economic and cultural aspects at the beginning of the twenty-first century were very rapid. These changes mainly covered the developed world. However, their influence affected the developing world. Societies around the world have been dramatically changing, especially with regard to the availability and ease of access to digital information and communication technologies. So, in the era of rapid changes, teachers and dominant classroom practice were more likely to remain traditional. It was focused on content, the teacher also directed didactic training focused on the content transfer, and its reproduction remained the rule of pedagogy [10].

With the emergence of media technologies in 21st century the traditional digital literacy stopped to be sufficient for the human to survive in a new media environment. More and more teachers and researchers in the field of informatics have studied the essence of the digital literacy in the education [11].

The digital literacy is usually considered as a combination of technical, procedural, cognitive and emotionally social skills. For example, the use of a computer program implies the application of procedural skills (for instance, processing files and editing visual images), as well as cognitive skills (for instance, the ability to intuitively decrypt or “read” visual messages embedded in graphical user interfaces). Similarly, searching for data in the Internet is regarded as a combination of procedural skills (working with search engines) and cognitive skills (data estimation, sorting false and biased data, and also distinguishing between relevant and non-crucial data). Effective chatting is deemed to be accompanied by the use of certain social and emotional skills. In the framework of a growing addiction to digital working and learning environments the digital literacy was conceived as a “survival skill,” a key skill that helps users to complete efficiently complex digital tasks [12].

Currently in order to achieve the digital literacy we need media education. Regardless of the perspective, with the purpose of which the research and analysis are conducted, especially from the point of interdisciplinary view, it is evident that we are passing a new stage in the western civilization. After the Neolithic and then the Industrial Revolution, the digital revolution leads to the third great stage: the information society and / or communication society. This causes the emergence of a new social, political, cultural and economic order, the evolution and results of which are so far unpredictable and uncertain [13].

Researchers around the world are exploring new ways of spreading computer-based literacy among all. Many forms go far beyond the typical classroom format, including a variety of learning methods and learning environments [14]. The deeper analysis of this phenomenon would allow, in essence, calculating its impact and more profoundly identifying those social and cultural variables that can cause a potential gap in the use of digital media in relation to the previously mentioned risks or opportunities for the development of education [15].

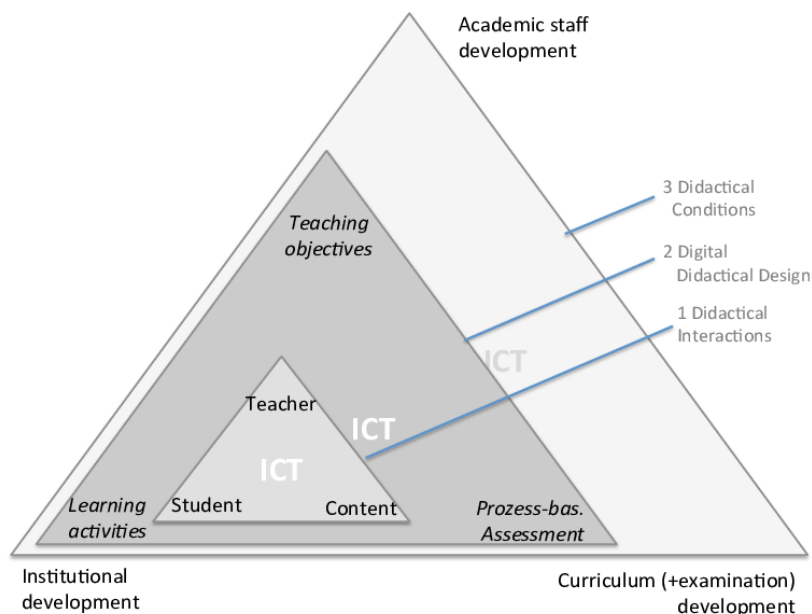
Pedagogical digital competence relates to the knowledge, skills, relations and approaches towards digital technologies, educational theory, subject, context and relations between them [16].

Undoubtedly, digital competence and its various elements are essential components of training in the 21st century. The growing trend in the development of new technologies, such as robotics, “Internet of Things”, or artificial intelligence, among many other aspects, sets new challenges that we, as educational institutions, cannot ignore [17].

Didactic technological competencies were an integral part of the teacher’s professional competency profile, not considering the subject taught by the teacher. In overall, these competencies can be defined as the teacher’s ability to use the material and technical learning means during teaching the school subject that he/she teaches. The content of these competencies obviously depended on the time, and while in the past it was changing very slowly, at present, due to the influence of the rapid development of digital technologies, it has been changing very quickly. In terms of the latest digital technologies, the teacher’s didactic technological competencies can be defined as her / his professional digital literacy skills for using digital learning tools and their application in practice of teaching the subject [9].

The methodological learning basis in complex environments is cognitive pedagogy. The latter, by analogy with classical pedagogy, considers the human as a system that is perceiving the world, but from non-classical view as a self-organizing system in the framework of his/her experience, and in post-non-classical one as a self-developing, historical system of autopoietic type, experiencing the impact of educational communication arising in the learning environment [18].

In the age of the Internet, technologies are always a part of classrooms, courses, and educational institutions. The matter is how integrated they are: from poorly integrated, teachers exchange documents, to high integration, teachers use technologies in the form of multimodality. The innovation of mobile technologies and media tablets leads to a new situation in educational institutions at different levels. The application of such “media tablets” devices influences many levels of education, starting from people’s behavior in the classroom, from courses’ content, events and programs that take place outside the classroom, to decision-making both at the local and national level. The new situation covers three levels of didactics: a) the relationship between the teacher, students and content (didactic interaction [19]), b) digital didactic design (learning objectives, learning activity, assessment / feedback), and c) strategic institutional development, curriculum development (including programs’ development and exams) as well as advanced training for teachers (didactic conditions) and vice versa (Fig. 1) [20].



**Fig. 1.** Three layers of digital didactics

Source: Developed by authors based on Jahnke et al. [20].

The importance of competencies in the 21st century has given rise to the appearance of substantial topics related to the level of ensuring a necessary knowledge database for children and young people in order that they can be competent in modern and future societies [21].

As is widely known that each student has his/her own unique style of knowledge acquisition, his/her own cognitive characteristics that directly influence the learning of educational material. In line with the theory of multisensory learning, people have different types of perception, thinking and memory. So, the use of multisensory technology is important in organizing the educational process.

The concept of the multisensory learning in the digital environment covers all components of the didactic system: definition of objectives, content selection, organization and implementation of learning process, results' diagnostics, satisfaction of social needs for successful realization [22].

Many world countries pay high attention to the issue of digital literacy development and digital didactics. In our research the experience of Russia and China has analyzed.

In the next five years, 784.5 billion rubles will be spent on the modernization of education in the framework of the development of the national project "Education" in the Russian Federation. One of the goals of the national project is to be in the Top ten countries in the world as regards the quality of general education. The project implementation period is from January 2019 to the end of 2024. The project includes ten

federal projects, such as “Modern School”, “The Success of Each Child”, “Support for Families with Children”, “Digital Educational Environment”, “Teacher of the Future”, “Young Professionals”, “New Opportunities for Everyone”, “Social Activity”, “Education Export” and “Social Lifts for All”. This determines the main trend in terms of the relevance of the research on the modernization of the educational system [23].

The factors generating the need for building a digital educational process of the vocational education and training are three trends that characterize the development of a digital society [24]:

- Digital economy and new personnel requirements arisen due the digital economy;
- New digital technologies that form a digital environment and which are developing in it;
- Digital generation (new generation of students that has specific social and psychological features).

China has been a pioneer in integrating information and communication technologies for education (ICT4E) into national educational policy. Recognizing the role that technologies can have in the education in the late 1990s, the country has now become an international leader in promoting the benefits of ICT4E. However, at school and individual students’ levels, ICT4E still plays a subordinate role [25].

In overall, educational technologies are facing a rapid growth in China. The expansion of integration technologies in the education has become the main area of a government activity as a means to reform the school education and improve the quality of education throughout the country. The Chinese educational system has made significant efforts to improve its technology infrastructure and develop an appropriate policy with reference to the integration of technologies [26].

Since 2010 the Chinese government has been restructuring its educational system, and IT penetration in the education has played an important role within such changes. In 2010 the Ministry of Education of China published the Plan of the National Plan for the Reform and Development of Secondary and Long-Term Education in China, where accelerating of IT penetration in the education pays a special attention [27].

After online learning implementation in the country, distance learning in China in the form of radio and television became the basis for the gradual development of network education as the main form of modern distance learning. Tsinghua University, Zhejiang University, Hunan University and Peking University of Posts and Telecommunications, which are four common higher educational institutions, carried out pilot researches at the Institute of Modern Distance Learning through a large class of professionals. After more than 10 years of development the Ministry of Education of China has approved pilot schools for small education networks, in which tens of thousands of basic educational institutions are small-scale and the number of students reaches several million. In addition, training methods of internal employees for online learning applications are rapidly extending, and most of the country's leading enterprises create their own online learning network environment [27,28].

One of the key detected issues is that teachers have used technologies as a learning means more often than the use of technologies as a learning means of students [26].

Thus, the professional development leads to the change of the concept as well as the curriculum development. Such a professional development differs from the traditional one, in the framework of which the main focus is on technological transactions and will become important in the improvement of technological integration via the assistance to conceptual and pedagogical changes in teacher's activity [26].

Given the fact that our researches were originally based on efforts to better understand how to approach the organization of the learning process in the digital society and digital literacy, it has some limitations that affect the generalization of its results. When using data from an online survey, it should be born in mind that the total sample was small and limited to the digital literacy in Russia. Thus, our study is aimed at studying the achieved level of the digital literacy of teachers, as well as opportunities and promising trends in the field of digital didactics for the formation of necessary competencies, which is vital under building a new model for the education development within the establishment of the digital knowledge society.

## **2 Materials and Methods**

### **2.1 Research design**

In the present research two main methods have been used that is creation of abstract and logical model, and survey. We have used as a basis the hypothesis of the updated model of the didactic triangle, which incorporates the context (as a broad concept, including the curriculum, assessment, culture, etc.), proposed in the work of Choshanov [1], as well as elaborated by us its improved version taking into account the synthesis of three learning environments – real, virtual, and neurocognitive.

In the research there have been applied the data from the survey “Digital Literacy of Russian Teachers” conducted by NAFI Analytical Center [29]. The survey involved 634 teachers (higher education), as well as 555 teachers (general education). The survey results were estimated in order to adhere to the proportion of teachers' allocation in the federal districts of Russia.

### **2.2 Intervention**

Data collection was carried out by an online survey of school teachers and teachers of higher educational institutions on a structured questionnaire, including closed and open questions. In order to obtain objective results, respondents were asked not only to answer test questions, but also to assess the share of teachers in their educational institutions who do not work with digital technologies and do not use them in professional activities.

### **2.3 Research limitations**

In the research the level of teachers' digital literacy as the grounds for developing competencies in the field of contemporary education were studied. The proposed

modification of the model of developing digital literacy on the basis of the learning didactic triangle considers three main environments – real, virtual, and neurocognitive.

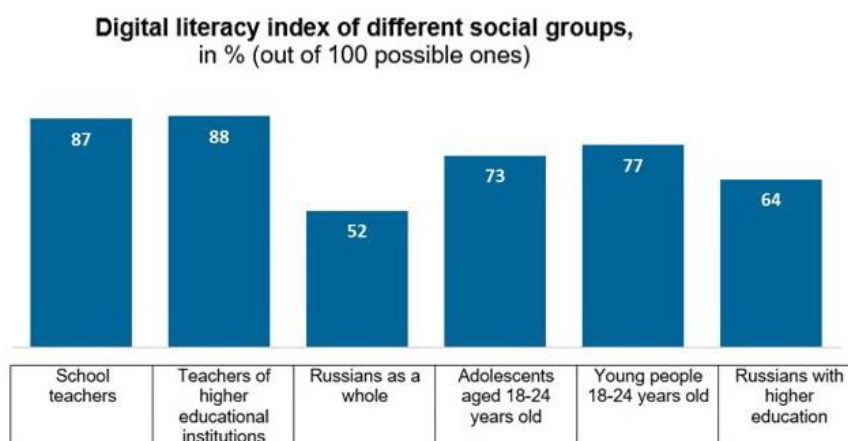
## 2.4 Statistical analysis

The maximum statistical error of the survey results makes up  $\pm 3.9\%$  for the sample of teachers of higher educational institutions and  $\pm 4.2\%$  is for the sample of school teachers.

## 3 Results

Based on the study of the level of teachers’ digital literacy, as well as opportunities and promising trends in the field of digital didactics in the formation of competencies as the grounds of a new model for the development of a new educational model, a comparative assessment of the digital literacy index was carried out both for Russians in general and for individual social subgroups.

To do this, we analyzed the data of the comprehensive measurement of the level of digital literacy in Russia conducted in 2018 by NAFI Analytical Center. In the framework of the research the obtained values of the digital literacy index were analyzed both for Russians in general and for individual social subgroups. In the aggregate of the compared indices for different social groups of the population, it was found that school teachers and teachers of higher educational institutions have a higher level of the digital literacy, which significantly exceeds the average Russian level. So, in Russia as a whole, the digital literacy index of the adult population by a similar measurement method makes up 52% out of 100% possible ones (Fig. 2).



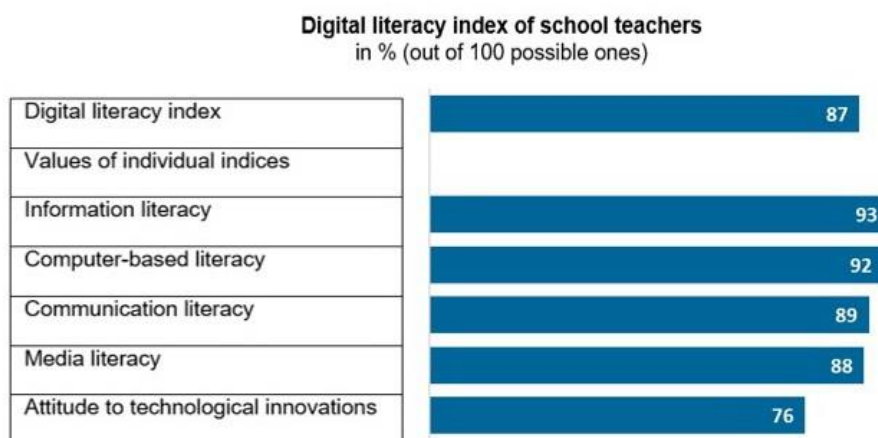
**Fig. 2.** Digital literacy of different social groups in Russia

Source: developed by authors based on NAFI survey “Digital literacy of Russian teachers” [29]



Considering the data obtained during the survey upon a comparative analysis of the level of digital literacy of teachers and their students, we can point out that teachers' level exceeds the same one of the digital literacy of adolescents 12-17 years old and young people 18-24 years old, despite the fact that representatives of these target subgroups have demonstrated rather high level of the digital literacy – 73% out of 100% possible ones among adolescents (14-17 years old), and 77% out of 100% possible ones – among young people aged 18-24 years.

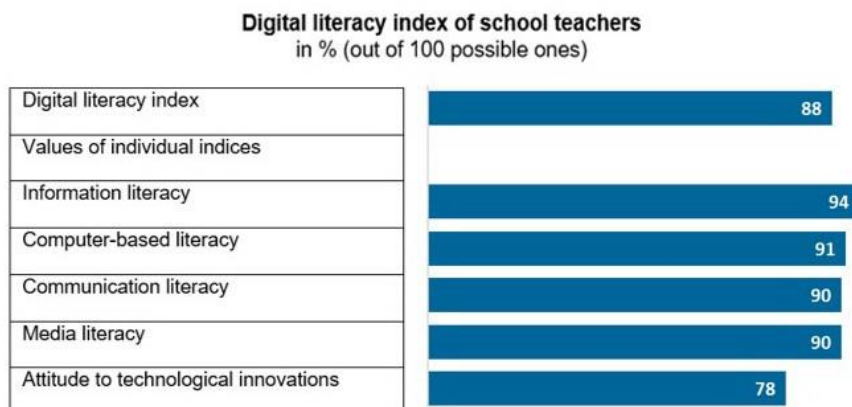
The digital literacy index of teachers is 87% out of 100% possible ones, which is a fairly high indicator. In terms of the digital literacy elements, the lowest value of the “attitude to technological innovation” sub-index makes up 76%. This indicator measured the knowledge of modern technological trends, skills to work with modern gadgets and applications, and attitudes to the benefits of technological innovations. We should highlight that teachers reached the highest level in information and computer – based literacy – indicators are 93% and 92%, respectively (Fig. 3).



**Fig. 3.** Digital literacy of Russian school teachers

Source: developed by authors based on NAFI survey “Digital literacy of Russian teachers” [29]

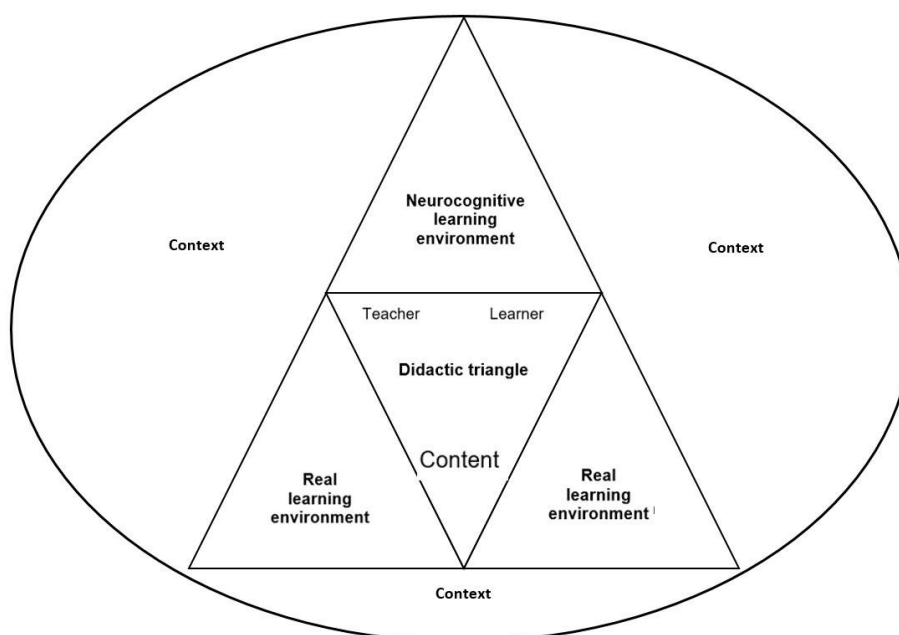
The other aspect of measuring the digital literacy index referred to teachers of higher educational institutions, upon which rather high indicators were also received. This testifies the presence in the teaching environment of the necessary level of knowledge, skills and attitudes in the field of digital technologies. We can state that the work in the system of modern education today is impossible without knowledge, skills and attitudes in all five components of the digital literacy. The digital literacy index of teachers of higher educational institutions is 88% out of 100% possible ones (Fig. 4). The analysis of the individual components of the digital literacy index among teachers of higher educational institutions revealed lower indicators compared to school teachers (for example, computer literacy). At the same time, the ratio of the attitude of teachers of higher educational institutions to technological innovations is higher – 78%.



**Fig. 4.** Digital literacy of Russian teachers of higher educational institutions

Source: developed by authors based on NAFI survey “Digital literacy of Russian teachers” [29]

In view of the survey and theoretical researches, we justified a modern model of digital literacy formation based on the didactic learning triangle. The model is grounded on the synthesis of three learning environments - real, virtual, and neurocognitive (Fig. 5).



**Fig. 5.** Model of digital literacy formation based on the didactic learning triangle

Source. The own development of the author considering the modification of approaches [1,19,20]

The proposed approach as for the model development of digital literacy based on the didactic learning triangle in up-to-date environment supposes a synergetic interaction of real and virtual environment, as well as neurocognitive one. The real learning environment is a traditional school and university institutional activity. The virtual or the so-called e-learning environment is a new one grounded on the use of information and communication technologies of transfer and acquisition of the knowledge. The neurocognitive learning environment is an activity on acquiring knowledge and skills through experience, emotions, personal contacts and other cognitive forms.

## **4 Discussion**

The general research is focused on the search of means for the development of competent knowledge of students under the specialty “pedagogy” as regards the selection and assessment of e-learning resources as an integral part of didactic and methodological learning means at the different learning stages and in different classes. Considering the level of the development of information and communication technologies such type of competencies is becoming an important element of the professional teacher’s profile and defines his/her achievements in the class and out of it within the general learning process. The experience in technologies and a content filling are foremost components. To reflect and extend opportunities for the implementation of various learning strategies through different e-learning resources become more essential. So, as technology advances, in addition to access to electronic resources and content design, navigation capabilities, levels of intuitive interface and personalization, integration degree, caution, and research perspectives should focus on training design. All this, in the conditions of developing the competence of specialists under the specialty “pedagogy” on the comprehensive examination of electronic educational resources, will ensure their more targeted and systematic use in the educational process, as well as their continuous improvement in accordance with the applied learning strategies in their diversity [22].

Classical learning models in the form of the didactic triangle, which includes the student, teacher and educational content, reflect a number of didactic principles widely used in pedagogy, which are deemed as the main active element of the learning environment of the teacher who implements a training methodology. The student is to a certain extent non-active and may undergo the teacher’s influence. The relations between the teacher and the student determine the quality of the learning process. Thus, in opinion of designers of e-learning systems and simulators with the purpose to create an effective e-learning system, the modeling of the working environment, functions and logic of the teacher’s actions using technology is sufficient. This assumption, which is controversial from the point of view of psychology and pedagogical psychology, is widely discussed in the engineering and pedagogical environment and is the basis of e-didactics – a comprehensive discipline about teaching methods in the new pedagogical reality of the technology age [18].

Digital literacy skills are those that characterize the ability to localize, systematize, assess and analyze the information using digital technologies. The Internet phenome-

non promotes web-based multimedia learning tools that include images, video and audio files, as well as the text. The person knowing the digital literacy is deemed a socially responsible user of the Internet and social networks [11].

Moreover, the traditional understanding of the didactics does not meet requirements of the information society with a fast ICT development. The didactics of the digital era is transformed into the science, engineering and learning art. The didactics represents a developing area, which is theoretically expanded based on the combination of the research and teaching. In order to accept the challenge and react to learning complexities in the digital era with intensive use of information and communication technologies, scientists are looking for innovative solutions [1].

In higher education, one of the most outstanding tasks is to train people to solve global issues today and tomorrow. Accordingly, as the educational content is now freely proposed and available anytime, anywhere via the Internet, traditional educational formats are challenging. The main role of universities, apart from researches, is to provide unique learning opportunities in a stimulating environment [30].

College students need to develop core competencies suitable for the society with knowledge and information, especially for the fourth industrial revolution. In the digital learning environment, when students use a learning strategy, it is important to take into account that digital devices and applications will contribute to the development of core competencies. In this regard, this study examined the impact of the digital literacy and the role of learning strategies on students' perception of core competencies [31].

The formation of a new information ecosystem requires rethinking of our approach towards higher education. The high level skills needed by the society cannot be effectively developed in the framework of traditional teaching models based on the reproduction of material from the teacher to the student [23].

The education is a practical activity, and the training is an art, not only the science, both equally knowledge and skills [16].

The digital literacy is a number of competencies, which the individual has with the purpose of a proper use of digital devices in the digital era, convenient access, application, assessment, analysis and data fusion, as well as the creation of new knowledge [2].

One of the key factors to success in the development of the digital literacy among the smart generation is supported by an active role of librarian teachers in conducting, connecting and continuing the process of intellectual transformation. Only due to librarian teachers who have initiated changes in digital transformation the synergetic capacities can be greatly used in the formation of smart cities using data and digital technologies in local and global contexts [32].

## **5 Conclusion**

The digital literacy formation model was developed based on the didactic learning triangle taking into account the synthesis of three learning environments – real, virtual and neurocognitive.

The analysis of the survey data demonstrated that in the aggregate of the compared indices for different social groups of the population, school teachers and lecturers of higher educational institutions have reached the higher level of the digital literacy, which significantly exceeds the average Russian level. So, in Russia as a whole the index of the digital literacy of the adult population by a similar measurement method makes up 52% out of 100% possible ones, school teachers – 87%, lecturers of higher educational institutions – 88%.

The use of research results in practice is possible with the improvement of training programs, the exchange of international experience and further researches.

## 6 Acknowledgement

The first author was supported by Innovation Project of Guang Xi Graduate Education (No.JGY2018020; JGY2019031); Ali Research's 2020 "Huoshui" Young Academics Project; Scientific Research Funding Project of ZhuJiang-XiJiang Economic Belt Development Research Institute in GuangXi Normal University; Guangxi Natural Science Foundation.

## 7 References

- [1] Choshanov, M.A. (2013). E-didactics: New view on education theory in digital technology era. *Educational technologies and society (Educational Technology & Society)*, 16(3): 684-696.
- [2] Kaeophanuek, S., Na-Songkhla, J., Nilsook, P. (2019). A Learning Process Model to Enhance Digital Literacy using Critical Inquiry through Digital Storytelling (CIDST). *International Journal of Emerging Technologies in Learning*, 14(3): 22-37. <https://doi.org/10.3991/ijet.v14i03.8326>
- [3] Abderrahim, E.M., Mohamed, E., Azeddine N. (2013). An Evaluation Model of Digital Educational Resources. *International Journal of Emerging Technologies in Learning*, 8(2): 29-35.
- [4] Matviyevskaya, E.G., Tavstukha, O.G., Galustyan, O.V., Ignatov, P.A., Miroshnikova, D.M. (2019). Formation of Information and Communication Competence of Future Teachers. *International Journal of Emerging Technologies in Learning*, 14(19): 65-76. <https://doi.org/10.3991/ijet.v14i19.10990>
- [5] Garito, M.A. (2013). Distance learning: The new era of the university. *Procedia – Social and Behavioral Sciences*, 93: 1749-1754. <https://doi.org/10.1016/j.sbspro.2013.10.110>
- [6] Nikolić, V., Petković, D., Denić, N., Milovančević, M., Gavrilović, S. (2018). Appraisal and review of e-learning and ICT systems in teaching process, *Physica A*, 1: 1-16.
- [7] Krumsvik, R.J. (2008). Situated learning and teachers' digital competence. *Education and Information Technologies*, 13(4): 279-290. <https://doi.org/10.1007/s10639-008-9069-5>
- [8] Saripudin, S., Sumarto, S., Juanda, E.A., Abdullah, A.G., Ana, A., Ariyanti T. (2019). Digital Literacy Qualitative Analysis in Vocational Teachers. *Proceedings of the 1st Vocational Education International Conference (VEIC 2019)*, 19 December 2019, pp. 262-270. <https://doi.org/10.2991/assehr.k.191217.043>
- [9] Záhorec, J., Hašková, A., Munk, M. (2019). Teachers' Professional Digital Literacy Skills and Their Upgrade. *European Journal of Contemporary Education*, 8(2): 378-393.

- [10] Hans, A., Akhter, S. (2013). Emerging Trends in Teacher's Education. *The Macrotheme Review*, 2(2): 23-31.
- [11] Zhao, P., Kynäshlahti, H., Sintonen, S. (2016). A qualitative analysis of the digital literacy of arts education teachers in Chinese junior high and high schools. *Journal of Librarianship and Information Science*, 50(1): 77-87. <https://doi.org/10.1177/0961000616658341>
- [12] Aviram, A., Eshet-Alkalai, Y. (2006). Towards a Theory of Digital Literacy: Three Scenarios for the Next Steps. *European Journal of Open, Distance and E-Learning*, 9(1): 1-11.
- [13] Gómez Galán, J. (2015). Media Education as Theoretical and Practical Paradigm for Digital Literacy: An Interdisciplinary Analysis. *European Journal of Science and Theology*, 11(3): 31-44.
- [14] Starcic, A.I., Turk, Ž., Zajc, M. (2015). Transforming Pedagogical Approaches Using Tangible User Interface Enabled Computer Assisted Learning. *International Journal of Emerging Technologies in Learning*, 10(6): 42-52. <https://doi.org/10.3991/ijet.v10i6.4865>
- [15] Cortoni, I., Presti, V.L. (2018). Innovative Teaching and Digital Literacy in Preschool. App Content Analysis and Experimental Case Studies in a Sociological Perspective. *Italian Journal of Sociology of Education*, 10(2): 41-56.
- [16] From, J. (2017). Pedagogical Digital Competence – Between Values, Knowledge and Skills. *Higher Education Studies*, 7(2): 43-50.
- [17] Esteve-Mon, F.M., Angeles Llopis, M., Adell-Segura, J. (2020). Digital Competence and Computational Thinking of Student Teachers. *International Journal of Emerging Technologies in Learning*, 15(2): 29-41. <https://doi.org/10.3991/ijet.v15i02.11588>
- [18] Sergeiev, S.Ph. (2015). Methodological and didactic issues of e-learning. In Collection of scholarly articles XVIII Composite Conference “Internet and modern society” IMS-2015, University ITMO, St. Petersburg, 23-25 June 2015, pp. 105-120.
- [19] Klafki, W. (1963). *Studien zur Bildungstheorie und Didaktik*. Weinheim: Beltz.
- [20] Jahnke, I., Mårell-Olsson, E., Norqvist, L., Olsson, A., Norberg, A. (2014). Digital Didactical Designs – Reimagining Designs for Teaching and Learning. In ICED 2014 Conference proceedings, Stockholm, pp. 15-18. [https://doi.org/10.1007/978-3-319-11200-8\\_13](https://doi.org/10.1007/978-3-319-11200-8_13)
- [21] Voogt, J., Erstad, O., Dede, C., Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of Computer Assisted Learning*, 29: 403-413. <https://doi.org/10.1111/jcal.12029>
- [22] Tsankov, N., Damyanov, I. (2019). Transforming Pedagogical Approaches Using Tangible User Interface Enabled Computer Assisted Learning. *International Journal of Emerging Technologies in Learning*, 14(7): 216-225. <https://doi.org/10.3991/ijet.v10i6.4865>
- [23] Rumyantseva, A., Tarutko, O. (2019). Modern Digital Educational Environment as a Tool for the Education Development in Russia. *Advances in Social Science, Education and Humanities Research*, 315: 94-97.
- [24] Bilenko, P.N., Blinov, V.I., Dulinov, M.V., Yesenina, Ye.Yu., Kondakov, A.M., Sergeiev, I.S. (2019). Didactic concept of digital vocational education and training, under scientific supervision V. I. Blinov. Moscow: Publishing House “Pen”.
- [25] Schulte, B. (2018). Digital technologies for education in China: National ambitions meet local realities. *MERICCS Papers on China*, 6: 31-38.
- [26] Li, G., Ni, X. (2012). Use of technology to support the learning and teaching of English in China. In C. Leung, J. Yuan (Eds.), *Perspectives on teaching and learning English literacy in China*. New York: Springer, pp. 145-160. [https://doi.org/10.1007/978-94-007-4994-8\\_10](https://doi.org/10.1007/978-94-007-4994-8_10)
- [27] Zhao, K., Yang, Q., Ma, X. (2017). Exploration of an Open Online Learning Platform Based on Google Cloud Computing. *International Journal of Emerging Technologies in Learning*, 12(7): 17-31. <https://doi.org/10.3991/ijet.v12i07.7249>

- [28] Liyanagunawardena, T.R., Adams, A.A., Williams, S.A. (2013). MOOCs: A systematic study of the published literature 2008-2012. *The International Review of Research in Open and Distributed Learning*, 14(3): 202-227. <https://doi.org/10.19173/irrodl.v14i3.1455>
- [29] NAFI Analytical Center (2019). Digital literacy of Russian teachers. Readiness to use digital technologies in learning process. Retrieved from: <https://nafi.ru/projects/sotsialnoe-razvitie/tsifrovaya-gramotnost-rossiyskikh-pedagogov/>
- [30] Ossiannilsson, E. (2019). Innovative Learning and Innovative Learning Spaces. *Asian Journal of Distance Education*, 14(1): 98-116.
- [31] Kim, K.T. (2019). The Structural Relationship among Digital Literacy, Learning Strategies, and Core Competencies among South Korean College Students. *Educational Sciences: Theory & Practice*, 19(2): 3-21. <https://doi.org/10.12738/estp.2019.2.001>
- [32] Chan, H.M.Y. (2019). Conduct, Connect, Continue: Foster students' digital literacy at a school. In IFLA WLIC 2019 - Athens, Greece - Libraries: dialogue for change, Session S05 – Continuing Professional Development and Workplace Learning. In: Librarians and information professionals as (pro)motors of change: immersing, including and initiating digital transformation for smart societies, 20-21 August 2019, Zagreb, Croatia.

## 8 Authors

**Zhi-Jiang Liu** is with School of Economics and Management, GuangXi Normal University in Guilin of China.

**Tretyakova Natalia Vladimirovna** is a Doctor of Pedagogical Sciences & Associate Professor of the Theory and Methods of Physical Culture Department in Russian State Vocational Pedagogical University at Ekaterinburg in Russia.

**Fedorov Vladimir Anatolyevich** is a Doctor of Pedagogical Sciences and Professor of the Vocational Pedagogical Education Methodology Department in Russian State Vocational Pedagogical University at Ekaterinburg in Russia.

**Kharakhordina Marina Viktorovna** works in Russian State Vocational Pedagogical University at Ekaterinburg in Russia.

Article submitted 2020-04-06. Resubmitted 2020-05-11. Final acceptance 2020-05-11. Final version published as submitted by the authors.