

# A Model of Future Mathematics Teachers' Preparedness to Organize Mobile Learning for Schoolchildren

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## Abstract

Born in the digital world, children cannot imagine life without mobile devices and technologies, which contributes to the transformation of the education system. Mobile devices allow getting information on the Internet anywhere and at any time, the methodology of teaching subjects changes accordingly, the educational process becomes interactive. Mobile technologies and devices have an effective didactic and methodological potential, which requires targeted training of future teachers for their use in teaching activities. The purpose of the paper is to theoretically substantiate and develop a model for forming the readiness of a future mathematics teacher to organise mobile learning for schoolchildren. To create a model of future teachers' readiness for mobile education of schoolchildren, system-activity, personality-oriented and analytical approaches were applied. Analysis and generalisation of the research results of domestic and foreign scientists on this problem are the main research methods, as well as conceptual and terminological analysis and pedagogical modelling. The paper substantiates the relevance and necessity of purposeful preparation of future mathematics teachers to organise mobile education of schoolchildren. The concept of mobile learning of schoolchildren is clarified, its main features are determined. The readiness of future mathematics teachers to organise mobile learning of schoolchildren is considered as a set of motivational, personal, theoretical, activity and reflexive components, which allowed us to systematise and model the process of training teachers for this activity. The model presented by the author, the main components of which are conceptual, content, activity and reflexive blocks, reflects the peculiarities of a future mathematics teacher's readiness for mobile learning of schoolchildren. The developed model will allow us to reach a higher level of training of mathematics teachers, providing personal and professional development of students.

**Keywords:** mobile learning of schoolchildren, future math teacher, mobile technologies, mobile devices

## 1. Introduction

In 2020, the pandemic gave an impetus to the rapid development of distance and mobile learning technologies. Teachers were given the opportunity to rethink their approach to online learning, to study and implement the issues of organizing the educational process using distance technologies in practice, to review the methodology of teaching disciplines. In modern realities, the effectiveness of the educational process largely depends on the use of digital educational resources, distance learning platforms, network and mobile technologies by teachers (Irina et al., 2019).

An analysis of the available scientific sources in the field of mobile learning has shown that there are enough studies, which concern both the conceptual foundations of mobile learning (S. Kuvshinov (2007), V.A. Kuklev (2010), I.N. Golitsyna (2017), S.V. Titova (2012), A. Kukulska-Hulme (2019), J. Traxler (2009), H. Crompton (2018), J. Attewell (2005), and the field of mobile learning application in various subject areas (M. Yu. Novikov (2017), N.N. Kasatkina (2017), Yu.V. Troshina (2015), R.S. Nagovitsyn, A.A. Miroshnichenko and S.Yu. Senator (2018), E. Galimullina, E. Ljubimova and R. Ibatullin (2020). D.O. Koroleva (2016) conducted a study of the readiness of Russian schoolchildren to use mobile and network technologies. The author speaks about the "insensitivity of the education system to modern technologies", while schoolchildren are active users of ICT. Despite a lot of research in this area, there are problems with the use of mobile technologies in teaching mathematics. If mobile technologies are used, it is usually fragmentary. The didactic potential of using mobile technologies in the process of teaching mathematics to

schoolchildren is not sufficiently disclosed (Al-Madani, 2020). In our opinion, the solution to the above problems is achieved by the professionalism of teachers. UNESCO experts note that training teachers to use mobile technologies is a more important task than investing in technology as such (UNESCO policy recommendations for mobile learning, 2015).

Training teachers to organise mobile education of schoolchildren should be purposeful, well-organised, rich in content and methodically equipped process. In this regard, we will outline the *purpose of the paper* – the theoretical justification and development of a model of a future mathematics teacher's readiness to use mobile learning for schoolchildren.

## 2. Literature Review

At the moment, there are several definitions and interpretations of the concept of "mobile learning" in the scientific literature, these definitions are based on either technological features or didactic capabilities of these devices. According to GOST R 52653-2006 (2006), mobile learning is understood as "e-learning using mobile devices, which is not limited to the location or change of students' location". V.A. Kuklev (2010) considers mobile learning as "e-learning using mobile devices, independent of time and place, using special software on a pedagogical basis of interdisciplinary and modular approaches". When defining the concept of mobile learning, some scientists focus on the technical component. So, M. A. Rodionov and O.M. Gubanova (2020) define mobile learning as "a type of learning in which communication between a teacher and a student occurs through a mobile device". J. Traxler (2009) claims that "mobile learning completely changes the learning process since mobile devices not only modify the forms of material presentation and access to it but also contribute to the creation of new forms of cognition and mentality." In his opinion, it is "a new form of education, different from distance or mixed, which characterises a new round of development of informatisation of human society. Education becomes timely, sufficient and personalised".

The mobile learning model allows you to represent fully and clearly the components of the educational process using mobile technologies. There are several models of mobile learning, the main difference of which is the number of incoming components. So, a FRAME model proposed by M. Koole (2009) is based on the interaction of three aspects: technical, user and social. The model of Yu.V. Troshina (2015) presents mobile learning as a set of four main blocks: an educational component, a communicative component, an organisational component of training and a technical component. Unlike the FRAME model, this model takes into account such important components as education and training organisation. N.N. Kasatkina (2017), offers a model for learning foreign languages using mobile devices. This model consists of five systematising components: language, user, technical, pedagogical and organisational, and social. In our opinion, of all the presented models, the model of Yu. V. Troshina and N. O. Verbitskaya most fully describes the learning process.

Mobile education of schoolchildren, unlike adults, has its own characteristics. Adults are inclined to receive education independently, they can plan and evaluate the course of training, choose the necessary software and technical means (Stukalenko et al., 2016). They have a certain experience through which new information is filtered. Not all students are ready for self-education and self-discipline, so, teachers need to pay great attention not only to the content part of the lesson but also to the organisation (forms, methods and means of teaching) when organising mobile learning with students. Having considered various interpretations of the concept of "mobile learning", we believe that mobile learning of schoolchildren is the part of distance learning where mobile devices are used. With such training, students should have continuous access to educational resources without being tied to their location, with the possibility of independently choosing learning tools, with the opportunity to interact with each other and with their teacher. Mobile devices and technologies make young people more mobile and sociable, quickly reacting to changes taking place in the environment, and most importantly - able to perceive a large amount of information, while simultaneously performing related actions (Osanova et al., 2019). Undoubtedly, this has an impact on the development of children's personality. Teachers need to look for ways to use mobile technologies in teaching to form children's interest in learning and optimise the teaching process.

## 3. Materials and Methods

The research is based on system-activity, personality-oriented and analytical approaches. The application of the system-activity approach as the methodological basis of this study allows us to consider the main concept of the study "formation of future mathematics teachers' readiness to organise mobile learning of schoolchildren" as a systemic phenomenon, to consider the training process as an integral unified system of structured and interrelated

activities. In the study, the personality-oriented approach focuses primarily on the personality of students, on the processes of self-knowledge and self-actualisation of future mathematics teachers, and not on educational technologies. The analytical approach allows us to decompose the process under study into its component parts, to identify the influence of the individual parts on the entire system.

The main research methods are theoretical ones: analysis of scientific literature concerning the problems of mobile learning, professional training of teachers for the use of mobile technologies in the educational process, system, conceptual and terminological analysis, generalisation. To understand the logic of forming the readiness of future mathematics teachers to organise mobile learning of schoolchildren, the method of pedagogical modelling was used.

In modern education, there are studies, which describe the experience of teaching academic disciplines using mobile technologies. Mark and Adriana Camilleri (2020) describe a positive experience of teaching mathematics in primary school using mobile technologies. Students were offered to solve math problems on a mobile application in a playful way. The children noted that they developed analytical abilities and a competitive spirit in addition to acquiring skills for solving mathematical problems because they received a reward for each correctly solved problem. The works of H. Crompton and D. Burke (2018), C. Norries, A. Hossain and E. Soloway (2011), M.A. Al-Khateeb (2018) describe the results of studies that allow us to talk about improving students' academic performance when using mobile learning. Scientists note that mobile technologies allow expanding the learning process beyond the classroom. Teachers' readiness to organise mobile training of schoolchildren is one of the main criteria for success. "Under the formation of future teachers' readiness, we will understand the process of personality formation under the influence of personal-value factors, as a result of which a stable barrier is formed to any socially destructive influences" (Sharafeeva, 2021).

#### 4. Results and Discussion

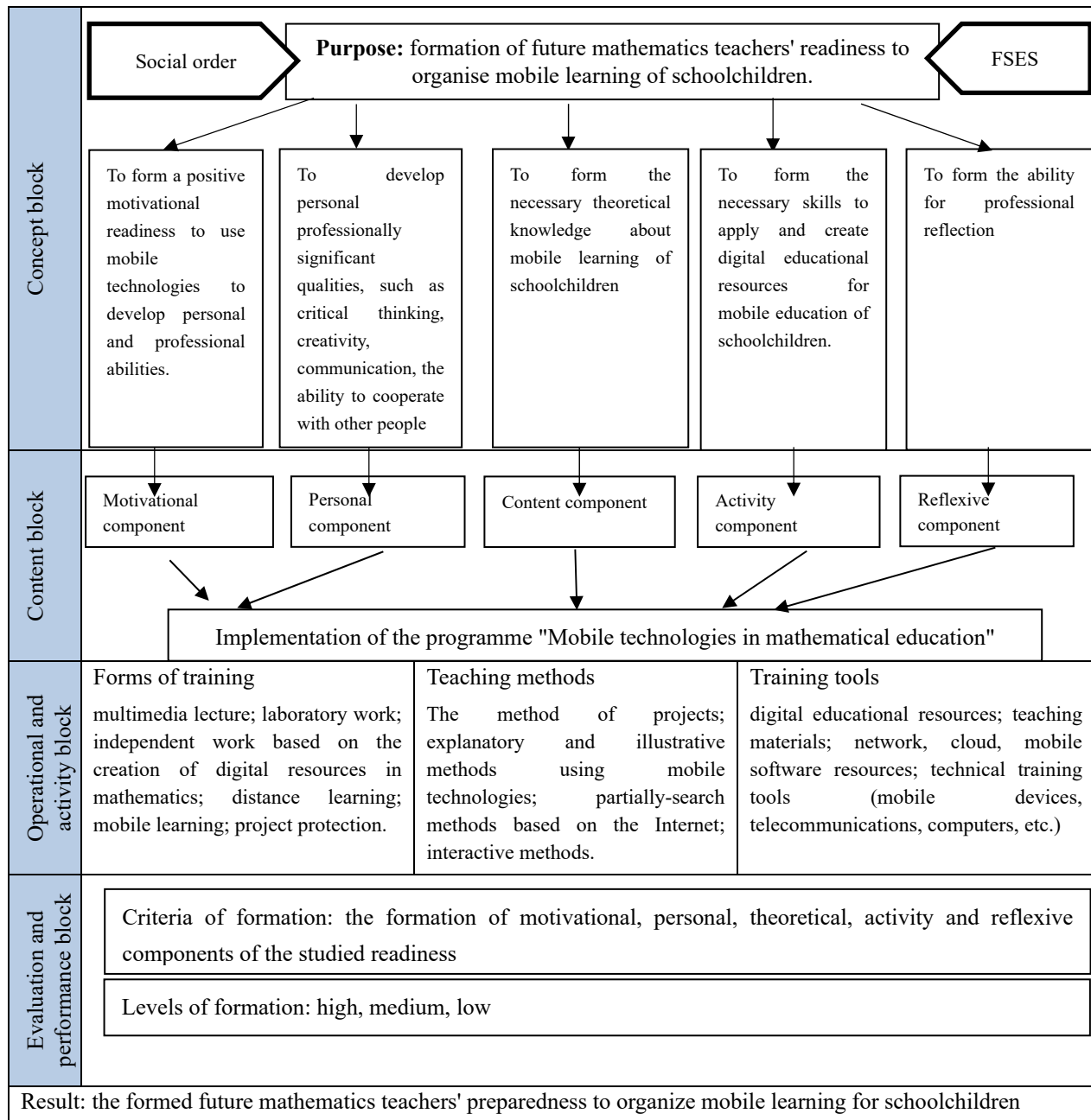
The modelling method is one of the most effective ways to study pedagogical processes. The model allows abstracting from the real process and studying the process holistically. The model is "a theoretical construction that reflects the essential features of the object (process) under study, embodies its author's understanding; a graphical, schematic or descriptive reflection of complex objects that allows studying, explaining and designing pedagogical processes and systems" (Zagvyazinsky & Zakirova, 2008). We consider the model of forming the readiness of a future mathematics teacher to organise mobile learning of schoolchildren as a system representing the unity of interrelated elements (purpose, content, forms, methods and means of teaching, the results of the educational process). Under the model of formation of such readiness of future teachers, we understand the description and theoretical justification of the main structural components of this process, such as conceptual, substantive, operational-activity and evaluative-effective.

Let's consider the main blocks of the model of a future mathematics teacher's readiness to organise mobile learning for schoolchildren (Figure 1).

The conceptual block of the model includes the main goal of preparing future teachers to organise mobile education of schoolchildren and the tasks to be solved to achieve this goal. The goal is primarily due to the social order, that is, the need of society for pedagogical personnel who masters mobile devices and technologies, who can organise mobile education of schoolchildren, as well as the Federal State Educational Standard of Higher Education in the direction of "Pedagogical Education", which reflects the requirements for the professional ICT competence of a teacher. The content block is represented by the implementation of the programme "Mobile technologies in mathematical education" for future teachers of mathematics. The course has an integrated character and is located at the intersection of such sciences as mathematics, computer science, methods of teaching mathematical disciplines, and it is also necessary to know the psychological and pedagogical foundations of teaching.

The course programme includes lectures and laboratory classes. At the introductory lecture, teachers introduce students to the purpose, content and structure of the course. Here, students are divided into subgroups and determined with the topic of the project. Its essence is to study mobile applications (mobile application wizards, digital educational resources in mathematics) or to conduct research on a theoretical issue in the field of mobile learning. The defence of the work should be carried out in the form of a master class during lectures. The theoretical material for the course is studied by students independently in a remote format, there are test tasks after each lecture. During laboratory classes, students study mobile educational technologies, conduct math lessons using mobile technologies. This method of conducting the course allows students not only to get the theoretical and practical basics of mobile learning but also develops skills for independent study of modern software products, develops

communication, critical thinking, creativity and teamwork skills (Kisiołek et al., 2020). The practical orientation of the course allows combining fundamental mathematical education with professional and applied training.



**Figure 1.** The Model of Formation of a Future Mathematics Teachers' Preparedness to Organize Mobile Learning for Schoolchildren

The result of the implementation of the program content is the formation of motivational, personal, theoretical, active and reflexive components of future mathematics teachers' readiness to organise mobile learning of schoolchildren. We will briefly describe each of these components, they are described in more detail in the article "The content and structure of future mathematics teachers' readiness to organise mobile learning of schoolchildren" (Sharafeva, 2021).

1. The motivational component of a future mathematics teacher's readiness to organise mobile education of schoolchildren is the need to use mobile technologies in teaching activities, as well as awareness of the need to use these technologies for the development of personal and professional abilities.
2. The personal component of a future mathematics teachers' preparedness to organize mobile learning for schoolchildren contains such skills as critical thinking, creativity, communication, the ability to cooperate with other people.
3. The theoretical component of a future mathematics teacher's readiness to organise mobile education of schoolchildren includes psychological and pedagogical knowledge, knowledge of mathematics and methods of teaching, knowledge of information, in particular mobile technologies.
4. The activity (practical) component of a future mathematics teacher's readiness to organise mobile education for schoolchildren includes using existing mobile educational applications and creating their own, taking into account all the conditions and features of the educational process, as well as the ability to independently replenish their knowledge, master new mobile technologies and devices and implement them in professional activities.
5. The reflexive component of a future teacher's readiness to organise mobile learning of schoolchildren reflects the ability to analyse their teaching activities using mobile technologies and devices.

The operational and activity block of the model contains a set of methods, means and forms to organise the activities of future teachers in unity with mobile learning methods. The project method is one of the teaching methods. Having divided into subgroups, students need to decide on the topic of the project and develop a concept. The topic should be relevant, interesting and useful for math teachers. In the second lecture session, each subgroup presents the topic, the purpose and objectives, the main stages of the project work. Within the framework of the project, students need to choose an application or an educational resource (a mobile application wizard, digital educational resources in mathematics, web resources, etc.). Before deciding on a software application or resource, students need to study the market of available applications (resources), determine the selection criteria and analyse them according to these criteria. The defence of the project is carried out in an interactive form using digital resources. The relevance of the selected applications (resources), the team's work on the project, the design of materials and the protection of the project are evaluated. At the beginning of the project launch, it is advisable to conduct reflection to form the meaningfulness of joint activities, establish contact with the group and at the end of the activity, after the defence. This scheme of organising project work has its advantages:

1. it promotes the development of students' 4K competence. Working in a team, students learn to listen to others, ask questions, express and argue their opinions, help others, share information.
2. Students are invited to study the market of current mobile applications, digital educational resources in mathematics and to choose an optimal one.
3. In the process of working on the project, students use cloud and mobile technologies that allow all participants to work remotely and at any time.
4. Future teachers learn to present the results of their projects and conduct a reflection.

In addition to project work, future teachers need to develop and conduct a fragment of a math lesson. Unlike project work, the purpose of which is team building, conducting a lesson will allow the development of the methodological and information culture of future teachers.

The evaluation and performance block contains the criteria and levels of formation of future mathematics teachers' readiness to organise mobile learning of schoolchildren. The result of the described model is a future mathematics teacher with a certain level of readiness to organise mobile learning of schoolchildren. The preparation of future mathematics teachers for mobile education of schoolchildren according to this model allows students:

- 1) master the theoretical foundations of mobile learning, thereby systematise and deepen knowledge in the field of ICT;
- 2) acquire practical skills to use digital educational resources in mathematics using mobile technologies;
- 3) develop skills for self-study of software products;
- 4) gain experience working in a team (goal setting, communication);
- 5) development of professional reflection.

Our model, the main components of which are conceptual, content, activity and reflexive blocks, reflects the peculiarities of preparing a future mathematics teacher to organise mobile learning of schoolchildren. V.A. Kuklev (2010) offers a model of the mobile learning process, which "includes a purposeful and orderly set and sequence of a

teacher and a student's actions through joint and (or) individual study of structured learning resources, work in educational communities." In his opinion, "the changes made to the pedagogical system of mobile learning are concentrated around the content of training, means, methods and forms of the technological subsystem". Our model, in contrast to the model of V. A. Kuklev (2010), is focused on training future mathematics teachers and contains components of their readiness to organise mobile learning of schoolchildren. The component approach to modelling allows us to study each component in more detail, the totality of which contributes to the consideration of the process of preparing future teachers to organise mobile learning as an integral system.

I Ismail, S. Bokhare, S.N. Azizan and N. Azman (2013) conducted a study to determine the level of adoption of mobile technologies by teachers in Malaysia. The scientists identified the following components of the level of adoption of mobile technologies by school teachers: awareness and motivation, training and courses, training design, support and tools. L.N. Alexandrova identifies a system of motivational, cognitive and procedural components in the structure of teachers' readiness to use ICT. The paper also reveals the content of the motivational component of teachers' readiness to use ICT through a complex of professional and cognitive motives (Alexandrova, 2019).

## 5. Conclusions

Analysing the works, which describe the structure of teachers' readiness to organise mobile learning, it is necessary to notice a general pattern, namely the presence of such components as motivational, theoretical and activity (practical). In addition to these components, we have identified personal and reflexive components in this study, since we consider the readiness to organise mobile learning of schoolchildren as part of the teacher's readiness for pedagogical activity, consisting of personal and professional growth. The reflexive component of future teachers' readiness to organise mobile learning of schoolchildren reflects the ability to analyse their teaching activities using mobile devices and technologies.

The practical significance of the research is that using the author's model will allow reaching a higher quality level of training of mathematics teachers, which ensures the personal and professional development of students. The results of this study can be used both in training mathematics bachelors of pedagogical education and advanced training mathematics teachers to increase their readiness to organise mobile learning of schoolchildren.

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