Развитие творческого потенциала будущих педагогов в практике разработки мобильных приложений

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АННОТАЦИЯ

Проблема и цель. Инновации, обусловленные вызовами времени и развитием мобильных технологий, предполагают обогащение спектра дидактических методов и средств, в том числе и для развития креативности наставников цифровой школы. *Цель исследования* – изучить влияние участия будущих педагогов в деятельности по разработке мобильных приложений на развитие их творческого потенциала.

Методы исследования. Мобильное приложение – программа, спроектированная в среде разработки и обладающая определённым дидактическим потенциалом. В эксперименте задействовано 98 студентов Вятского государственного университета (Российская Федерация). Программа подготовки: 44.03.05 Педагогическое образование (уровень – бакалавриат), профиль: «Информатика и физика». Деятельность по разработке мобильных приложений реализована на занятиях по дисциплинам: «Современные информационные технологии», «Теория алгоритмов», «Теория и методика обучения информатике». Среда разработки – платформа MIT App Inventor. На диагностическом этапе применена методика «Определение творческой активности личности» (М. М. Кашапов, О. Н. Ракитская). Метод статистической обработки – критерий χ^2 (хи-квадрат) Пирсона.

Результаты. Особенность практики разработки мобильных приложений заключается в том, что деятельность студентов экспериментальной группы реализована по этапам «Изучение инструментов конструктора», «Проектирование несложных технических решений», «Создание учебного приложения по инструкции от преподавателя», «Разработка пользовательской инструкции для учебного приложения», «Применение в условиях дидактического взаимодействия». На каждом этапе предусматриваются возможности, чтобы студенты смогли проявить своё ценностное отношение к педагогическому творчеству, применить теоретические знания, выразить свои интересы и приоритеты. Выявлены статистически достоверные различия в качественных изменениях, произошедших в педагогической системе ($\chi^2 = 6.507$; $p < 0.05$).

Заключение. Сформулированы возможности практики разработки мобильных приложений, учёт которых способствует развитию творческого потенциала педагога: организация конструктивного диалога в рамках информационного взаимодействия при изучении инструментария за счёт наличия каналов обратной связи; закрепление фундаментальных теоретических знаний; выбор сюжета, содержания, оформления и др.

КЛЮЧЕВЫЕ СЛОВА

цифровая образовательная технология, ценностное отношение, педагогическое творчество, программирование, пользовательская инструкция, платформа MIT App Inventor

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Development of creative potential of future teachers in the practice of developing mobile applications

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ABSTRACT

Problem and aim. Innovations caused by the challenges of the time and the development of mobile technologies suggest enriching the range of didactic methods and tools, including for developing the creativity of digital school mentors. *The purpose of the study* is to study the impact of future teachers' participation in mobile application development activities on building their creative potential.

Research methods. A mobile application is a program designed in a development environment and possessing a certain didactic potential. The experiment involved 98 students of Vyatka State University (Russian Federation) of the training program 44.03.05 Pedagogical education (bachelor's degree program), training program specialization "Computer Science and Physics". Mobile application development activities are implemented in classes on the following disciplines: "Modern Information Technologies", "Theory of Algorithms", "Theory and Methods of Teaching Computer Science". Development environment – MIT App Inventor platform. At the diagnostic stage, the method "Definition of the creative activity of the individual" (M. M. Kashapov, O. N. Rakitskaya) was used. In statistical data processing, the Pearson's chi-squared test was used.

Results. The peculiarity of the mobile application development practice is that the students' activities in the experimental group are implemented according to the stages: "Studying the tools", "Designing simple technical solutions", "Creating an educational application according to the teacher's instructions", "Developing user instructions for an educational application", "Application in the conditions of didactic interaction". At each stage, opportunities for students to demonstrate their value attitude to pedagogical creativity, apply theoretical knowledge, express their interests and priorities are provided. Statistically significant differences in the qualitative changes that occurred in the pedagogical system were revealed ($\chi^2 = 6.507$; $p < 0.05$).

Conclusion. The possibilities of mobile application development practice are formulated, the consideration of which contributes to the development of the creative potential of the teacher: organization of constructive dialogue within the framework of information interaction during the study of the toolkit due to the availability of feedback channels; consolidation of fundamental theoretical knowledge; choice of plot, content, design, etc.

KEYWORDS

digital educational technology, value attitude, pedagogical creativity, programming, user manual, MIT App Inventor platform

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INTRODUCTION

UNESCO experts consider the culture and creative potential of humanity as a global public good and a unique resource on a global scale. The organization implements the UNESCO Creative Cities Network and the World Around Us arts festival [1]. Analysts of the VK Education platform surveyed 1,400 students and university graduates and note that the most popular social skill is creativity (21% of respondents) [2]. Students considered such skills as communication skills (18%) and decision-making (17%) to be less important.

M. Demirok et al. also study students' opinions on the possibilities of personal development using digital technologies in the field of modern education [3]. As a result of the study, most students stated that they did not use information technology for self-development. However, they see the didactic potential of digital technologies for the formation of such personal qualities as communication skills, time and stress management, speed reading, creativity and the ability to innovate. R. Watkins, E. Barak-Medina try to understand how justified are the predictions of some experts that AI can deprive representatives of creative professions of their jobs [4]. R. Watkins, E. Barak-Medina rightly note that artificial intelligence changes the process of creating educational content. This is especially noticeable in graphics, writing texts and music. AI helps to automate routine tasks and expands the space for creativity. The authors raise the issue if new technologies can help the creator or replace him/her. A. A. Auzan, A. I. Bakhtigaraeva, V. Bryzgalin point out that the concept of creativity and the creative economy is evolving [5]. The main content of the definition of creativity is the interaction of human creativity, ideas, intellectual property, knowledge and technology.

D. Mahmudah, U. Cahyana, A. Soeprapto note that students who study using mobile devices have more developed creative thinking skills than those who study using traditional means [6]. L. Ali et al. conclude that the wave of technologies and trends of Industry 4.0 has a powerful impact on almost all sectors of culture, science, and education [7]. The results show that the development of skills necessary for the socio-economic and technological development of students should begin in primary school. And a huge role in solving this problem is given to the teacher. M. S. Mirzoev, L. R. Sharafeyeva prove that mobile pedagogy is one of the promising areas of digital didactics. In this regard, the importance of preparing future teachers for organizing mobile learning increases [8]. E. V. Soboleva et al. summarize the findings of various researchers on the didactic potential of mobile tools for training digital teachers. The authors note that the issues of the influence of mobile learning on the development of personal qualities and characteristics remain unaddressed [9]. Thus, on the one hand, mobile technologies have an objectively powerful potential for supporting motivation, communication and exchange of experience between people. However, two conditions are true: studies that suggest that generative AI is capable of supporting (replacing) a person in solving creative problems appear; the aspect of implementing mobile applications and corresponding software in activating learning and cognition is most actively developing and methodologically developed.

Research hypothesis: the practice of developing mobile applications will contribute to the development of the creative potential of future digital school mentors if their value priorities, knowledge system and ideas about the organization of pedagogical activity are taken into account during m-learning.

The purpose of the work is to study the impact of future teachers' participation in the development of mobile applications on the building their creative potential.

Research objectives:

1) to clarify the didactic potential of mobile learning at the current stage of digitalization of education and active development of AI;

2) to determine the capabilities of mobile technologies, the consideration of which will create additional resources for the development of the creative potential of future teachers;

3) experimentally test the effectiveness of the proposed operating system.

MATERIALS AND METHODS

The creative potential of a teacher in the unity of three components: value, cognitive, activity (or professional and personal realization). A mobile application is software, a functional web product that is specially developed based on the capabilities of modern gadgets. A mobile application for didactic purposes is distinguished by the fact that it is a software product, the functions and appearance of which are originally intended to work on mobile platforms in order to achieve socially significant educational goals. The practice of developing and using mobile applications for the development of creative potential is implemented among students of the training program 44.03.05 – Pedagogical education (two educational program specializations). Program level: bachelor's degree, educational program specialization: "Computer Science and Physics". The experiment was organized during classes in the following subjects: "Modern Information Technologies", "Theory of Algorithms", "Theory and Methods of Teaching Computer Science". The experiment was conducted at Vyatka State University. 98 fourth-year students studying at the Faculty of Computer Science, Mathematics and Physics were involved. The average age was 21. Among the participants, 64% were girls and 36% were boys.

For the professional and personal development of the teacher, the tools of the MIT App Inventor cloud environment were used. During the selection process, at different stages of the study, the potential of the following services was assessed: iBuildApp, Glide, Adalo, Bubble, MIT App Inventor, Kodular, etc. Selection criteria: tariffs and distribution conditions, capabilities and limitations of mobile platforms, a database of templates and ready-made forms (screens), tools for dragging components onto the screen (constructor prototype), adding own code, ease of installation, ease of testing and publishing, integration with external services and API, a user-friendly constructor interface.

To assess the level of creative potential, a questionnaire was used, the authors are O. N. Rakitskaya, M. M. Kashapov. The questionnaire includes 44 questions. Respondents are asked to read the statements and determine whether they agree with them (yes/no). The questionnaire uses the concept of "stan": 1 stan – 1-16 points; 2 stan – 18-19 points; 3 stan – 20-22 points; 4 stan – 23-24 points; 5 stan – 25-27 points; 6 stan – 28-30 points; 7 stan – 32 points; 8 stan – 33 points; 9 stan – 36-38 points; 10 stan – 40 points and more. Values from 4 to 7 stans – the level of creative potential is "average"; less than 4 stans – "low"; more than 7 stans – "high". In statistical data processing, the Pearson's chi-squared test was used.

LITERATURE REVIEW

UNESCO supports the implementation of initiatives that enrich the didactic potential of new information technologies for peaceful, free and equal coexistence of all cultures and nations [1]1. A. Vrapi et al. substantiate that the development of individuality and personal qualities is an important stage in preparing students for effective interaction in society, self-determination, and admission to higher education institutions [10]. As a result, changes are required in the training of students and the development of their universal skills. To develop these skills, the authors propose using innovative approaches based on modern educational technologies.

R. Beghetto, M. Karwowski, R. Reiter-Palmon argue that confidence in one's creative abilities is necessary for a person to make creative decisions and be willing to take intellectual risks [11]. M. A. Sandoval, J. Morales Moreno consider the question of whether it is possible to develop students' creativity skills through the development of digital stories in a social network [12]. M. Bojórquez-Roque et al. prove that digital competences of university students are developed through a holistic digital learning ecosystem that integrates: (a) virtual learning environments, (b) digital learning tools, and (c) teaching methods [13].

J. Cuases et al. study the role of video games in learning. The authors focus on the idea that education should adapt to the changing needs of students and new technologies [14]. J. Cuases et al. conclude that video games can improve the quality of learning and prepare students for the industrial future. However, the implementation of digital tools requires special training for those teachers who use them in education and development. E. Alvarez, L. Ruiz determine that the inclusion of mobile technologies in education opens up prospects for the development of new teaching scenarios

[15]. The authors analyzed the educational potential provided by mobile devices in and outside the classroom. Mobile learning is presented by E. Alvarez, L. Ruiz as a strategy to overcome the digital divide, to promote public policy in the context of transforming the traditional role of a teacher. The authors propose to develop and implement integrated program complexes at the state level to prepare both teachers and students for information interaction in the context of mobile learning.

Z. Akrami, V. Amani, J. Bavardi indicate that mobile learning allows access to educational resources at any time and in any place, which contributes to the development of creative problem solving and critical thinking skills [16]. As the authors point out, the obtained results are of paramount importance for the development and implementation of mobile learning strategies in the training of in-demand specialists. A. Camarda et al. indicate that modern theories of creative thinking suggest that the generation of creative ideas by novices in the field of design and engineering is limited by intuitive cognitive biases [17]. R. Salhab, W. Daher note that the implementation of mobile learning is becoming a hot topic for many educational institutions [18]. This is happening, according to the authors, because working with mobile applications promotes communication, information sharing, reflection and creativity. However, the results of the study showed that learning supported by mobile technologies also contributes to the development of cognitive curiosity, emotional intelligence, inspiration and pleasure, motivation and creativity, beisdes class attendance also increases.

D. Mahmudah, U. Cahyana, A. Soeprapto analyze the impact of mobile learning tools on students' creative thinking when studying chemical bonds [6]. S. Adablanu, M. Offei, A. Boateng consider the sustainability of the integration of mobile learning into the educational environment of the University of Ghana [19]. The authors' findings emphasize the importance of a reliable infrastructure, adequate resource allocation and support at all levels of university management for the idea of m-learning development.

D. Siswanto, B. Iswanto, Y. Rahmawati indicate that there is an increasing need to regulate the interaction of participants in the didactic process within the framework of mobile learning [20]. They see this need as being due to the fact that students and teachers more often use smartphones to solve educational problems. According to the authors, mobile learning increases the accessibility, involvement and effectiveness of the educational process. Using physics as an example, D. Siswanto, B. Iswanto, Y. Rahmawati note that the learning process becomes interactive, contributing to increased independence and academic achievement of students. The review also notes that mobile learning contributes to the development of critical thinking skills and a creative approach to problem solving. However, there is also a problem of preventing abuse, information security and protecting academic integrity. This study shows that mobile learning not only plays a transformative role in teaching, but also provides opportunities for the development of independence, criticality and creativity in cognition.

P. Avendaño-López, A. Torres, C. Figueroa-Anzures present a variant of teaching discrete random variables using the mobile application "Probability Distributions" [21]. The results of the study showed that students achieved a better interpretation of problems and creative application of the results obtained. According to the authors, this happened because students focused on analytical activities rather than on manual calculations. F. Montenegro-Castro et al. indicate that the use of mobile devices and applications contribute to the development of skills that constitute the essence of mathematical thinking [22]. In addition, working with mobile applications has a positive and multifaceted effect on academic performance, student motivation and personalization of learning. However, scientists insist that it is extremely important to eliminate inequality in access to mobile applications, restrictions on their installation on devices. It is also necessary to guarantee to participants in the educational process that the integration of mobile applications into mathematical education will be fair and long-term.

Y. Ananda et al. analyze the trends and impact of mobile learning using bibliometric analysis [23]. The authors identified the following new trends: integration of mobile applications with AR, AI and creative industries. H. Uzunboylu, N. Azhar describe the features of mobile learning in various options for interaction between subjects of the didactic process in the "teacher-student" system [24]. The possibilities of effective use of mobile learning in conditions of uneven technical equipment and different psychological readiness of the subjects of interaction are analyzed. The importance of mobile learning is derived by the authors from the fact that information flows are becoming more complex in the developing "digital universe". This fact necessitates the development of such skills

in future graduates as the ability to quickly make a non-trivial decision in conditions of uncertainty, criticality and independence.

Y. Hernández et al. analyze the role of teacher involvement in improving the effectiveness of education based on information interaction in a virtual digital environment [25]. The results emphasize the importance of the involvement and interest of teachers in achieving effective results of such learning. The involvement of teachers contributes to meaningful learning and development of critical and creative thinking of students, improving the quality of higher education and contributing to the effective social integration of graduates.

R. Siaj, M. Zeer, M. Odeh study the impact of mobile learning on the development of creative thinking skills in students in Bethlehem [26]. The authors conclude by recommending raising teachers' awareness of the importance of mobile learning as a significant factor in the quality of learning. In addition, it is proposed to constantly improve the qualifications of current teachers in terms of mastering new mobile tools and applications. O. Felicia, O. Awodiji prove that "soft skills" (including creativity) are often key factors influencing teachers' effectiveness [27]. I. Ismail, S. N. Azizan, N. Azman study teachers' perceptions of the implementation of mobile learning in schools [28]. The results of the study revealed problems, in particular, the question of whether mobile phones can be effectively used as teaching tools in Malaysian schools. A. Baltynova et al. in their study evaluate the didactic foundations for training future teachers to use digital technologies [29]. The authors formulate recommendations for improving the training programs for student teachers, including in terms of their mastery of mobile learning tools.

K. Parajuli notes that a smartphone in everyday communication is a dynamic device for storing information, searching for online materials and disseminating ideas [30]. This technology can improve the effectiveness of teachers. The authors insist that experts, educators, teachers and politicians need to reconsider the benefits of using smartphones for educational purposes to improve teachers' skills, taking into account their active participation in the personal and professional lives of mentors.

A. N. Khuziakhmetov, M. S. Mirzoev, L. R. Sharafeeva study the problem of training highly qualified personnel who are able to use digital tools and resources in pedagogical activities and who have a digital culture [31]. Three levels of problem solving are identified: 1) readiness to use mobile devices and applications in mentoring activities; 2) readiness to model educational situations using mobile devices and applications; 3) readiness for information interaction in a mobile educational environment.

E. V. Soboleva et al. analyze the impact of mobile application development practices on the development of multicultural competence of future teachers. In the work, the authors substantiate [9]: mobile learning has didactic potential both during the training of specialists at the university and during their work; digital school teachers need to be trained to use mobile tools and technologies to solve educational problems, including the development of soft skills; the choice of content for a mobile application for didactic purposes is of great importance in solving the two problems.

Thus, mobile applications which have the identified didactic potential can and should be actively used to develop creativity and creative potential of the digital school mentors themselves.

RESEARCH PROGRAM

The main objective of the experiment is to verify that organizing the practice of developing mobile applications will provide additional conditions for developing the creative potential of future teachers. At the first stage, aspects of the relevance of the research problem were identified: the need to develop the creative potential of teachers was substantiated, the didactic capabilities of mobile technologies were identified, and the critical analysis of the shift in emphasis in the education system to saturating information interaction with services operating on the basis of AI was carried out. In particular, it was determined that mobile didactics has a more developed methodological and regulatory framework. In addition, ethical issues and copyright protection issues do not allow equating the value of the results of generative neural networks and human intellectual creative activity. Here, the analysis of mobile services for designing mobile applications

was carried out. It was revealed and substantiated that MIT App Inventor is a no-code Google constructor which have a large set of ready-made modules. By placing them, the user (even a beginner) can create a design for a future program. The logic of presenting educational content is implemented using the simplest algorithms.

Next, the questionnaire was selected (authors O. N. Rakitskaya, M. M. Kashapov) to assess the creative potential of the teacher. The following were also considered: the method for assessing the level of innovative potential (modification of the method by T. V. Morozova), and the Torrance Tests of Creative Thinking. Reasons for choosing this method: firstly, the authors consider creative potential as a set of creative abilities inherent in each person; secondly, they pay attention to the values and focus on the personality; thirdly, the developers are guided by the fact that these capabilities, values and focus are manifested in activities. Using the questionnaire, all respondents who made up the general sample were divided into the experimental and the control group, each included 49 students. The level of development of creative potential was determined according to the questionnaire materials and was interpreted as follows:

1. "High" level is creative, creatively active personality. Characterized by a desire to overcome familiar norms and ways of acting. In the course of solving creative problems clearly demonstrates initiative and professional interests, strives for self-improvement and independence. In expressing a value attitude in pedagogical creativity, uses mobile technologies without errors.

2. "Average" level – the student has moderate creativity, manifested in creative activities. Does not always strive to overcome familiar norms and ways of acting. In unfamiliar situations of information interaction, prefers to act according to traditional and proven algorithms. In the course of solving creative problems (in most cases), shows initiative, strives for self-improvement and independence. Uses mobile technologies for a value attitude in pedagogical creativity without gross technical errors.

3. "Low" level – The future teacher does not have clearly expressed creative priorities in life. In most pedagogical situations the student is not engaged in understanding and accepting the value nature of creativity. The student needs intensive assistance from a teacher at all stages of development practice: when choosing a project topic, when compiling the code for a mobile application, when designing it, when writing instructions, and when understanding its applicability at school.

At the second stage, future teachers studied the materials of the disciplines according to the work programs approved at the university. At the third stage of the study, specifically those capabilities of mobile technologies were identified, the consideration of which allows creating additional resources for the development of the creative potential of teachers.

RESEARCH RESULTS

The practice of developing mobile applications to support the building creative potential in future teachers is a specially organized educational activity of students, including the stages of "Studying the tools", "Designing simple technical solutions", "Creating an educational application according to the teacher's instructions", "Developing user instructions for an educational application", "Application in the conditions of didactic interaction". At each stage of the activity, opportunities for future teachers to be able to demonstrate their value attitude to creativity, implement the system of acquired knowledge, express their interests and professional aspirations are provided.

Stage "Studying the tools". As part of the course "Modern information technologies", students of pedagogical training programs study various technologies, including cloud and mobile. The software tool that supports mobile design is MIT App Inventor. Students examined the arrangement of components on the smartphone screen, images (icons) and block options at the individual pace. For example, blocks for selection, for performing certain operations depending on the fulfillment of logical conditions. Here, the realization of oneself as a subject of creative programming activities took place.

Next, the following components were considered: SensorAccelerometer, images. As an intermediate result – creation of the application "Coin". The following components were used: button, sound, image. Approximate names for intermediate final applications: "Animal", "Family". After studying such components as button, canvas, HorizontalLayout, students created a mini-project "Drawing". The following components were used: input windows, Yandex. Translator, SpeechRecognition, SpeechToText. The designed application is "Translator". At the final stage of the discipline, students studied the components: SelectFromList, ActionStarter. And created the intermediate final application "Links".

Stage "Designing simple technical solutions". To pass the credit, students submitted the development of all the above mini-applications. Students independently selected (created) images for all the specified developments ("Coin", "Family", "Links", etc.). There was no final project planned for this stage of training. Then, in the classes of the "Theory of Algorithms", students of pedagogical training program study the properties of algorithms, their types and methods of recording. They consider the option of using a game strategy as an algorithm, i.e. a complete plan of how the player will behave in each possible game situation.

Stage "Creating an educational application according to the teacher's instructions". Students were asked to choose one task from those proposed by the mentor and implement the corresponding application in MIT App Inventor. The development was carried out according to one of the analyzed algorithms – game strategies. Let us present one of the options for the developed applications "Lucky Seven". The essence of the project is a game application that functions according to the rules: when starting the system, it randomly gives out (generates) three numbers; if one of the dropped numbers is seven, then coins and the word "Victory" appear on the application screen; if there is no seven in the dropped numbers, then in this case, coins do not appear, but only the word "Defeat" flashes.

1. First, a title is created. To the left of the screen, you find the "User Interface", hold down the "Label" component and move it to the desired location.

2. Next, you define 3 components for writing numbers. Arrange them horizontally, in one row. Use "Arrangement". It can be found on the left of the screen – on the "Palette", below the "User Interface". Set "HorizontalArrangement". Then, in this arrangement, you need to add three labels – for the first, second and third numbers. To do this, go back to the "User Interface" and move the three labels to the arrangement.

3. Add a label where you will display the game result. Also add an image. Go to the palette, select "Vertical Layout". Place the label (for the game result) and also the image on the smartphone screen.

4. Add a button to start the game. To do this, go to "User Interface", find the "Button" component. Click and move it below the vertical layout with the label and image.

5. Next, configure the component properties. For example, for "Screen1". Find "AlignHorizontally", select "Center". Next, configure the screen title, scroll down the properties, find "Title" and enter "Lucky 7". Similarly, perform the actions (configuring the location, titles, tips, images) for other labels.

6. In the upper right corner, click "Blocks". You should receive three random numbers from the system. These numbers need to be stored somewhere. Therefore, you will have three numbers – add three variables. On the left, find the "Blocks" section, in it the "Built-in" subsection and click "Variables".

7. Click on the "Initialize Global Variable Name in" block and move it. In the "Name" cell, enter "Num1" – this is the first variable. Initialize it, find it in the "Mathematics" block section and insert zero. Create other variables. In the "Name" cell (where Num is now), enter "1", "2", "3" in ascending order in each one.

8. Proceed to the game itself. In the "Blocks" section, at the bottom, find the "Button1" element. Click and select the first block, move it.

9. We need to assign random numbers from "0" to "9" to our variables. Go to "Blocks", find the "Variables" section. Select the "Assign" block, move it and insert the button block.

10. Select the "Num1" variable. Go to the "Mathematics" section, select the "Random integer in the range from 1 to 100" block. Move it. Change the values from 1 to 100 to 0 to 9. Copy "Assign to random integer in the range" and paste below, assign to "Num2" and "Num3".

11. Next, we display our numbers in the labels. To do this, look for "Label2" in the blocks on the left, click and select the "Assign – Label2 – Text" block and move it, inserting it below the blocks with variables.

12. Click "Variables", select the "Get" block and paste it into the green cell. In the "Get" block, select "Num1".

13. Copy the green blocks and paste them below. Change the labels and variables in ascending order ("Label2", "Label3", "Label4", "Num1", "Num2", "Num3").

14. Let’s use the selection structures. They are in the "Control" blocks. Go to, select the "If, then" block, move it and insert it into the button block. In the "Parameters" block, select the "Else" block and click.

15. Go to the "Logic" blocks, select the "Or" block. Move and paste into the block after "If". Then add another similar block after the "Or" block. Go to the "Logic" blocks, add equalities into the "Or" blocks in empty cells. Then copy the "Get" blocks with "Num" and paste into the "Logic" block cells.

16. Go to the blocks, find the "Mathematics" section, select the "" block and insert it into the cells of the variable equality blocks, change "0" to "7". If our action is performed (number=7), then this is true. And we write "Victory", if it is not performed, then we write "Defeat". Find "Label5" in the blocks, click and select the "Assign – Label5, "Text" block, move it to the button block after "Then".

17. Next, find the "Text" section, select the first empty block, move it and insert it into the "Label5" block. Enter "Victory" into the empty block. Create a copy with the label "Victory" and insert it into "Else". Change "Victory" to "Defeat".

18. Refine the application according to the logic and strategy of the game. Check its functionality.

Stage "Developing user instructions for an educational application". As part of the course "Theory and Methods of Teaching Computer Science", students not only designed a mobile application for didactic purposes. They created user instructions for others (future students) on how to create such an application. Students determined the topic of the application, its software implementation, content and design. Moreover, future teachers independently selected (created) images for the user interface components. Their creativity was also demonstrated when determining the details in the steps of the user instructions. Let's consider an example of an application from students and their instructions. While studying the topic "Mechanical Oscillations", Anya and Sasha did not understand what could be considered one complete oscillation. Therefore, their physics tutor decided to create an application for a phone that would help students understand this topic. And, in addition, to train students in counting pendulum oscillations.

1. Go to the website (https://appinventor.mit.edu/). Click "Creat Apps!" Register using Google account. On the top panel there is a tab "Projects" – select "Start a new project".

2. Start working with the "Designer" section. Select the following components: Screen1 (Video Player, Question Caption), Horizontal Layout1 (Answer Label, Answer Text), Horizontal Layout2 (Answer Button, Refresh Button).

3. Arrange the selected components on the screen as shown in the image in the instructions.

4. In Media, upload a video of the pendulum swings. In the properties of "Video Player 1", select the height, width, and in "Source", select the uploaded video.

5. Properties of the "Question" label. In the text column, we need to enter our task, for example: "How many oscillations does the pendulum make?". In the "AnswerLabel" properties, in the "Text" column, we enter – "Enter the answer".

6. In the "Correct/Incorrect” label properties, in the "Text” column, we need to enter "Correct/

Incorrect". After clicking the "Check answer" button, the user will see "Correct!" or "Incorrect!" instead of our text.

7. For the "Answer" and "Update" buttons, in the text column, specify the corresponding names "Check answer" and "Update". When you click on the answer check button, the text entered by the user will be checked against the answer we have specified. When you click on the "Update" button, the "Correct/Incorrect" text and the answer entry field will be updated.

8. Go to the "Blocks" section. For the "UpdateButton" and "AnswerButton" buttons, select the following block systems: "When UpdateButton. Click…do" and "When AnswerButton.Click…do". The last block should include a handler for the "If, then, else" branching structure.

Stage "Application in conditions of didactic interaction". Then the students of the experimental group checked the functionality of the developed applications and user instructions during practice at school. The students first conducted physics classes, where they used a teaching tool to support the study of the topic (for example, mechanical vibrations). And then, during computer science lessons, they organized extracurricular activities for schoolchildren to develop such a mobile application.

The students of the control group were not involved in either the development of mobile applications or in writing the corresponding user instructions as part of the classes on "Theory and Methods of Teaching Computer Science". They designed various electronic educational resources, came up with task systems, created instructions for other mentors. For example, a step-by-step guide to getting started with Wordwall: registration, creating tasks, using templates and ready-made exercises. Or they studied the capabilities of the Yandex. Forms service as one of the free and convenient tools for a digital school teacher. The service allows you to conduct tests, votes, create surveys. "Yandex.Forms" can be used for personal purposes (free of charge), to support educational initiatives, and for business. The students in the control group examined in detail various didactic possibilities in the process of creating their own form. The developed form was also used by future teachers in practice at school.

Table 1 presents the results of measuring the level of creative potential of future teachers using the method of O. N. Rakitskaya, M. M. Kashapov (before and after practice).

Table 1 The results of the influence of students' involvement in the practice of application development on the level of their creative potential

Level	Groups			
	Experimental (49 future teachers)		Control (49 future teachers)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
High	8 (16%)	14 (29%)	9 (18%)	10 (20%)
Average	20 (41%)	28 (57%)	20 (41%)	21 (43%)
Low	21 (43%)	7 (14%)	20 (41%)	18 (37%)

For $\alpha = 0.05$, χ^2_{crit} is equal to 5.991. It is determined that $\chi^2_{obs.1} < \chi^2_{crit}$ (0.083 < 5.991), and $\chi^2_{obs.2} > \chi^2_{crit}$ (6.507>5.991). Therefore, the difference in the levels of creative potential for the experimental and control groups can be considered non-random. Let's analyze the changes in the levels:

1. In the control group, the same dynamics were observed for the "High" and "Average" levels: 2% or 1 person. For the "Low" level, the positive dynamics are twice as large.

2. In the experimental group, the dynamics for all levels are much more intense and pronounced. For example, for the "Average" level – 8 people or 16%.

When analyzing the data presented in the table of distribution of levels of creative potential, we conclude that in each of the groups there is a fairly high number of students with the creative potential level – "Average". The reason may be that the respondents are senior students of pedagogical training programs who had one teaching practice and participate in university life.

DISCUSSION

In the presented research materials, the findings of UNESCO experts that the culture and creative potential of humanity are a global public good and a unique resource on a global scale are taken into account [1]. The results of the work confirm the findings of Y. Hernández et al. that unity in the involvement of both teachers and their students contributes to the development of critical and creative thinking, social integration of graduates and improving the quality of education in general [25]. The research materials also present arguments in favor of the theories of M. S. Mirzoev, L. R. Sharafeev that mobile pedagogy is a promising direction of digital didactics [8]. The conclusions that were formulated based on the results of the practice of developing mobile applications complement the earlier conclusions of E. V. Soboleva et al. on the didactic potential of mobile tools for training digital teachers [9]. The researchers' attention is focused specifically on the issues of the influence of mobile learning on the development of personal qualities and characteristics.

As a direction for the development of the study, we note the following: the inclusion of elements of working with generative neural networks in the practice of developing mobile applications. For example, at the stage of creating images for user interface components. However, writing the user instructions themselves and the text for the content is still planned to be left to students – future teachers.

CONCLUSION

The development of the creative potential of future digital school mentors occurs in the course of specially organized activities – the practice of developing mobile applications. It occurs in the environment of software development for a mobile application in the sequence of educational and cognitive actions.

It was revealed that in order to create own mobile application, the developer needs to know the functionality. The basic principles of algorithmization must be understood. The future digital school mentor is supported by the block programming environment – MIT App Inventor. The student's mastery of the main components, their location and grouping by tabs (Designer, Blocks) and directly by blocks ("Control", "Logic", "Mathematics") is one of the stages of educational activities. During this first stage, according to the logic of the presented study, the future teacher realizes that he/she is a subject of creative activities and understands the specifics of working in the environment. At the second stage, the developer gets the opportunity to demonstrate value attitudes to the pedagogical creativity in the framework of designing mini-applications, choosing their design and content. At the third stage, students work creatively with information (theory of algorithms) and demonstrate mastery of the software toolkit according to the teacher's instructions. However, here, future teachers take into account their aspirations, values, and priorities when choosing the topic of the educational task and its technical implementation. At the fourth stage, students demonstrate their creative abilities to the maximum (application of necessary information at the right moment, imagination, refinement of details, improvement of the initial idea), creatively oriented outlook and system of pedagogical knowledge in two aspects: thinking over and implementing an educational mobile application; drawing up user instructions.

At the fifth stage, future teachers creatively apply the developed applications and instructions to solve non-standard pedagogical problems. Thus, the following opportunities for the practice of developing mobile applications have been identified, the consideration of which contributes to the development of the creative potential of the teacher to the greatest extent:

- organizing a constructive dialogue within the framework of information interaction in the classroom when studying the tools due to the availability of feedback channels. For example, tools and components of the development environment (images, blocks, screens);
- reinforcing fundamental theoretical knowledge, patterns, algorithms (for example, game strategy, branching design);
- choosing a plot, content, design (including inserting media) for filling mobile applications. For example, an image of a family, soundtrack for the "Victory" event;

- enriching the range of pedagogical influences within the framework of the teacher's work duties. For example, a pocket mobile simulator for counting pendulum swings;
- transferring some of the control and verification functions to a mobile application within the framework of professional pedagogical communication. For example, this MIT App Inventor environment does not understand the entered value, does not launch the application.

Of course, there is a need to take into account such issues as ensuring data security (when entering them to solve problems), maintaining health and technological dependence. The obtained results of the study are planned to be used to improve the forms and methods of teaching for the previously mentioned disciplines.

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