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Preparing a Future Teacher in Order to Form an Appropriate Level of Digital Competence

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ABSTRACT:
Technology proliferated in our daily lives, including in the educational system. To make good use of it, it is so important that teachers have the best training in its use and possibilities. Results showed that the training programs carried out improved the digital competencies of students of primary education degrees.We encourage teachers, not only future teachers but also current teachers, to take these types of training programs in order to improve their digital competency, which is a necessity in current society.

During preparing a future teacher in order to form an appropriate level of digital competence, it is necessary to focus students on the necessity to master modern and perspective software and hardware tools of information technology for the development of interactive digital content, in particular, educational resources in the format of augmented reality applications (AR-applications). This is due to the fact that augmented reality technology (AR-technology), as a powerful visualization tool and an effective way to provide educational information to students, modernizes the education technologies themselves, enriching them with new tools and methods, expanding their didactic and cognitive capabilities. Placing virtual objects in a specific environment, in which they are initially absent, allows us to simulate unusual educational practices. The study of augmented reality technologies will provide the future teacher with an opportunity to identify the advantages and disadvantages of these pedagogical tools, master them and determine the degree of their effective use in professional pedagogical activity (Poddubnaya & Kulikova, 2018). Currently, the development of engineering education is declared one of the priorities of government policy in the field of education. On the one hand, measures are being taken to popularize engineering education, attracting young people to the field of science, the formation of motivation for a conscious choice of engineering and technical professions, the demonstration of the latest scientific developments and achievements in the field of breakthrough technologies of science and technology. On the other hand, there is a decrease in the motivation of high school pupils to study natural sciences and physics in particular. The possibility of teaching physics using augmented reality was previously considered by scientists, for example, conducting virtual laboratory work in physics with pupils (Sannikov, 2014). Visualization, using augmented reality, phase diagrams, solving equations of mathematical physics, according to researchers, allows students to look deep into the processes, motivating them to a deeper study of physical theories. A number of scientists believe that the use of augmented reality in the study of physical phenomena by pupils increases the visibility and enhances interest in the subject (Kurzayeva et al., 2017). Therefore, how to use augmented reality technologies in the educational process for future physics teachers is currently an urgent task.

Education in the master’s course on the direction of 44.04.01 Pedagogical education, profile Physical education assumes the future teacher has a serious substantive base obtained from the course of general 16 Irina M. Agibova, Tatyana A. Kulikova, Natalya A. Poddubnaya, Olga V. Fedina / Proceedings IFTE-2020 physics in undergraduate studies. It should be kept in mind that one of the most important functions of the course of general physics is to strengthen the professional motivation of the future physics teacher, aiming it at applying special knowledge in order to assist for developing a pupil’s personality (Agibova & Fedina, 2019). The knowledge and skills acquired by students during the education process of the discipline

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"Digital Technologies in Science and Education" and the course of general physics are used by us to prepare the future teacher for organization of the educational process in physics using augmented reality technology. During studying the discipline "Methods of Teaching Physics in Secondary School" in practical classes, we train students to develop and use interactive educational resources with augmented reality.

Methodology Research methods In the research process, the following methods were used: study and theoretical analysis of psychological, pedagogical, methodological literature; generalization of Russian and foreign experience in training a future teacher in order to form his/her digital competence; observational, experimental, praximetric methods.

Experimental base of research. The experimental base of the research is the North-Caucasian Federal University. Research stages Implementation of the created technology for the development of digital competence of the future teacher in the conditions of informatization and digitalization of modern teacher education was carried out in three stages.

The first stage involved the analysis of scientific, psychological and pedagogical literature, research of the current state of the problem, synthesis of Russian and foreign experience in preparing future teachers to form their digital competence. The second stage was to develop the content of educational and methodological materials for students for the disciplines: "Digital Technologies in Science and Education" and "Methods of Teaching Physics in a Secondary School", which is part of the system of preparing master's students in the direction 44.04.01 Pedagogical Education, profile Physical education, in order to form an appropriate level of digital competence; the mastering of modern and perspective software and

hardware information technology for interactive digital content development and educational resources in the format of AR-applications; development of digital competence of the future physics teacher in the field of application of augmented reality technologies in professional activities; competent use during the lesson, in extracurricular and project activities of educational AR-applications. The third stage was devoted to checking the effectiveness of using the developed technology for the formation of digital competence of a future physics teacher.

Results. Digital competency development technology

The approach we used to develop the digital competence of the future physics teacher has a certain unification and is considered by us as a pedagogical technology. By this technology we understand the purposeful and personality-oriented process of subject-subject interaction between the teacher and the

student, during which the teacher, taking into account the level of students' readiness to use augmented reality technologies, motivational-value relationships, applies modern teaching methods and tools, activates students' productive cognitive activity. The formation of the digital competence of the future physics teacher begins with studying the discipline "Digital Technologies in Science and Education", which is aimed at developing ideas about educational opportunities and hardware-software technology of augmented reality.

The structure of the discipline consists of the following sections.

Section 1. Technologies of augmented reality in the educational process The essence of augmented reality technologies, methods for their implementation and application area. The work principles and functionality of AR-applications. Classification and comparison of virtual and augmented reality systems. Analysis of practical experience in using augmented reality systems in the educational process.

Section 2. Technology of development of educational AR-applications Approaches to developing applications using augmented reality technologies. Overview and comparative characteristics of development tools for AR-applications. Comparative characteristics of AR-content development tools in browsers.

Section 3. Tools for creating educational AR-applications. Software and technology for the development of augmented reality elements and their use in the educational process. Designing educational AR-content using various software tools. Students get acquainted with the methodological features of the application of augmented reality technologies in the physics teaching during studying the discipline "Methods of Teaching Physics in a Secondary School. Most physics textbooks include reading materials describing curious historical facts, interesting phenomena, and fascinating experiments in order to interest by the subject and prepare pupils for reading non-fiction. Illustrations to the text are not always demonstrative. The use of AR-technology allows to

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eliminate this drawback, which will increase the interest and motivation of pupils. Working with texts in the seventh and eighth grades is a propaedeutic of completing tasks for understanding texts with physical content that pupils will meet when passing the exam in the ninth grade. To complete them, you need to read the text, understand it, and then execute the exercise. Typically, in such exercises, a diagram of the experimental setup is presented, a description of the experiment (for example, Hilbert's experiment with a terella) or physical phenomenon (for example, the appearance of the lower and upper mirages) is given. For teaching how to execute this kind of exercises, technology augmented reality can be used, which will cause a desire to read physical texts in the future and will contribute to executing exercises of understanding a text with physical content. The particular interest is the organization of personal observations or experiments conducted by pupils at home. Such activities contribute to: increasing interest to a subject; the formation of such character traits as curiosity and observation; development of cognitive abilities; teaching methods of scientific knowledge; the formation of the ability to consciously absorb knowledge; the development of the need for self-education; preparation for scientific activity. Processes, observation of phenomena or conducting experiments at home should be carried out purposefully and organized. The teacher needs to highlight moments that can cause difficulties and think about how to help pupils overcome them. In this case, the homework of the pupils will be successful and productive. "Interactive AR-map for personal observations and experiments" will help the pupil formulate the goals and objectives of the research, determine the stages of the work. The questions or exercises contained in the map will allow the pupil to analyze, make generalization, and formulate conclusions.

While completing task 1, to view the experience demo, the pupil should point the smartphone or tablet at the AR-task icon. To homework, such as an observation of the phenomenon, was targeted, pupils are invited to highlight the features of electrified bodies and draw a conclusion. Observation of the phenomenon will prepare the pupil for the second and third tasks, in which it is necessary to independently conduct experiments on electrification. Eighth grade pupils are taking their first steps in experimental physics. It is necessary to teach them to set up experiments and formulate conclusions. In case of difficulty, the pupil can view the theoretical material by activating the AR-help icon. The cognitive component of readiness was evaluated in the course of monitoring students' work according to the following parameters: the ability to independently determine the need for using digital technologies in the lesson; correctly select digital instruments, depending on the purpose of the lesson; ability to work with educational and popular science literature; the ability to independently apply the knowledge of AR-technology in practice. The technological component of readiness is assessed by the necessary knowledge, skills and abilities to use the hardware and software of AR-technologies in the education process at school. The level of formation of all the indicated components individually for each student made it possible to diagnose the initial level of readiness in general for first master's course students. An analysis of the data obtained at the ascertaining stage showed that first master's course students have not high enough formation level of digital competency. There was a contradiction between the interest shown by students in augmented reality technologies and a low level of knowledge in this area. This also confirmed our conclusion about the necessity of experimental training, taking into account the level of readiness of students, and justified the choice of appropriate technology.

The formative stage The formative experiment was aimed at clarifying the role, place and didactic capabilities of augmented reality technology tools in the development of digital competence of a future physics teacher, the development of formation technology of digital competence in the conditions of informatization and digitalization of modern pedagogical education.

The integration of new technologies in education depends mainly on the attitudes and aptitudes of teachers. Therefore, future teachers must be trained as digitally competent individuals in order to eliminate the barrier to digital tools in education. Teachers are a key element in technological transformation since their attitude towards educational technologies is a determining factor in responding to educational innovation and technological advances in today's society. However, the level of digital skills is very low among teachers; they consider themselves to have some knowledge about ICT but they do not know how to use it properly. Even those who believe they have good digital skills showed difficulties in integrating ICT into

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their practical classes. This is due to the fact that most intervention programs aimed at teacher training in digital competence are usually limited to instrumental issues. The use of technology is then discussed in more classical aspects of the teacher profile, such as being an expert in technological content, but the implementation of innovative pedagogical practices that consolidate the use of ICT in the classroom is ignored.

Thus, digital literacy, as a process of acquiring competencies to understand and manage technologies, must be present in the university training of teachers. The main objective of this study was to analyze the effect of different programs on the development of the digital competence of teachers, with the purpose of determining whether or not they improve it. We only found articles where training programs were developed for future teachers, and so, we extend our offer to people who create intervention programs for educators to foster teachers who are working at schools at this moment undertaking a digital training course. There is no specific intervention program that everyone uses, each researcher carried out a different one and all of them produced good results. The TPACK model was one of the most used in the studies selected. It includes all the things that teachers have to know: technological, pedagogical, and content knowledge. This training strategy will make teachers use ICT in their educational practice effectively. Moreover, it could be included in every single intervention program as content to teach. Nevertheless, as mentioned before, all the studies showed an improvement in the digital skills of future teachers after an intervention program. Not only the generic knowledge about ICT but also the five areas of digital competence evaluated in some European and Spanish frameworks are fostered. Some studies showed improvements in the following specific areas: information and navigation, communication and collaboration, content creation, security, and problem-solving. They represent the digital competence that every citizen must obtain in the technological environment we live.

Finally, this systematic review could have important educational implications, especially after the situation experienced in these years, in which technologies played a fundamental role and were the only possible way to respond to the teaching-learning process, based on distance education. Some programs exist and have good results, now it is time to identify the weak points and resolve them.

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