KAZAN
IC YOUTH
CAPITAL 2022

OIC Youth Scientific Congress

Kazan, Republic of Tatarstan
(Russian Federation)

OIC YOUTH SCIENTIFIC CONGRESS

20-23 November 2022

OIC Youth Scientific Congress is a part of Kazan OIC Youth Capital 2022 international Programme. The Congress is organized by the Ministry of Youth Affairs of the Republic of Tatarstan (Russian Federation) and the Islamic Cooperation Youth Forum (ICYF) is organizing the OIC Youth Scientific Congress in partnership with Kazan Federal University, the Academy of Youth Diplomacy, Academy of Creative Youth of the Republic of Tatarstan and Tatarstan Republican Youth Public Foundation "SELET".

The Congress aims to create an international cooperation platform for the formation of prerequisites for the sustainable development of international cooperation in the scientific field with the OIC region.

The program intends to achieve the following objectives:

- Establishment of a unified scientific platform for interaction of young scientists of the OIC the Member States within the framework of international scientific cooperation;

- Developing deeper scientific awareness and understanding of Sustainable Development Goals, especially those related to the role of youth in science, technology and innovation like SDG 4 Quality Education and SDG 17 Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

Participants: 100 delegates from 56 OIC member states and observer states – young scientists, researchers, and innovators of the Russian Federation and OIC countries aged 18-35 .

The Congress focuses on the following subtopics:

1. Urban Studies

By 2030, there will be 41 metropolises with 720 million people in the world. And by 2025, 600 cities will provide more than 60% of global GDP growth. If large cities are becoming increasingly attractive to our planet's inhabitants, questions are being raised about the comfort and convenience of urban spaces, their sustainability, carbon footprint reduction, and social inclusiveness. The section will discuss the results of interdisciplinary research on urban spaces emerging and developing in different parts of our planet. Experts in the fields of architecture, sociology, economics, ecology, and others interested in the development of contemporary urban spaces are invited.

2. Modern Technologies in Education

The section will cover a wide range of issues related to the educational process at school and the training of future teachers and psychologists. In particular, it will address the digitalization of the educational process, migration pedagogy, conflict mediation, and gadget addiction of students. Research results in the field of tutoring will be presented, as well as technologies for developing functional literacy and critical thinking among students, motivation, and digital and research competencies of education personnel.

3. Petroleum Engineering Technologies

In the context of the global energy crisis and regional and national energy sustainability issues, it is becoming more important to develop deposits of hydrocarbons with hard-to-recover reserves. High-viscosity hydrocarbons, shale oil and gas fields, low-porosity

reservoirs, and fields with a complex geological structure require special approaches to geological prospecting and exploration, as well as the application of new development technologies. The development of import-substituting technologies, reagents, and equipment aimed at solving the production of hydrocarbons from such reserves is also becoming a very topical issue. The section will provide a forum for discussion, exchange of views, and presentation of solutions in the field of hard-to-recover hydrocarbons, as well as discussion of future joint projects.

4. Current Research in Medicine

The focus will be on genetic and cellular technologies in biomedicine, as well as new approaches to preventing and overcoming the development and spread of antibiotic resistance. Specifically, current trends in the development of medicines and treatments based on gene and cell therapy approach to the cultivation of native and genetically modified cells for tissue engineering, promising methods for disease diagnosis and personalized drug selection, and the development of new antimicrobial agents and therapeutic approaches.

FOREWORD

Dear participants of the Congress!
Dear friends!

I am happy to welcome you at the OIC Youth Scientific Congress! This event is highly important for our country as a whole and the Republic of Tatarstan. Kazan hosts the Congress the same year it proudly holds the title of the "OIC Youth Capital 2022". These days Kazan has become the centre of attraction for young scientists, researchers, innovators from the Russian Federation and OIC countries. In the era of global challenges, one of the major goals for the social and economic development in our regions and countries is to support young scholars. The role of science is of paramount importance for the development and strengthening of the intercultural dialogue.

There are more than 1 million young people aged 14 to 35 in the Republic of Tatarstan. They are different people with different goals and needs. They live in urban and rural areas. They are students, young specialists, teenagers and young families. One of the key priorities for us is to enhance support measures for the young scholars of Tatarstan.

Without any doubt, this Congress will provide opportunities for an in-depth discussion of such highly relevant research fields as urban studies, modern technologies in education, oil and gas industry and medicine. I really hope that this Congress will become a good tradition.

Thank you all for your interest in the Congress. I wish you fruitful work and all the best!

H.E Mr. Timur Suleymanov
Minister of Youth Affairs of the Republic of Tatarstan

We are living in the global information age. Not only youths but all of humanity must be disposed toward processing and checking information. In this respect, this most essential instrument of power is importantly noted to require possessing information and beyond that, the capability of processing it. At a time when various ways exist to easily obtain information, facilitating and enabling accessibility to accurate information gains more importance. Youths are surely the most important intermediaries and agents of accessing and using accurate information. At this stage, scrutinizing the youths who will dynamize and guide society and thus undertake this mission of knowledge as the actors of great new changes also gains importance.

Having approximately two billion youths living around the world and the majority of them living in Organisation of Islamic Cooperation (OIC) member states requires the Islamic Cooperation Youth Forum (ICYF) to perform great tasks in order to form a healthy relationship between information and youths. With this mentality and awareness, ICYF has engaged in multi-faceted activities to solve and overcome the many problems youths experience or may potentially experience these days. In this regard, ICYF harnesses youths' transformational potential to help prepare them for the changing future of economics, knowledge, governance, and development. Important steps are being taken to empower youths to voice their opinions and play active and decisive roles in reimagining and transforming the future.

The OIC Youth Strategy reaffirms the importance of developing the capacities of science, knowledge, and innovation through specialized academic and education institutions by promoting youth involvement in science and technology, analyzing knowledge in the fields of science and technology, enhancing teaching, and learning staff mobility, and providing opportunities for international cooperation.

OIC Youth Scientific Congress is organized by the ICYF in cooperation with the Ministry of Youth Affairs of the Republic

of Tatarstan and will constitute an important step in establishing a healthy relationship for youths with scientific knowledge. This congress also gains an important function when one considers that information is no longer one-sided and interdisciplinary approaches are more suitable for stratifying the current understanding of knowledge. The fact that different disciplines such as urban studies, education, engineering, and medicine will be discussed in the context of current developments and technology in this congress is remarkable in terms of accurately capturing these layered trends. Other important aspect is that around 100 young participants from OIC countries have joined on an academic platform for this congress by developing academic cooperation between OIC countries and raising awareness about scientific knowledge. As such, this congress plays an important role in forming the prerequisites for the sustainable development of international cooperation in scientific fields within the OIC region.

I hope that this congress will be an important step for having the youths in OIC countries gain awareness and the relevant experience in understanding, interpreting, and transferring scientific knowledge, and I wish that the outputs that will be revealed after the congress will be able to bring good results to all of humanity.

H.E Mr. Taha Ayhan
The President of the Islamic Cooperation Youth Forum

Dear friends!

Nowadays, international cooperation in the field of science and higher education is a key driver for building a competitive knowledge economy and a prosperous society. An important trend of recent years is the deepening of cooperation within regional integration associations and international organizations that play a significant role in the search for answers to global challenges. Among such international associations is the Organization of Islamic Cooperation, which was created to ensure Islamic solidarity in the social, economic and political spheres and unites 57 member states with a population of about 1.5 billion people.

The Republic of Tatarstan is a leader among the regions of the Russian Federation in establishing ties with the countries of the Islamic world. A new impetus to the development of cooperation was given by the receipt by the city of Kazan, the capital of the Republic of Tatarstan, of the status of the OIC Youth Capital in 2022. The holding of many international events in Tatarstan contributes to the involvement of young people in international and intercultural dialogue. Kazan Federal University, as one of the leading Russian universities and the flagship of the education system of the Republic of Tatarstan, will become a unifying platform for consolidating the efforts of young scientists for the sustainable development and prosperity of the OIC countries. The OIC Youth Scientific Congress, which we are holding together with the Islamic Cooperation Youth Forum, the Ministry of Youth Affairs of the Republic of Tatarstan, the Academy of Youth Diplomacy and other youth public organizations, is aimed at creating a dialogue platform for the sustainable development of international scientific relations in the OIC countries. The topical scientific agenda and the wide geography of the Congress participants are the key to the success of our event.

I wish the participants of the Congress fruitful work, new knowledge, and notable achievements!

H.E. Mr. Lenar Safin
Rector of Kazan Federal University

Contents

Chapter 1. MODERN TECHNOLOGIES IN EDUCATION

1.1 Investigating Engineering Students' Learning Experience and Satisfaction with Online Learning Amidst COVID-19 Pandemic

Abdulaziz Abdullahi[1], Abdallah Almamun[2]
Hassan Usman Katsina Polytechnic, Katsina State of Nigeria
Islamic University of Technology, Dhaka Bangladesh
e-mail: abdulazizabdullahi@iut-dhaka.edu

Abstract. Online learning is increasingly becoming the part of the student learning experience, especially during the ongoing global crisis of the COVID-19 pandemic that resulted in social restriction and lockdown across the affected countries. Many institutions around the world have no choice but to transform to a fully online mode of delivery to ensure learning continuity. This study investigates the learning experience and satisfaction with online learning of engineering university students during the COVID-19 pandemic.

In this study, several constructs relating to students' learning experiences were examined. A total of 217 respondents participated in the study. A cross-sectional survey method has been applied and the obtained data were analyzed quantitatively using the research software SPSS. The study reveals that students confront negative experiences towards online classes due to the immediate transition from the traditional learning environment. They also demonstrated less satisfaction with the online classes. The result further indicated that the technical issue was found to be an important factor in determining students' satisfaction with online learning. Similarly, constructs such as perception of online learning and approaches to online learning were found to have a significant effect on students' online learning satisfaction. The result also shows a direct correlation between satisfaction level and students' learning experience.

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1.2 Reflexivity as a factor in successful adaptation of international and Russian students

A.A.Dostatnyaya[1], Zh. A. Amantay[2], E.Bzhoyan[3]
[1, 2, 3] Peoples' Friendship University of Russia, (RUDN University), Moscow, Russia
e-mail: zhuldyzabaikyzy@mail.ru

Abstract. The article presents the results of an empirical study that help to identify the success of adaptability of foreign and Russian students with different levels of reflexivity. Reflexivity is a factor of successful adaptability of foreign and Russian students.

Keywords: reflexion, reflexivity, adaptivity, adaptive process, foreign students, educational environment, characteristics.

Introduction to the Problem. Nowadays reflexion has become one of the most important issues which is treated as a mechanism of human social life in all its manifestations, as a mechanism of self-organization and self-development of complex systems, as a source and means of personal freedom. Reflexion has been included as both a subject and an object of study in the science of consciousness (philosophy, psychology, pedagogy), theory of thinking (cognitive psychology, hermeneutics, didactics), analysis of personality (psychology, pedagogy), and theory of activity (psychology, management).

The contemporary psychological research that is devoted to the problem of reflexivity has greatly expanded the theoretical and methodological boundaries of this phenomenon. The analysis of a personality is treated as a mechanism of human life in society in all its manifestations. Reflexion appears as a subject and object of study in the sciences of consciousness: in philosophy, psychology, pedagogy, as well as in cognitive psychology, management psychology, work psychology, psychohygiene, etc.

Over the past decade the range of research tools providing objective facts about the specific manifestation of this phenomenon has expanded. And at the same time, there are different interpretations of Russian and foreign researchers in the analysis of this phenomenon.

A brief analysis of literature.

The analysis of scientific literature reveals certain trends in the study of reflexivity within Russian and foreign psychology. Thus, for example, in western psychology this phenomenon is considered mainly in the context of personal reflexion: M. Eckenberg, J. Moon - research in the field of educational psychology, J. Hoyer and A. Klein, S. Pinchaen, J. Sneed and S. Weitbone, N. Kichodge and G. Geneva, K. Tope and J. Barski - in developmental psychology, S. Pinken and P. Sneede - in narrative psychology, S. Bachos and J. Schneder - in personality psychology, as they point out in their work [3]. "N. Kichodge and G. Geneva state that personal reflexion and cultural critical consciousness fully engage analysis, control and personal beliefs about the value of cultural diversity in learning activities, and the best ways to teach ethnically diverse students with maximum positive effects. However, in order to incorporate a more interesting knowledge and appreciation of cultural diversity and engage in these ongoing critical analyses, teachers must have a full understanding of their own cultures and those of different ethnic groups. G. Geneva and N. Kichodge show the main difficulties in developing personal reflexion, such as the lack of discussion among members of different cultures about their beliefs and attitudes. Teachers avoid analyzing prejudices, thoughts, racial and cultural behaviors. No matter how much students listen intently to professors' reflective discourse, their own personal reflection and critical awareness of racism, ethnicity, and cultural diversity will not be achieved.

In Russian psychology reflexivity is considered as a result of a subject's comprehension of his or her own life activities according to L.S. Vygotsky, A.N. Leontiev, S.L. Rubinstein, F.E. Vasilyuk, M.R. Ginzburg, N.I. Gutkina, A.F. Lazursky, and others.

Research Methods. The research was conducted in two stages. At the first stage of research the degree of development of such personal property as reflexivity was revealed by means of a level of reflexivity definition (A.V. Karpov) and diagnostics of the type of reflexivity as a steady personal trait (D.A. Leontiev, E.M. Lapteva, E.N. Osin and A.J. Salikhova). At the second stage, the methods of socio-psychological adaptation diagnostics were applied (C. Rogers, R. Diamond), which included the following integral indicators: "Adaptation"; "Acceptance of others"; "Internality"; "Self-perception"; "Emotional comfort"; "Desire for domination". To diagnose adaptability as a personality trait, we used a form test "Adaptability" (A.I. Krupnova), which contains such scales as: communicativeness, confidence, emotionality, nostalgia, alienation, and adaptation.

The respondents were PFUR international and Russian students aged 18 to 22. A total of 188 students, including 96 first-year students (in the 2nd semester) and 92 third-year students (at in the 4th semester) from different countries - Asia, Latin America, Africa, Arab countries, CIS countries and Russian Federation took part in the test.

According to the results of the study, we came to the conclusion that among Russian students 25% showed a low level of personal reflexion, 65.60% - the average level, 9.40% - the high level. We suggest that most Russian students have underdeveloped reflection, which may mean that they tend to go into the world of illusion and fantasy, replace real events, invent something that does not really exist. 65.60% of students have an average level of reflexion, which indicates that they often analyze themselves and their attitude towards others. 9.40 % of respondents have a

high level of reflexion: they can qualitatively comprehend their internal self and their actions in the external world.

Among foreign students 20.70% have the low level of reflexion, 68.40% - the average level. The foreign students of PFUR have insufficiently developed reflexion; the respondents are not able to analyze their thoughts, feelings and actions.

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1.3 Disadvantages and advantages of introduction of modern technologies in education

K. Belikova
Moscow State University of Psychology and Education, Moscow, Russia
e-mail: kseniya.belikova.2004@mail.ru

In the modern world introduction of technologies has a huge impact on various areas of our lives. However, the area that affects all people without exception is education. It is constantly changing under the influence of variability of the world, the needs of people, the relevance of information.

The introduction of technologies into education has both negative and positive sides. For example, if we take the elementary school: parents buy touch phones for their children to use them only for educational purposes, but this idea has failed. Children do not yet have control that would allow them to focus strictly on studying with devices that are created not only for serious purposes but also for entertainment. If education was focused exclusively on technologies, adaptation to the processes in the future would go more slowly, since children would have less developed skills they need in the early stages of development.

While introduction of modern technologies in elementary school has a more negative impact, in high school technologies are convenient not only for students who perform tasks, but also for teachers who check these tasks. For example, the electronic diary that contains assignments and grades is the best option, because a visual image of completed assignments and received grades helps to create a general portrait of a student's academic performance at school. In this way, it is easier for teachers to motivate children to get their grades up, since the grades are visible both to them and their teachers. An opportunity to complete tasks at any convenient time is a great option for studying.

However, there is another side of this process: due to the system failures, network problems, websites with tasks, as it often happens, block access to attached tasks. It may be stressful for a child who can worriy about the fact that he has not had time to complete the task and is at risk to receive a bad grade, even if he has completed this task. In this matter, it is necessary to take a human factor into account. For teachers it is important to understand that technical problems may occur, so, they have to keep in touch with the students in order to send and receive assessments themselves.

Another aspect of learning is distance education. There are many advantages – no need to spend time to commute to an educational institution, it also saves money on travel and food, provides a more convenient and reliable system to provide feedback to tasks, and other positive aspects. However, when we take our natural needs into consideration, we will get a completely different picture if we consider the possibility of distance education from the point of a person as a social and biological being. We all need society and communication, but the distance learning makes it impossible to communicate live. Also, we lose the very atmosphere of a learning process, the opportunity to talk to a teacher in person and ask questions.

On the one hand, the introduction of modern technologies allows society to develop and make education more convenient. But, on the other hand, the stress due to the natural characteristics of a person, makes us not to immerse ourselves in a completely digital education.

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1.4 Integration of Instagram and TikTok into the Contemporary Teaching

D.A. Cherkassov
Suleyman Demirel University, Kaskelen, Kazakhstan
e-mail: dmitriy.cherkassov@sdu.edu.kz

Social media are increasingly visible in higher education settings as instructors look for technologies to mediate and enhance their instruction as well as promote the active learning for students [1]. Modern teachers tend to stay up-to-date with students' preferences/interests/expectations and innovative teaching trends. Obviously, social media platforms, such as TikTok and Instagram, play a crucial role in the lives of 'zoomers', meaning that teachers are expected to benefit from this notion and find ways to incorporate them into the learning process. The use of social media is beneficial but should be applied in a limited way without the risk of getting addicted [2]. Similarly, while the author does not neglect the potential drawbacks of social media, the preference for this particular presentation is given to the positive aspects and their implementation into the learning process. This session is planned to be held in the format of an interactive workshop, and it aims to address four main aspects regarding the use of social media in education. First, it briefly discusses the importance of TikTok and Instagram for 'zoomers'. Second, the session a) highlights the significance of current trends in Instagram and Tiktok, b) gives a brief clarification on the ways to adapt them to the subject matter of various disciplines, and c) shares the steps to be taken for posting the very first video. To be more precise, the presenter plans to demonstrate his own sample videos that have been successfully adapted to the popular trends, such as Squid Game, as well as give some useful recommendations on how to search for trendy topics. In addition to that, the author will share his personal experience of "how it all started" regarding his social media involvement. Third, it offers a set of practical activities that can serve as ready-to-use materials for the class or be adapted based on class specifics and/or teacher's/students' preferences. Finally, it provides an opportunity for the session participants to practise one or two social media-related activities within the workshop to gain some hands-on experience. The presented information is primarily based on the teaching experience of the presenter who has been both actively involved in social media as an edupreneur and English language instructor implementing TikTok and Instagram into the lessons. Both of the accounts in Instagram

and TikTok are led by a team of three members, but the presenter is the only person to conduct the workshop on behalf of the whole team. To shed some light on the popularity of the accounts, the former has over 3 thousand followers, and the latter - over 14 thousand followers.

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1.5 Distance learning technologies: the present state and prospects for modern higher education

Sergey Efremov[1], Tatiana Batarova[2]

[1] Second-year student in the field of 44.03.01 "Teacher training education", profile "History education" of the Volga Academy of Education and Arts named after St. Alexiy Metropolitan of Moscow, Togliatti, Russia

[2] Candidate of Pedagogical Sciences, Associate Professor at the Department of Pedagogy and Psychology of the Volga Academy of Education and Arts named after St. Alexiy, Metropolitan of Moscow, Togliatti, Russia

e-mail: sefremov2001@mail.ru

Abstract: The paper discusses modern pedagogical technologies used in the practice of domestic distance learning. It is emphasized that distance learning is a technologically proven sequence of providing a student with fixed volumes of structured meaningful educational materials, which ensures the implementation and evaluation of the stages of the student's cognitive activity.

Keywords: distance learning, state and prospects for developing distance learning, pedagogical technologies, pros and cons of working in online format, tools of "digital didactics".

The technology of distance learning is a product of the 20th century. May 30, 1997 can be considered as the date of the official development of distance learning in Russia, when Order No. 1050 of the Ministry of Education of Russia was issued, allowing to conduct the experiment of distance learning in the field of education.

In January 2003, distance learning practices had a high level of sophistication, so they became legally independent [2], but remote education received the large-scale recognition only in the last decade due to the COVID-19 restrictions.

The importance of improving distance learning due to the epidemiological situation for all countries of the world is recognized at the state level [2].

The digitalization of distance learning has caused terminological diversity. The categories of "educational technologies", "pedagogical technologies", "teaching technologies" are logically connected.

In the 21st century, the interaction of teachers and students that provide interactivity through information and communication networks proves to be promising.

Distance learning allows obtaining education without a requirement to attend an educational institution, with the help of modern information, educational technologies and telecommunications systems.

The technology of distance learning has the following characteristics in its structure: communicative interaction, use of information technologies, development and application of the acquired knowledge. It turns out that in distance learning both technical support and ICT competence are important for a teacher. Thus, the appearance of

a new concept, such as "digital didactics" is not accidental.

Nowadays, a wide variety of forms is used in distance learning: online conferences, online lessons, workshops using the Miro interactive whiteboard, MoodleCloud, the Edmodo web application, GOOGLE CLASSROOM, the organization of the pedagogical process in the MOODLE system.

The Volga Academy of Education and Arts (Togliatti) has a developed practice of using the MOODLE distance learning system. The advantages of the MOODLE system are:

1) tools to create high-quality courses in all academic fields;

2) extensive management tools;

3) the opportunity to publish educational content in various formats – audio, video, text, flash, etc.

Due to the growing demand for distance learning and the unique experience it creates, especially during a challenging epidemiological situation, it is necessary for higher schools to understand certain advantages, disadvantages and problems of online education, actively using the advantages and neutralizing the disadvantages.

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1.6 The use of blogs as a pedagogic resource: assuring interaction and learning improvement

Francisco Panguana Jr.
Faculty of Agrarian Sciences, Zambeze University, Republic of Mozambique
e-mail: franciscopanguane@gmail.com

The present work outlines an experience of using an educational blog as a pedagogic resource during the challenging period resulted from the COVID-19 pandemic. When we designed the educational tool, we were interested in creating a teaching and learning environment that could allow continuation of the educational process and creation of learning opportunities for students of the Faculty of Agrarian Sciences, Zambeze University. Technologies are important in education. Thus, web-tools make education more inclusive and engage more learners [5]. Hereby, we are aimed at indicating and explaining didactic benefits of a blog as a tool in order to enhance the interaction between teachers and learners and improve learning outcomes in higher education. The research was based in Carvalho (2008); it demonstrates that the use of web tools facilitates, stimulates social interaction and improves

learning outcomes. In terms of methodology, it is important to mention that this work is based on literature review and action research: our own experience of using the educational blog during the pandemic. We concluded that, when being used as a pedagogic resource, the blog allows (a) permanent provision of diversified digital didactic material (books, audios, videos, brochures, etc) to students; (b) more interaction between a lecturer and students through in comments section under posts; (c) accessibility to teaching and learning environment where contents, objectives, learning resources and work methodologies are posted and (d) use of diverse teaching methods of teaching activities. The blog has broken physical barriers to interaction between a lecturer and students and assured collaborative work during lessons. All didactic elements were easy to apply in an educational process: learning objectives were presented to students; the lecturer evaluated students based on their comments; students posed their doubts and the lecturer clarified them, etc. In addition, our record reveals that the learning outcomes have improved compared to the ones of a previous year when lessons were organized in a traditional form. As a conclusion, we recommend using the blog as a teaching tool because this platform can help to improve the learning outcomes, enhance permanent and efficient interaction between a lecturer and students and provides an unlimited access to didactic materials.

Keywords: web; educational blog; pedagogic resource; learning environment.

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1.7 Factors of the digital education system

Kemal Gaitnazarov
Communication Officer (UNV) UNICEF in Cambodia, Young SDG Ambassador of Turkmenistan
e-mail: kemalgaitnazarov@gmail.com

What is the digital education system? The digital education system envisages the widespread use of technologies in the field of science and education. The digital education system is recognized in the world as a way to educate with the help of information technologies, which means a system of electronic data and the methodology used by

them. There is a number of factors that contribute to the implementation of the digital education system.

1. Strengthening the economy

In the time when market relations are expanding, the role of education in solving economic problems is becoming more and more important, and the task of providing the labor market with manpower is becoming vital. Therefore, the comprehensive use of the opportunities provided by modern innovative technologies in the field of education helps to a certain extent to prevent the deteriorating nature of education. At a time when modern market relations are growing, the level of economic growth is becoming more and more informed. It requires professionals to master modern information technologies and be able to use them actively and effectively in their professional work.

2. Community development

The world is moving from an industrial society to an information society, education to information technology. Today, telephone devices, computers, tablets and other technologies are becoming an integral part of our daily lives. According to the study, the number of people using mobile phones worldwide was 1 percent in 1995 compared to 73 percent in 2014 [2].

These achievements of science and technology should make a significant contribution to the general education system in modern society, especially the improvement of the level of physical health and moral readiness of people and provision of software for their education. The day-to-day growing flow of information and high-tech production in the world is based on the development of public consciousness. This, in its turn, increases the desire of young people to improve their education and gain a multifaceted education, that leads to competition between countries and educational institutions in this area. In the international context or due to the competition in education at a state level, it is possible to make progress in countries that are implementing new innovative technologies, making extensive use of digital

resources and improving the quality of education.

1.1.3. Advances in technology

Nowadays, the requirements for the creation of information technologies have increased. Software, databases and management tools have already become independent products [1]. The widespread use of information technologies, electronic form of teaching and digital materials in the education systems around the world, as well as in our country, leads to the emergence of new methodologies and opportunities in the field of education. As noted above, the continuous discoveries made by people in the world history allow their perception of consciousness to move in a positive direction. And in the twenty-first century, the widespread use of those technologies has led to the emergence of the digital education system. Most people associate their lives with internet media, even though the e-governance system remains. In the online world, there are e-libraries and a variety of websites for readers and people with special skills. According to a study by the World Cellular Information Service, the number of people using the Internet has reached 3.9 billion by 2018, and the figure continues to grow rapidly [3].

In this regard, one of the most important issues is the development of the Internet, improvement of the quality of education, creation of various conditions for self-education in the electronic world, and the availability of resources related to information exchange and communication.

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1.8 The specifics of teaching Russian in Turkey: modern challenges in the field of education and ways to solve them

A. Golubeva[1], N.M. Morozova[2].
[1] Nizhny Novgorod State Linguistics University, Nizhny Novgorod, Russian Federation
[2] Nizhny Novgorod State Linguistics University, Nizhny Novgorod, Russian Federation
e-mail: aminagolubeva2002@mail.ru

The interest of Turkish people in the Russian language was growing during the period of the Ottoman Empire and is still on. Year by year the number of translations made from Russian into Turkish is increasing. The Russian language is taught at Turkish universities as one of the foreign languages. Some universities have faculties of Russian language and literature. Every year, 750-800 students start learning Russian. In addition to tourism, specialists are in demand in the field of foreign trade and banking. The knowledge of the Russian language gives a great chance to get a well-paid job.

When teaching Russian to foreigners, a teacher faces a number of obstacles that arise when students master vocabulary and grammar skills. One of the obstacles is a universal characteristic of all student groups, regardless of their nationality. It occurs due to the pressure of language patterns familiar to them. But each language has its own patterns, so the second obstacle is associated with the dominance of specific language cliches inherent in the native language. There is also an obstacle that lies in a different mentality of students, when the ethnocultural, historical and religious traditions, social conditions of each nation do not coincide with the Russian ones; it can create obstacles to the assimilation of the material. The non–equivalent vocabulary, the discrepancy of background meanings, differences in associative thinking, different aesthetic ideals, literary and artistic preferences - all this makes up the difference between the world view and the national one, which is the issue under study. An obstacle may also occur due to teaching methods that differ from the ones applied by their own teachers at schools. Even the manner of teacher's communication with students, his mood, verbal reactions can be a hindrance in learning [1].

Teachers know their students well, they pay great attention when selecting didactic materials for classroom work, taking interests and a future profession of students into account. However, the evidence from practice suggests that there are few innovations, monotonous teaching methods are often tedious, although they can help to learn a foreign language, but when often used in the classroom, students lose interest in them. Having a variety of methods of teaching Russian, a teacher should find and use the best of them in his work.

The best practices should be based on the following principles:

1. Learning the Russian language not only in a classroom, but also during extracurricular events, in order to enhance students' interest in learning the language.

2. Multi-stage training is an increase in text material.

3. Teaching discussion during the educational process in order to foster the ability to think and innovate.

4. Development of students' initiative by teachers and parents.

5. When explaining new words, it is possible to provide tasks when students are engaged in asking questions, reflection and giving answers to the teacher. Such tasks can help to awake interest among students and stimulate their active participation in the educational process.

6. Having received texts on a certain topic, the teacher can structure a lesson in the form of a quiz or a scientific discussion, where students can ask questions, or a presenter can pose questions while students express their opinion on the suggested topic.

The role of a teacher in such educational process is reduced only to fixing verbal and grammatical mistakes for their further correction and teaching in the classroom [2].

The phenomenon of Russian schools is a way to promote the Russian culture and values around the world. One of the examples is the International Russian School «Klassika-M» in Alanya. A modern space with large spacious classrooms, modern equipment, a large territory, an indoor gym - all this creates comfortable conditions for students. The teaching staff of the Klassika-M school in Alanya is represented by highly-qualified teachers with extensive experience in education, both in Russia and abroad.

Thus, the role of a teacher is changing: a teacher becomes an assistant for students and a coordinator who helps students to keep going, mastering a new language. The teacher in the classroom is constantly looking for new and diverse teaching methods to motivate students to speak more, mastering their communicative skills.

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1.9 Personality-oriented technologies in educational activities

Gomzina K.A[1], Veretennikova V.B[2]
[1]Institute of Psychology and Education, Kazan Federal University, Kazan, Russian Federation
[2]Scientific supervisor – Candidate of Pedagogical Sciences, Senior Lecturer, Institute of Psychology and Education, Kazan Federal University, Kazan, Russian Federation
e-mail: axanagomzina@yandex.ru

Psychological and pedagogical studies of the recent decades have shown that not only the teacher's knowledge of age and individual characteristics is of the primary importance, but also the personal characteristics and capabilities of pupils. Due to the rapid social, economic, technological and psychological changes, modern programs of psychological and pedagogical support for younger generations are primarily aimed at identifying various forms of activity characteristics of a child himself which is reflected in a personality-oriented pedagogical method.

Personality-oriented technologies are an educational system where a child is the highest value and placed at the center of the educational process. The personality-oriented education is based on the well-known principles of humanistic pedagogy: the self-worth of an individual, respect for him/her, kindness and affection are the major approaches. In other words, personality-oriented education is a way to organize the educational process based on deep respect for the personality of the child, taking into account the peculiarities of his individual development, the attitude towards him as a conscious, full-fledged participant in the educational process

The problem with this approach lies in the fact that the basic structures of personality are being formed in the preschool period of childhood, which imposes a special responsibility on a family and preschool educational institution for developing the necessary personal qualities in children, therefore it is very important to implement this technology correctly and even make it a priority. Based on this idea, a teacher should set goals that allow each child to develop creativity, imagination, ingenuity; the ability to negotiate, interact with each other; the ability for critical thinking and making independent choices; the ability to pose problems and find solutions; indifference to the problems of society, the country, the environment. After all, the process of socialization of an individual begins in childhood and continues throughout his life.

Various forms and methods of organizing work with children should be applied in an educational process. The main requirements for a good

lesson is to create an atmosphere when each child gains interest in each type of work, as well as encourage children to use a variety of ways to complete tasks without fear of making mistakes, discussing not only what «we learned» (what we mastered) with children, but also what they liked and disliked, explaining the reasons why it is important to encourage children's desire for new ideas.

The technologies of personality-oriented teaching of preschoolers should be flexible and help to balance the disadvantages of individual needs and techniques that has an impact on the process, work with children on the material that was not digested by them, helping them to get to the required level. Thus, we understand that a teacher will not be able to organize his work properly based on a personality-oriented approach without knowing all the characteristics of his students. Within the framework of this technology, touch boxes and happening can be used as an unconventional method of drawing.

The sensory bag is a manual for the sensorial development of young children, which stimulates the development of cognitive processes, enriches the sensory experience of children and promotes the development of motor skills. Depending on the way a child is filling in the box and by playing with it, a teacher can develop and improve all five senses of a child.

Happening is drawing with fingers. This is a way of sticking fingers to the surface of the paper in different ways (we put dots with our fingertips, draw lines with fingers (we color 1-2 fingers and lean them to the paper to draw stars, trees, etc., or all fingers at once to draw flowers and snowflakes will turn out).

Therefore, modern preschool educational institutions need teachers who know how to interact with different categories of children, who take the personal traits of each child into consideration, develop children while communicating with them, who is able to organize a «zone of proximal development» for each child, and engage children in different types of activities. This requires a high level of teaching competence in the field of child development psychology, personality-oriented educational development technologies and, in particular, technologies that can help to ensure an individual approach to each child.

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1.10 Developing and Introducing Methodological Guidelines for Laboratory Work on the Mechanics Section of the General Physics Course for Bilingual Students into the Educational Process

Burganova Elvina[1], Ivanova Aida[2], Mannangulova Dinara[3], Garnaeva Guzel[4]
[1] Russia, Kazan, Kazan Federal University
[2] Russia, Kazan, Kazan Federal University
[3] Russia, Kazan, Kazan Federal University
[4] Russia, Kazan, Kazan Federal University
e-mail: aidaelnarovna@mail.ru

Abstract: The article reveals the solution to the problem of effective teaching a course in Physics at higher educational institutions for students of non-profile direction and development of national education through the introduction of bilingualism in the teaching process of practical works in the course of Physics. The article contains a description of creating a laboratory complex, writing bilingual tutorials on performing laboratory works on Physics, as well as the process of introducing the laboratory practical work in the educational activities of students of a non-core direction.

Keywords: Physics, laboratory complex, methodological guides, bilingualism, approbation, students of non-profile direction of studies, Mechanics.

The relevance of laboratory classes in Physics is manifested in the need to create conditions for effective assimilation of educational material by students. Teaching the discipline of «Physics» can be effective only if there are laboratory classes in the curriculum focused on development of practical and experimental skills of students. Among the advantages of this type of work is motivation for cognitive activity, which is of particular importance.

The following problem requires thorough consideration: the development of national education, which involves the study of disciplines in addition and in their native language. According to Kitrosskaya I.I., Tolkacheva S.D., Shcherba L.V., the bilingual education is characterized by a positive impact on the intellect [1].

Since 2018, the Department of Bilingual and Digital Education has been established at Kazan Federal University. In the curriculum for preparation of future teachers there is a course in «Physics». For the purposes of this course, a laboratory complex was organized for teaching «Mechanics» in the general course of Physics. The complex includes 10 laboratory works and methodological manuals. A classroom was organized for laboratory classes, physical tools and accessories were supplied.

The Institute of Philology and Intercultural Communication has given us the opportunity to cooperate with such companies as Pasco [2] and Releon [3].

Fig. 1: Releon equipment

The following topics were selected: «Measuring Instruments. Caliper», «Determination of density of solid bodies», «Lever equilibrium conditions», «Moving downhill with acceleration», «Study of laws of conservation of momentum and energy», «Measurement of spring stiffness», «Study of free vibrations of a string pendulum», «Coefficients of friction, rolling and sliding force», «Determination of Archimedes' pushing force acting on a body immersed in liquid», «Determination of efficiency when the body is lifted on an inclined plane».

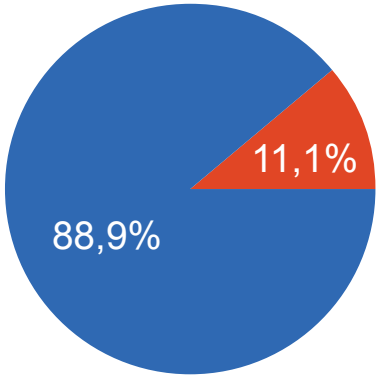
The structure of the manuals is very standardized and contains the number and topics of laboratory practice, a clearly formulated goal, a list of tools used, theoretical

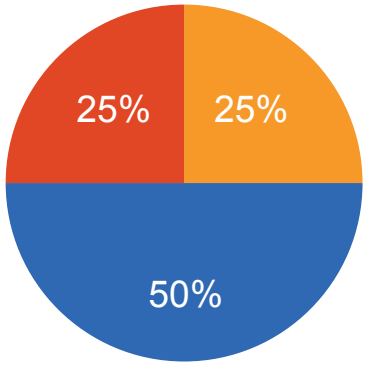
Fig. 2 The process of performing the laboratory. Laboratory work «Lever Equilibrium Conditions»

Fig. 3 The process of performing the work «Studying the laws of conservation of momentum and energy»

material needed to perform the work, a detailed description of the experiment and a list of control questions. In addition, we found it necessary to add quantitative and qualitative tasks that reflect the essence of the observed physical phenomenon, a glossary containing basic concepts and applications that reveal the principle of operation of the main devices.

Following designing and implementation of methodological manuals for laboratory work, a fragmentary approbation was carried out; the purpose was to identify the advantages and possible disadvantages in the design and accessibility of the presentation of the material in the manuals that were designed.





According to the students' opinion, 10 laboratory works is sufficient to study the section of "Mechanics" in the course of General Physics.

The vast majority of respondents (88.9%) suggest that the developed methodological manuals for laboratory works on Physics are understandable and accessible.

50% of students suggest that orientation to bilingualism will effectively manifest itself if the teaching aids are provided in two languages.

Thus, based on the theoretical basis of the methodological manuals design, while taking the importance of a bilingual approach into account, we have introduced the methodological materials for laboratory work to teach Physics into the educational process and proved their effectiveness.

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1.11 Risk-tolerant behaviour, forum theatre, teacher training, social risks, risk-based teacher training

L.R. Kayumova[1], V.G. Zakirova[2]
[1, 2] Kazan (Volga Region) Federal University, Russia, Kazan, Russian Federation
e-mail: kaioum@mail.ru

Research problem. We live in an environment of constant change and risk. According to the scientific data, the significant events that have taken place in the education system over the past 2 to 5 years are: the forced introduction of digital online education during the pandemic, the increasing complexity of inter-ethnic relations in schools due to the growing number of migrants, etc. [9]. For example, studies of the school environment during the pandemic found that there was an increase in the number of juvenile crimes. Part of the reason was the growing

aggressiveness and social unrest among children and adolescents [7]. The particular attention can be paid to the problem of increasing negative manifestations in the youth and children environment, activity of extremist movements such as columbine, school-shooting and AUE (a criminalized informal group among teenagers) on the territory of Russia. The tragic event that took place in Kazan, Russia, literally shook the citizens of one of the safest cities and led to reviewing many school safety issues [8].

Under these conditions, the personal social responsibility of schools and teaching staff towards society for the well-being and future of young people is increasing. For this reason, it is important to develop the teacher's personal readiness to work in risky conditions and make proper decisions in high-risk situations.

At the same time, within the framework of this study, we have introduced the concept of risk-tolerant behaviour as a characteristic of the adaptive behaviour pattern of a teacher in risk-bearing, stressful and dangerous situations. Risk-tolerant behaviour is the integration of cognitive, behavioural and emotional characteristics of a teacher's personality in situations of social instability. The model of risk-tolerant behaviour formed by teachers will allow them to accurately assess the current circumstances, evaluate the level of threats, select adequate models of conflict resolution or preservation of life and health of their students.

The aim of this study is to pilot and test the forum theatre technology for the development of teachers' risk-tolerant behaviour.

The questions under study are:

• What are the conditions for application of the forum theatre technology in shaping the risk-tolerant behaviour of preservice teachers?

• What are the components of risk-tolerant behaviour of teachers?

Methodology or methods. The study sample consisted of preservice teachers of the Institute of Psychology and Education of Kazan Federal University. Fifty-nine students took part in the experiment. Diagnostics and work in the forum theatre format were carried out in the 1st year of

studies (59 students), in the 5th year, there were 54 students in the experiment due to expulsion. The ethnic composition of the group was diverse (Tatars, Russians, Armenians, Uzbeks, Azerbaijanis). The experimental group included 30 students.

For diagnostics, we applied the methods for determining the 'Personality Orientation in Communication', Thomas' Test.

Thomas' test includes the types of conflict-handling behaviour (adapted by Grishina). This technique allows for identification of the conflict-handling behavior types. Thomas proceeded from the fact that people should not avoid conflicts or resolve them at any cost but should be able to manage them competently. In his questionnaire for identifying typical behaviour, Thomas describes each of the five possible variants listed in his 12 judgements of an individual's behaviour in a conflict situation.

The technique "Personality orientation in communication». The technique is designed to study a person's orientation in communication. According to the technique, it is possible to distinguish dialogic, authoritarian, manipulative, conformal, alterocentric, indifferent orientations of a person in a situation of communication. The technique includes statements with behavior patterns in various communication situations. These options make it possible to identify goals, means, desirable and acceptable ways of behaviour for an individual.

At the formative stage, the forum theatre technology was applied. A forum theatre is a technology in vocational training. As Freshwater and Stickley [2] point out, vocational training requires development of students' «emotional competence» which can give them confidence to communicate in a variety of situations. The research by Yvonne Middlewick, Trevor J. Kettle, James J. Wilson in the field of healthcare professional training proves that the use of an experiential theatre technique, such as the forum theatre, allows students to explore and practice different interaction trajectories in unpredictable situations.

In teacher training, this technology is implemented according to the «understand-accept-love» principle. Within the framework of the forum theatre technology, students study the algorithm of theatre

performances, where various situations including conflicts, atypical danger (seizure of a school), and bullying are played out. The ultimate goal is to identify stereotypes and combat them. In forum theatre training the methods are used to develop skills in profiling, self-regulation and handling conflict situations.

Conclusions. We will present the results of the study providing answers to two questions under study.

1. The forum theatre technology was selected as the basis for the experiment. In the process of work, we had to modify the stages when applying the forum theatre and psychological support. Our recommendations concern specifically the monitoring algorithm and the 'theatricalisation' of real cases from school life. We also changed the training system for actor-trainers of the forum-theatre: we introduced the concept of immersion in the role and anchoring in the «present self», etc.

2. The applied diagnostic methods allowed us to reveal that certain behavioural patterns predominate in preservice teachers, who successfully resolve conflicts and dangerous situations in education.

Thomas' Test results. Students in the control group try to avoid rivalry tactics (10.3%), resolving conflicts with other tactics: cooperation(21.7%),compromise (25.7%), avoidance (21.1%), accommodation (21.2%). On the contrary, the participanфts of the experimental group, demonstrate the acceptance of all tactics. At the same time, they confidently use rivalry tactics.

The results based on the methodology of «Personality orientation in communication» clearly demonstrate the tendencies of increase in the manipulative orientation of the students of the experimental group (26% of the control group vs. 36.8% of the experimental group) and decrease in the conformal one (20.9% of the control group vs. 16.4% experimental group) and alterocentric orientations of students (24.9% of the control group vs. 21.8% of the experimental group). These results indicate that the experimental group, having completed training within the framework of forum theatre technology became more interested in managing processes in the education system, in communication situations they

choose a leadership position. On the other hand, this is how they declare their readiness to take the responsibility for the situation outcomes.

Keywords: risk-oriented teacher training, safe educational environment, forum theater.

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1.12 Podcasts as a means of teaching speaking in English lessons

L.S. Komissarova[1]
[1] Nosov Magnitogorsk State Technical University, Magnitogorsk, Russia
e-mail: lyudmila-komisarova@mail.ru

The aim of the study is to develop students' communicative skills in foreign language communication using the developed podcast creation technology as a means of teaching speaking in English classes based on intercultural communication experience. Experimental and descriptive research methods were applied as the main methods of the study. The study presents the features and prospects of using this method in foreign language classes. During the 70-hour course of English as a foreign language, 18 students of the experimental group were trained on the basis of the podcast recording method within the framework of the learning technology developed for the purposes of this study. The material for the analysis was 18 questionnaires, 36 podcasts recorded by foreign students in the course of teaching a foreign language and the results of academic performance. When analyzing the responses of students before and after experimental training, the following mathematical coefficients were used: the average efficiency coefficient. The evaluation of the indicators was based on the results of an oral exam. The results showed that the participants of the experimental groups significantly exceeded the control group in terms of the level of development of speaking skills. The indicator of the quality of students' work in the experimental group turned out to be 25% higher than the indicator of students in the control group. The results of the experiment provide a conclusion about the effectiveness of this training method, as well as the key points that need further revision.

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1.13 The role of virtual reality in education

A. G. Kuznetsov[1]
[1]North-West institute of Management – Branch of the Russian Presidential Academy of National Economy and Public Administration (Russia), Saint-Petersburg, Russian Federation
e-mail: alexkuznec98@gmail.com

Today, virtual reality is a rapidly developing computer technology. Advances in microprocessors, data communications, tools for human-machine interaction and the collected information about the environment have led to the emergence of very realistic virtual worlds. A group of analysts from ABI Research says that by 2022 the global VR market will grow to 5-6 billion US dollars [1]. There are the successful examples of using VR in education. The study that was conducted in Beijing on «The Impact of Virtual Reality on Academic Activities», demonstrated that children were taught the same discipline, but one group was taught by the classical method, and the second group was taught using VR. As a result, a test was carried out. The first group was successful by 73%, and the second by 93%. In addition, the VR group showed a deeper understanding of the topic and consolidated the acquired knowledge better (according to the test results after two weeks).

Virtual reality learning is based on immersive technologies - a virtual extension of reality that allows you to better perceive and understand the surrounding reality. That is, they literally immerse a person in a given event environment. Virtual space allows you to examine in detail objects and processes that are impossible or very difficult to trace in the real world. For example, the anatomic features of the human body, the work of various mechanisms, etc. Flights into space, diving hundreds of meters under water, traveling through the human body - VR provides tremendous opportunities. Looking at the current trends, we can say with confidence that over time, VR equipment will become more affordable.

One of the key factors in the spread of the technology will be the increase in available VR content. Not only for schools, but also for universities and other institutions. At the same time, virtual reality can be used in education at any age - both for primary school students and for older people who decide to learn a new profession or improve existing skills.

The appearance of a personal digital device (laptop, tablet or smartphone) for each participant in the educational process allows you to freely interact with the digital educational environment via the Internet. As a result, an educational organization inevitably turns into an integrator of two environments where a set of educational activities is planned and carried out: physical (classrooms, laboratories, etc.) and virtual environment (hybrid cloud).

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1.14 Development of the Learning Management System for Tahfizh House with Service-Oriented Architecture

M.H.Maraghi[1]
[1] Islamic University of Indonesia, Yogyakarta, Indonesia
e-mail: maraghi.mhasan45@gmail.com

The rapid advancement of information technology can actually trigger consequences in various areas of human life. The world of education must follow technological developments by implementing information systems into the educational process to support the academic success. In the field of education, technology can facilitate learning activities. The Tahfizh House is an educational institution for memorizing the Qur'an. The students study, memorize the Qur'an and repeat the material, then recite the memorized material with an Ustadz. Supporting religious subject matter is given systematically and arranged by looking at the needs of students based on their age. Many Tahfizh houses still apply conventional learning systems.

A Learning Management System is an advanced technology that can be an alternative learning means in this sophisticated era. This is an application commonly used for online teaching and learning activities for the purpose of managing, recording, searching for materials, reporting activities, providing materials and training through a network or in other activities carried out online. LMS provides a variety of services that make it easy to download and share studying materials, deposit memorized verses, lead online discussions, do quizzes, assessments and send reports.

Based on the problems that have been mentioned, the reviewer aims to design a web-based Learning Management System (LMS) so the students can easily learn anytime and anywhere. The researcher has collected data, performed needs analysis and provided a system design. The researcher has carried out a primary information search through a series of questions and answers to one of the Tahfizh House member. Then observations and interviews were carried out to find out the efficiency of the learning process at Tahfizh House, as well as the relevant data was collected from the related books or journals.

Within this study, the researcher analyzed non-functional and functional needs: namely the LMS Admin has a right to manage and regulate the Learning Management System (LMS-based) educational process, Teachers/Ustadz who have a right to manage personal data, teaching activities and the values of students including adding, deleting, viewing and changing operations. Teachers can also print the e-report cards of students, and students who have access rights to view assignments, can view classes and grades.

Information systems that are successfully designed and ready-to-use will be tested in the learning process. The information system testing is run through all activities in the system using black box testing. When tests reveal an error, the repair work will be made to correct the error. Black box testing is carried out to identify whether the system is in line with what is stated in the functional specifications of the system. The black box is also used to test special functions of the designed software that is tested only based on output generated from data or input conditions given by existing functions without relying on how the process gets the output data. Based on interviews, observations, literature analysis, system design, implementation and testing, the researchers concluded that the research has succeeded resulted in a program that can be used as a tool for interaction between students and teachers. Also, the design of an information system is based on the Learning Management System (LMS) applying the Service-Oriented Architecture (SOA) method and the Waterfall development method. We suggest a further research of the role of parents in the system who can see the progress of their children when they are learning Tahfizh al-Qur'an; as well as the ways the learning materials and the system can be developed as not only web-based but also Android-based in order to make them more flexible.

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1.15 Singapore teaching methods in Social Studies

M.A. Merkulova
Chernyshevsky State University, Saratov, Russian Federation
e-mail: maria82530@yandex.ru

The research is relevant due to the need to form the ability of a person to think creatively and find non-standard solutions, develop initiative, and the ability to learn throughout life. Therefore, a modern approach to education is required, namely, the use of Singapore teaching methods.

The object of this research is the Singapore teaching methodology, the subject is the process of introduction and application of the Singapore methodology in Social Studies. The purpose of the work is to determine the possibility of using the methods of the Singapore education system in teaching Social Studies.

Cooperative learning, which is the basis of the Singapore methodology, is based on the ideas that appeared at the beginning of the previous century and were developed by such philosophers and psychologists as Morton Deutsch [1], D. Johnson [2], Spenser Kagan [3], R. Slavin [4]. In Russian pedagogy, the concepts of «pedagogy of cooperation» and collective/ group learning methods are more similar to «cooperative learning».

The theoretical significance of the research is represented by the possibility of writing scientific and practical articles, abstracts, monographs, textbooks, which may include a psychological and pedagogical analysis of the principles of the Singapore teaching methodology, combining several personality-oriented approaches for the development of students' skills.

The practical significance of the work lies in the fact that the results of the analysis obtained can be used not only when conducting Social Studies lessons in secondary schools, but also in additional education centres.

Any methodology of the Singapore structure seeks to develop students' personal responsibility, synchronous interaction, equal participation and positive interdependence.

An analysis of the Singapore teaching methodology has shown that its introduction into the education system is due to the success that Singapore has achieved as the result of education reforms.

The application of the Singapore methodology provides an activity–based approach and a relaxed study of any subject, which does not contradict the Federal State Educational Standard, the main paradigm of which is a personality-oriented approach to learning.

It is expected that the problems associated with the introduction of the Singapore education system will be gradually solved with the experience gained through constant cooperation with Singaporean specialists, and this will become an invaluable assistant in the practical implementation of the third-generation FSES.

It is worth noting that in 2014 at the annual All-Russian competition, the winner of the Teacher of the Year contest was Alla Nikolaevna Golovenkina, a biology teacher from the city of Nurlat, the Republic of Tatarstan, who applied the Singapore teaching methodology in her demo lesson. This fact is a good evidence of the prospects of the studied methodology.

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1.16 Surrealistic Approach to Education

M. Naqi Ejaz [1], M.J. Ahmad[2]
[1, 2] Mimar Studios (SMC-Pvt) Ltd., Islamabad, Pakistan
e-mail: naqi@mim.archi

The 21st century has marked the beginning of the multi-dimensional phenomenon of the Extended Reality. The aim was to help the world to adapt and improve the system of education using multifaceted realms through these foundational elements of the Augmented Reality and Virtual Reality. We have identified the need to eliminate the restricted approach and absorb the Virtual Reality and Augmented Reality that are purely virtual and augmented environments unto real environments. The demand for this technology in the education industry is developing rapidly, but the technical service support is not available, especially in those areas where education isn't given much importance to. However, this process may help to increase the literacy rate by around 45% and develop interest in children.

Many of the discussions of the reality and virtuality in the literature are mainly focused on virtual environments, when one can depict virtual objects using graphic techniques which are of sufficiently high quality to make those virtual objects appear 'real' [1]. It will expand the overall research trends in the field of education and among institutions in various countries when implementing the extended reality in the field of education. The application of the extended reality is an emerging trend in the field of education. There will be more products of extended reality in education. The educational technology is an indispensable component of sustainable development of education in the future.

Based on our conclusions, we can add AR videos to images in the text book which would give a complete description on the topics. [Fig.1.]. This is an entire practice of turning 2D images into videos with audios. A Virtual Classrooms can also be accessed through the headsets. This will involve an enhanced sense of 'presence' within digital spaces. [Fig.2.].

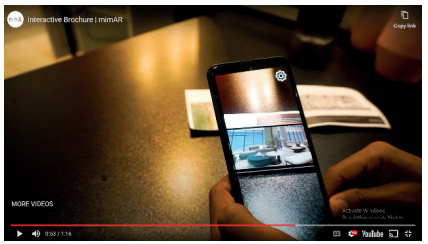

Fig.1. 2D images into Video. Informative Videos in text books. https://www.youtube.com/watch?v=M4Wda8X-5Us&t=45s

Fig.2.Detailofavirtualclassroom with interactive instructors https://www.linkedin.com/posts/naqiejaz_saudiarabia-vr-virtualreality-activity-6982037200817295360-_vUs/

The level of students' knowledge will be improved, and they will more likely be interested and adaptive towards a scientific technology and accept innovation more easily. Therefore, the use of extended reality can promote education for sustainable development [2].

The metaverse might be viewed as the next generation of the Internet, where visitors will enjoy more immersive and interactive experiences. Technologies will affect the ability to deliver positive and effective critical feedback. This exploration will also transform the forms of interaction between an instructor and students through the use of technology.

In recent years, the AR technology has attracted much attention in teaching Mathematics and Science, because it can create a personalized learning

environment and enhance students' activity [3]. It can provide the real-time interaction [4], concretize information, and create a permanent learning environment [5]. Other AR benefits include getting experiences that people cannot access in real life [6].

Keywords: Extended Reality, Virtual Reality, Augmented Reality, Sustainable Development, Inclusive Learning, Revolutionary Educational Practice, Interactive Learning.

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1.17 Modern Technologies in Education: Moodle as a Teaching Tool in Entrepreneurship Higher Education

A. Nurmatov
Course Leader at TEAM University, Tashkent, Uzbekistan
e-mail: azamat.numatov@teamuni.uz

Recently, the majority of educational institutions in Uzbekistan did not use modern technologies as a part of neither curricular nor extra-curricular activities. The main reasons for that seemed to be the lack of private institutions and access to modern technologies. However, due to the COVID-19 restrictions and lockdown, most institutions in Uzbekistan had to move to online teaching and learning methods. Also, with the change in governance, there have been several improvements in education, specifically, private universities have started operating in the country. According to [Jeelani et. al., 2014, P. 116], one of the benefits of private universities is the quick technology adoption and online support. Likewise, our university, TEAM university, is the first private university aimed at teaching Entrepreneurship by adopting Moodle as a teaching and learning tool. [Sanchez and Hueros, 2010, P. 1632] also underline the importance of e-learning as a fundamental tool for competitive advantage in higher education institutions.

Moodle is used as a tool to provide a convenient platform to achieve educational objectives. Taking into account the research findings of [Prensky, 2001, P. 6], most young people spend most of their time in front of the computers chatting, surfing Internet and messaging. Therefore, our university did not expect that students would face difficulties when using Moodle and its functions. Despite our positive expectations, several trainings have been provided

to students as well as the faculty members on the positive impacts and functioning of the platform. Moodle provides the excellent opportunity in social engagement and negotiation both asynchronously, such as in forms of emails and discussions, and synchronously, which creates opportunities for social engagement at any time a student may need. Also, a formative feedback can be received by tutors as well as by peers which encourage learners to be more engaged and persisted compared to a traditional learning environment [Doolittle, 1990]. Overall, students become multidimensional participants in a sociocultural process of making "knowing how we know" the ultimate accomplishment [Shaunda, 2010, P. 200]. This also correlated with the sociocultural and constructivist practices of teaching and learning by Vygotsky.

A research into the effectiveness of Moodle as a modern technology in education was carried out at TEAM university among learners studying the entrepreneurship course. Mainly, the purpose was a) to identify what are the most useful functions of Moodle that boosted learning and teaching, b) if Moodle can enhance social skills of students, c) what other functions can make students' learning more effective and efficient and d) overall satisfaction of student when using Moodle.

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1.18 Digitalization in Training of Future Teachers

Aynur Rzayeva Mirali
Azerbaijan University of Languages, Baku, Azerbaijan
e-mail: rzayevahaynour@gmail.com

Applying information and communication technologies are an essential and integrated part of modern education in the whole world. The main requirement for the 21st century educators and pedagogues is the turn into digital skills from traditional teaching methods. Using digital technologies, educators' and teachers' self-development process helps them to integrate into the global education network. Due to this principle, applied in many developed countries, the Azerbaijani education system has been adjusted to the modern global education system; and digitalization is widely spread not only in higher education but also in schools, both in urban and rural areas of the country. Currently, the modern and future expert teachers use a wide range of digital tools and platforms for their self-development and teaching process. Telecommunication technologies are of paramount importance in distance and traditional methods, so during the COVID-19 pandemic and the post-pandemic period, distance learning and hybrid learning penetrated into the professional life. These are the new notions like multimedia textbooks, remote classes, Massive Open Online Courses (MOOC) that are self-paced and flexible, hybrid attendance international educational events, using cloud systems in order to access online databases everywhere without any obstacle,

assessment, as well filling in registers as virtually improved professionals' IT competencies. In the information society, learners get more independence in learning and research and, as a result, users can integrate into the correspondent scientific environment. Modern learners are inclined to solve and research issues in an agile way. Educators should behave adequately to satisfy their criteria, they should be adapted to all kinds of innovations [1].

As an English lecturer, we have surveyed to find out the rate of ICT tools used in an educational environment. The survey was conducted among 100 university students and the results were extremely surprising. 77% of the adult learners supported that the lectures designed based on ICT is thought-provoking and productive, 20% of the survey participants considered that digitalized classes are harmful or tiring, and only 3% of them were neutral. In conclusion, digitalization and its effect on our society can be considered effective and productive.

Overall, some important directions for professionals in the process of digitalization are identified and classified as follows: strategic local and international training courses for educators, adaptation to the digitalization of education, considering digitalization as an integrated part of the teachers' pedagogical readiness provision of the process with hardware, software and network resources according to requirement, training for mentors and facilitators in the framework of digitalization, using web tools and VR broadly in the education process, and ways to ensure a user's information security while being online.

To conclude, we must take into consideration that the training process of future teachers for professional activity in the context of digitalization of society and the education system is a varied and complex enough issue. The complexity of the matter is closely related to resistance to innovation by the elderly generation and some uncertainty in the organizing of training for pedagogical staff. The solution to this problem is provided by the Ministry of Science and Education of the Republic of Azerbaijan in regular programs and training sessions that are held to educate future teachers [2], [3].

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1.19 The use of Internet resources in teaching the Arabic language in the linguo-cultural aspect

Y.A. Saleh
Russian Islamic Institute, Kazan, Russian Federation
e-mail: yuliasaleh@yandex.ru

In recent decades, the global Internet has become the most important source of information, its educational potential is great. It is possible to carry out distance education through the technologies of the global network, which is especially important at the present time, since it became a requirement for health protection.

The Internet provides a unique opportunity for learning foreign languages, since it can be used to make learning more visual, interactive, and effective.

Arabic language students gain the ability to see and hear different forms of using Arabic in various contexts by incorporating online resources into their classes.

The opportunity to learn not just about pronunciation and intonation but also the meaning and metaphors of vocabulary use [1]. Al-Busaidi et al. found that using digital resources can increase the quality of Arabic teaching, resolve learning difficulties and make learning of Arabic language more enjoyable [3].

So, the tendency to apply advanced technologies in the learning process has touched the teaching of the Arabic language, which is one of the leading directions at present [5]. Nevertheless, with an abundance of various tools applicable in online teaching of foreign languages, Arabic language learning remains teacher-centred and textbook-oriented [2].

The relevance of this study is connected with the fact that the development of new methods of studying foreign languages using multimedia technologies is a popular direction of the world pedagogical science and modern linguistic research. However, in this area there is an almost complete absence of methodological developments for teaching the Arabic language using the resources of the global Internet, in particular, in the linguo-cultural aspect.

In the context of online learning, Arabic language teachers face the need to find new methods of conducting classes, using effective digital tools for interaction with students. In some recent studies it is stated that the degree to which accessible digital resources can be used in the Arabic language classroom is limited due to the lack of teacher training [2]. While it is concluded that the implementation of modern approaches can be simplified through the use of various digital resources.

Different authors classify resources that have the potential to be used in foreign language lessons in different ways. Based on the analysis of studies on this topic, the author has identified the following resources that can be applied in the teaching of Arabic in various aspects, including linguistics and regional studies: online classes, hybrid classes platforms; online boards, services for creating presentations, interactive worksheets, infographics and graphic design; programs for creating mind maps, word clouds; training simulators, online resources for creating interactive tasks, applications for spaced repetition of words, massive open online courses, specialized sites and applications designed for Arabic learners; non-adapted diverse content in Arabic language (social networks, streaming services, applications, podcasts).

In this study it is planned to consider in the fullest possible way the various online tools for teaching in general that have a potential for teaching Arabic in the linguo-cultural aspect, as well as their possible combinations when planning lessons. It is also planned to develop methodical recommendations and real cases of the application of the electronic board Miro, Canva graphics editor, Memrise/ Quizlet, Kahoot!, Iqraali apps, AlJazeera news resource, Arabic streaming services and social networks.

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1.20 Potential Metaverse Innovation in Education

[1]Aisha Salsabilla
[1]Department of Computer Science and Electronics, Gadjah Mada University, Yogyakarta, Indonesia
e-mail : aishasalsabilla1@gmail.com

The metaverse has been recognized as one of the technologies with the greatest potential today. However, the use of the metaverse for educational purposes is rarely discussed. Most educators might be unaware of the features of the metaverse, without even mentioning the potential applications of this emerging technology.

From the perspective of AI, there are several roles of the metaverse in education, namely, the provision of an authentic world that enables learners to "work" and "learn" with intelligent NPC tutors, peers, and tutees as well as other human learners. From the perspective of education, the roles of AI in the metaverse are very important. There are three roles of AI in providing educational services in addition to the roles of supporting arbitration, simulation, and decision-making in the metaverse [1]. The first one is an NPC tutor or advisor. In the metaverse, users can generally seek help or advice from other users who are knowledgeable or experienced. However, in some particular or professional domains, the advice from some "wise" or "experienced" NPCs could be required. The second one is an NPC tutee/student. This implies the need to have someone who can constantly be their trainees. For example, for a learner who is a pre-service teacher, he/she might need to practice his/her class-management or learning-design skills, and it is almost impossible to find a class to do this. The third one is an NPC peer. This role is very important from the perspective of social constructivism [2]. In a learning environment, it is always necessary for learners to interact with peers. An ideal case is when several users are experiencing and learning in the same contexts for the same educational purposes, so that they can discuss with each other during the learning process.

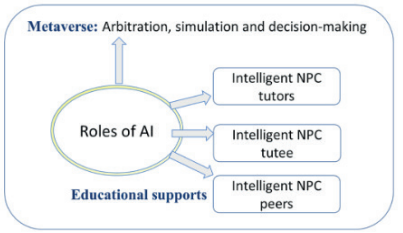

Fig.1. Framework for the metaverse in education

The potential applications and research issues of the metaverse in educational settings are also presented. This could happen in the metaverse if the creator aims to provide the experience or learning opportunities to the users. Therefore, there are many potential applications of the metaverse in education. Without the loss of generality, several reasons for adopting the metaverse for educational purposes are listed as follows:

1. To constantly situate learners in a cognitive or skill practicing environment

2. To constantly situate learners in the contexts to experience and learn what they generally do not have the opportunity to be involved in the real world.

3. To enable learners to perceive or learn something that requires long-term involvement and practice.

4. To encourage learners to try to create or explore something that they cannot afford to do in the real world.

5. To enable learners to have alternative thoughts and attempts regarding their careers or lives.

6. To enable learners to perceive, experience or observe things from different perspectives or roles.

To enable researchers who intend to be engaged in this research field, some potential research issues of the metaverse in education, which are proposed with reference to several position papers on

education technologies [3], are listed as follows:

1. Developing metaverse-based educational models or execution frameworks

2. Investigating the effects of metaverse-based educational environments on learners' learning performances and perceptions

3. Employing the metaverse as an assessment approach

4. Connecting the metaverse to the existing pedagogical theories

5. Proposing metaverse-based learning strategies

6. Examining learning performances and perceptions of learners with different personal features in metaverse-based contexts

7. Analyzing behavioral or interactive patterns of learners with different achievement levels in the metaverse

8. Developing metaverse training programs that are difficult to implement in real-world contexts

9. Defining ethical principles for employing the metaverse in educational settings

10. Finding new roles of AI in metaverse-based educational contexts

There are challenges in creating a metaverse, no matter whether for educational or other purposes [4]. In addition to the potential ethical issues mentioned above, the lack of relevant technological support is a problem at the present [5]. More importantly, it is expected that more studies related to metaverse-based education can be reported soon.

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[5] Dionisio et al. (2013)

1.21 Gamification in Mathematics: the Case Study of an Indonesian Vocational School

H. Solekhah[1], Damayanti [2]
[1] Sabilurrasyad Islamic Boarding School, Kendal, Indonesia
[2] Research Synergy Foundation, Bandung, Indonesia
e-mail: heny.solekhah@gmail.com

The COVID-19 pandemic has detrimental impacts on education, including STEM (Science, Technology, Engineering, and Mathematic) lessons. In many cases, many students have negative experiences and emotions in learning STEM [5]. After a long lockdown at schools, the reopen of face-to-face learning requires a teacher's creativity to increase the students' activeness. Digital games are considered as a potential method to teach STEM more effectively, so that the learners could improve their learning aims [10]. Gamification in math is a potential option to motivate the students. Gamification is the application of the game parts or elements originally designed for entertainment purposes to educational activities in order to engage participants [1]. By implementing gamification, students would have more playful learning experiences, better motivation and greater involvement [4]. To gamify mathematics, the game should create challenges, report scores, and make comparative rankings and levels [6].

Some researchers claim that gamification is positive, but the others find the mixed responses. There was a 50:50 responses from the students whether gamification was good or bad for them [9]. The inability to provide adequate challenges could make the students demotivated, bored or anxious [7]. Therefore, in this case study, the researchers

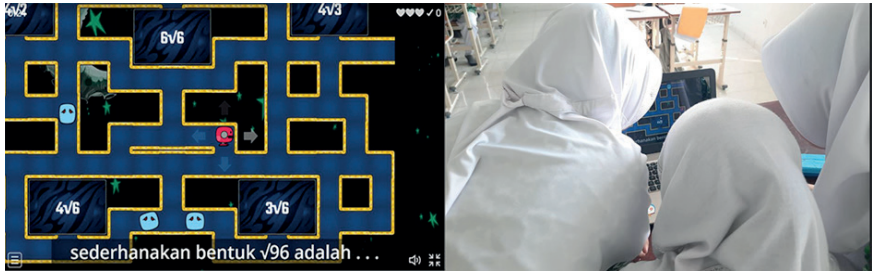

Fig. 1. Students Playing Worldwall - Maze Chase

attempted to investigate the students' perception of gamification in Mathematics and to receive the feedback about the future development of gamification opportunities at their school. The researcher utilized Wordwall to teach square roots in the tenth grade of a vocational school in Indonesia. The participants were 18 students (twelve males and six females) majoring visual communication design. They were divided into six groups consisting of three students. They had to compete with each other to achieve the highest level in the game on Wordwall – Maze Chase. They received randomized 18 questions of square roots (thirteen low order thinking questions, two medium order thinking questions, and three high order thinking questions). There were no time limits, and they had three lives to do the games. After the observation of the game sessions, there were three group discussions to investigate how the students experienced the game and how it could be done better in the future.

It was found that most students had positive perceptions about gamification in Math. During the game sessions, the group members cooperated in answering the questions correctly while avoiding the enemies. Although two groups failed during the first session, they reattempted to win the game to achieve the score as high as possible. Among 18 questions, the winner got score 13, while the lowest score was 4. The students also stated that the randomized questions were challenging, and they were happier when they received easy questions (low order thinking ones) while the higher order thinking questions needed more time to answer them. They expected that there would have more opportunities to play games during the lessons in the future, and someday, they could make their own games.

The findings confirmed the results of previous researches about the positive impact on gamification. During the games, there is a transition of emotions of control, arousal and flows. When the students mastered the knowledge or skills, the game results motivated them to be more progressive in continuing the learning process [11]. Gamification could increase motivation, the team spirit and cognition [3]. The competition between the players increases the communication and cooperation as well as develops the competences of an independent learner. Moreover, the repetition of failures is a productive way to learn and improve [7]. Although the research found that gamification in Math was positive, the limited number of participants and the research methods did not allow generalizing the findings. Therefore, the further research is needed to provide more confirming results.

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1.22 Education in the network space: the experience of the pandemic

V. Syusyukin[1]
[1] Saratov State University, Saratov, Russian Federation
e-mail: vladimirs23@bk.ru

The use of distance learning technologies in a secondary school is one of the possible pedagogical practices. However, it is worth noting that the school as a social institution implies, first of all, the format of full-time education using classical pedagogical methods in the context of a classical lesson. Actually, this is the foundation of the modern secondary school, the basis of the entire pedagogical model. However, this provision of modern pedagogy does not negate the fact that in a modern school the innovative teaching methods or distance learning are not sufficiently applied. Of course, the use of non-classical methods of education is represented in the Russian school. However, it is mainly used as a method of overcoming non-standard situations, often associated with individual characteristics of students, that is, these methods are purely instrumental in nature and are used in a limited way. At the same time, it should be said that the legislation in the field of education recognized distance learning and introduction of non-classical teaching methods [1].

The epidemiological situation in the country and the world in 2020 exposed the urgent need for distance learning, as well as the entire crisis situation in the traditional system of education. The Russian secondary school faced the complete impossibility of conducting full-time classes in the previous context. Moreover, the situation has aggravated when it has turned out that it is impossible to simply transfer a classic lesson to a remote space, since a teacher does not have an

opportunity to simultaneously monitor about 25 students.

A similar situation has developed in the field of higher education, where the distance learning has taken the place of traditional classroom interaction between a teacher and students. Of course, we agree with N.L. Antonova, who notes that «digitalization of higher education is changing the educational landscape, increasing the availability of educational services for different social groups and communities, erasing territorial boundaries, reducing the financial burden on universities, contributing to the development of partnership and cooperation between educational organizations» [2]. However, there are serious difficulties in this area.

Basically, universities organized DE on Zoom, Google Meet, Skype software. Here we immediately face the first problem, which is the system requirements of the programs. Some students have rather obsolete gadgets, which means that the use of the above-mentioned programs overloads the system and create risks of technical problems. It turns out that one of the most obvious problems that are lying on the surface, are the system requirements of the software, which can simply shake the whole concept of distance learning. If there is no suitable equipment, there is no education. That was the most obvious organizational difficulty BEFORE.

In conclusion, we would like to note that BEFORE is probably the only way out of the situation that has developed in the world. Despite the positive aspects of the so-called «distance learning», we must be aware that the very transition to the DE seriously distorts the entire education system: new risky areas appear, and those processes that were previously clear and obvious are transforming in a qualitatively new form. This forces us to treat the sphere of DE as a new research field that requires social, philosophical, phenomenological, and psychological analysis.

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1.23 Digitalization of the educational process as a key factor in the development of international student cooperation. Experience of the Higher School of Economics

Y.V. Voskoboynik[1]
[1]National Research University Higher School of Economics, Moscow, Russian Federation
e-mail: yuvvoskoboynik@gmail.com

The rapid development of technology and globalization have inevitably led to the digitalization of education. The COVID-19 pandemic has not only revealed the identified changes in the educational process, but also become a key factor in determining its development in the coming years. The innovations in the field of education that have appeared in recent years, started to be applied at different stages of the educational process. Today, more and more universities and institutions are implementing online learning, digital communication, etc., with students.

The Organization of Islamic Cooperation encourages the development of education and works on raising its accessibility to all the people according to the OIC-2025 Programme of Action [1]. Since, as noted in the plan, young people are forced to face problems of social and economic nature, which hinders the access to education, countries should interact with each other and help to establish academic links and exchange of experience.

One of the ways to solve this problem is related to implementation of international

student projects in the Internet space. Currently, many universities are establishing cooperation with each other, uniting students in research groups, conducting classes with students from other universities, advising professors on teaching methods. It seems that digitalization of education can help to go further and make international student projects a part of the educational process, as is actively happening now in the Higher School of Economics, which will be considered in a case-study. This format has many advantages for students: cross-cultural interactions, international networking, development and practice of language skills, etc.

According to the HSE Development Program until 2030, project activities should occupy a significant place in the educational process of students [2]. The report will present an analysis of HSE international projects over the past few years, including those with OIC countries, a rating of the contribution of digitalization to the learning process, and conclusions about their role in the development of students as researchers and professionals.

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1.24 Social and educational work with the youth on the basis of national cultural codes

Y. Yagelnitskaya, S. Bobryshov
Stavropol State Pedagogical Institute, Stavropol, Russian Federation
e-mail: yana.yagelnitskaya@gmail.com

The article is devoted to the analysis of Russian and international experience in social and educational work with the youth on the basis of national cultural codes as the most important tool for personal development, social integration and active citizenship of young people. The theoretical research methods are the analysis of the Russian and foreign literature on the research topic, comparison, classification of technologies for social and educational work with the youth, as well as the synthesis of collected information. The article deals with the concept of Russian and international experience in youth work, its goals, methods of work, as well as global development trends in this area.

Discussions about pedagogical models of preparing the younger generation for life under the conditions of the civilizational diversity of the modern world are largely determined by geopolitical, geo-economic, cultural and socio-psychological issues. Modern humanity is facing a choice: either it preserves the established national and cultural worlds or breaks the connection with the national tradition, giving a rise to a new social reality.

At the same time, it is important to note that, regardless of the choice made by a particular country, the processes of implementing educational and socio-educational activities in educational institutions are affected by globalization and mobility of society, manifested in an access to any information on the Internet, the mass dissemination of various cultural content, such as digital seminars, foreign trips, exchanges and internships, etc. Globalization has become a universal trend that marks the transition to universal values, while depersonalizing the national cultural code of people [2].

In this regard, many countries are trying to return to a traditional education system in order to find an opportunity to form unique national norms and values.

It is important to note that the main way to preserve and transmit the cultural traditions of the nation is its cultural code [1]. In this regard, we

raise the following question: what are the pedagogical resources of the school for involving schoolchildren in the life of the state, while shaping their cultural traditions and educating them as active citizens?

1. Education based on national cultural codes is an important system-forming element in the development of social education, because it involves integration of schoolchildren on the basis of common values.

2. National cultural codes act as a methodological platform that generates a system of views, assessments, preferences and combines such social education groups as patriotism, spiritual and moral, cultural, religious, civic education, etc.

3. Effective implementation of social and educational work is based on national cultural codes in the system of social and educational work at general educational institutions, based on the cooperation of actions: "state-society-family-school-student", laying the principles of voluntary participation, feasible contribution and common values.

4. In terms of the content, it is important to fill the methodological base of education within the framework of the complex interaction of philosophers, psychologists, teachers, economists, sociologists and other interested parties.

This determines the importance of studying Russian and international experience in the field of national cultural codes, social and educational work.

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1.25 Teachers as video content creators on YouTube: the values behind the practice

Ksenia Zavyalova[1], Conor Galvin[2]
[1] Institute of Psychology and Education, Kazan Federal University, Russian Federation
[2] College of Social Sciences & Law, UCD Dublin, Ireland
e-mail: k.zawyalowa@yandex.ru

The COVID-19 pandemic has created an unprecedented need for online learning. School teachers, as the majority of educators, needed to become digitally skilled almost overnight, and the emerged results ranged from the modest to the remarkable. A recent Canadian study, for example, found that during the current pandemic teachers are concerned about finding the meaningful ways to engage students in distance learning [7]. Furthermore, in recent years there has been a growing interest in research on teachers' interaction with social media as a pedagogical tool, and how this can contribute to their professional and personal development [1]. Yet, there has been a dearth of research that shows why school teachers invest time in creating and distributing visual media content via YouTube.

First of all, we argue that YouTube can be a space for social practices but can be considered as an affective space as well [5]. By adding the concept of digital gift [3], we introduce the imagined communities, where teachers create digital videos "out of a spirit of building something between them" [6]. Performance, introduced by Goffman [2], is also a defining aspect of belonging to these communities. In addition, we apply the value creation framework of Wenger-Trayner et al [8] to explore the five

dimensions of value for teachers' professional development.

Secondly, we analysed 115 YouTube video channels using the aforementioned framework. To date, semi-structured interviews have been organised with 15 participants. Preliminary results identified the personal and professional reasons underlying teachers' online sharing practices. Furthermore, it is also clear that content creation can generate altruism and be an aspiration for better teaching. Finally, the participants pointed out the emerging supportive environment within online communities.

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1.26 The Global Digital Learning Center: a way for the transformation in education

Zeeshan Ali
University of Central Asia, Tajikistan
e-mail: Zeehsan.ali_2026@ucentralasia.org

Education contributes to a positive social change and the development of a community. Pakistan does not have a modern education system. According to some statistics, the system is 60 years old and needs to be modified to develop people morally, technically and critically. Pakistan has over 200 million people; thus, modern education and access to open learning resources are more limited in remote areas. Our project is based on a designed solution, as our pilot project will be focused on GB and Chitral, which are Pakistan northern region. We suggest being focused on students attending public and private schools; being focused means to work with individual students revealing what resources are available for them in studies, how often the resources get updated, if they have an easy access to technologies, and what kind of problem they are facing while accessing various resources. We are aimed at collecting data to help us progress toward a solution. Moreover, through digitalization in education, we hope to provide free learning resources to remote areas while connecting them to the outside world. The free learning resources imply that the students have a wide range of modern learning sources to choose from. Digital learning will also help them develop their skills, and we intend to teach them how to overcome poverty in society using these learning resources and

developing skills. Our project is divided into two parts - visits to various locations in Gilgit Baltistan and Chitral. We plan to collect individual data as our team has already had expertise in the field because we have volunteers and students working in the same niche. They are skilled at guiding each village and school in gathering a wide range of data. The volunteers organize webinars, provide training and run camps and sessions. The second phase includes data collection and is to be led by Zconnect, which aims to provide technological awareness, digitization and modernization of educational institutions in GB and Chitral by utilizing the data we have collected. The team has been building websites and apps and developing teaching computer skills at educational organizations worldwide. So, with their help, we plan to find sponsors to purchase resources for the students, as this is our primary goal. Digital technologies can make a wide range of online data sources free for students, forming the first Global Learning Center. We are aimed at assisting students in remote areas by providing essential technologies connecting them to the rest of the world. The entire project will be completed in one year; in the first four months the data is to be collected from various villages. In the remaining eight months we plan to develop the Learning Center source with the assistance of technologies, experts and many professionals worldwide who will be linked via the platform. At the final stage, our project can transform education in remote and other areas, not only in Gilgit-Baltistan or Chitral; instead, it can change the Muslim world's education system. The Global Learning Center can assist in reaching a higher standard of living for citizens, which is the goal and mission of our project.

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1.27 School climate and its importance in single-sex schools in Kazakhstan

Talgat Zhussipbek
Karaganda Buketov University, Karagandy, Kazakhstan
e-mail: zhussipbektz@buketov.edu.kz

Intense controversial debates on the efficacy of single-sex education persist in communities around the globe. Research findings from a range of countries provide conflicting evidence as to the social and educational consequences of single-sex schooling.

Thus, the controversy over whether single-sex schools are more effective than co-educational schools has been long-standing and seems likely to continue.

Although co-ed schooling is currently dominant in most Western countries, researchers suggest that single-sex education has the potential to be more beneficial in some particular aspects, such as university entrance performance, academic attainment in certain disciplines, and girls' performance in 'male' subjects among many others. In addition, there has been an interest in the potential advantages of single-sex groupings within mixed schools in order to reap the perceived benefits of both systems. While presenting arguments in favour of single-sex schooling, many researchers controversially refer to the inherent biological and physiological differences between males and females.

Despite a large number of studies considering single-sex education advantageous, there is no clear consensus on the effectiveness of a single-sex environment by virtue of many factors, including the student selection process. outperformance exhibited by

some single-sex schools may be a result of the special attention and resources devoted to the advancement of students in those schools. She also mentioned that similar performance could be obtained if identical resources were invested in co-ed schools. In this regard, Halpern et al. [2011] asserted that any potential academic advantage of the single-sex institution can be attributed to students' initial pre-existing cultural capital.

There is anecdotal evidence pointing toward Kazakhstani single-sex schools performing better than their non-segregated counterparts. The argument of whether sex segregation is beneficial for boys and girls or if its impact is rather limited, or even an impediment to the students' social development and academic achievement, is disputed. In Kazakhstan, there seems to be a common belief that a single-sex environment helps students to improve their academic skills without being distracted by the opposite sex.

However, the situation is complicated by the fact that students in these institutions board, meaning schools have more control over how they spend their time and are also more likely to be from families where education is valued. In addition, there is some evidence that a single-sex environment negatively affects students' social development and self-concept.

The findings of this study indicate that the primary reason why students like studying in BILs and what encourages their academic achievements is the school climate, specifically the relationship among students and strong friendships. The study also demonstrated that teachers' and tutors' roles are considered the main factors in students' achievements. The study revealed that a single-sex environment is seen as one of the many school features, rather than the primary one, that contributed to learners' success. My findings also suggested that the student selection process may have a detrimental influence on students. Overall, there appears to be no consensus regarding these and other implications of sex segregation.

The reason for focusing on student and teachers' perceptions is based on a personal interest in their experience at single-sex secondary schools and my intentions to gain insight into gender-segregation in Kazakhstani secondary schools. This paper shares fieldwork experiences and facts faced in the process of carrying out interviews. Specifically, the importance of school climate will be discussed.

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Keywords: single-sex education; BIL; boarding school, school climate.

Chapter 2.
CURRENT RESEARCH IN MEDICINE

2.1 Targeted Photothermal Therapy of Melanoma in C57BL/6 Mice Using Au Nanoparticles and Infrared Laser

A. Ahmad[1], S. Rauf[2], S. Rehman[3]
[1]International Medical University, Bishkek, Kyrgyzstan
[2]International School of Medicine, Bishkek, Kyrgyzstan
[3]University of Peshawar, Peshawar, Pakistan
e-mail: adnanamd678@gmail.com

Nowadays, cancer can be described as a common disease of our society. According to the World Health Organization, 8.2 million people in the world (approximately 0.11% of worldwide population) die each year from cancer. A major challenge for cancer therapy remains in developing cancer treatments with less toxicity. The outcomes of preclinical and clinical studies conducted worldwide over a period of 25 years established phototherapy (PT) as a useful treatment for some cancer types. [1] Photodynamic therapy (PDT) and [2] photothermal therapy (PTT) are two critical PT treatments that aim to damage tumor cells. PDT utilizes a combination of drugs, [3] photosensitive molecules, also known as photosensitizers (PSs), and visible light of an appropriate wavelength in order to activate drugs. PTT employs agents to generate heat from illumination. Most clinically confirmed PSs target superficial lesions because of their limited effects on cancerous tissues and, consequently, this approach causes non-effective therapy to deep-seated cancerous tissues.

A combination of PDT and PTT with carbonaceous nanomaterials (CNs) offers additional active complementary and supplementary roles for deep tumors in cancer therapy. The effective delivery of therapeutic molecules into the cancer cell, containing surfaces, optimum sizes, and shapes of the gold (Au) nanoparticles are able to be enhanced with homing ligands and utilizable interactions. CNs have significant potential for biomedical applications due to their unique well-designed size, composition, biocompatibility and functionality. Each material has advantages and disadvantages such as degradability, solubility and drug loading capacity for cancer therapy. Benefiting from other research, the structural and chemical modification of the nanoparticles advantages and limitations of these nanomaterials (NMs) provide a new perspective on improving cancer therapy using these gold nanoparticles. Along with these classical approaches, the new treatment and technology also gained their significant role in treating cancer. Among them is photothermal therapy using nanoparticles.

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2.2 Gene signatures of cyclin-dependent kinases: a comparative study in native early and advanced stages of lung metastasis breast cancer among pre- and post-menopausal women

Muhammad Fazal Hussain Qureshi[1], Muzna Shah[1], Mahira Lakhani[1], Zain Jawed Abubaker[1], Danish Mohammad[1], Hira Farhan[1], Iman Zia[1], Rida Tafveez[1], Samahir Tariq Khan[1], Rubina Ghani[2], Shamim Mushtaq[3], Ghulam Haider[4]

[1]Dr. Ziauddin University Hospital, Clifton, Karachi, Pakistan
[2]Sohail University, Karachi, Pakistan
[3]Department of Biochemistry, Ziauddin University, Clifton, Karachi, Pakistan
[4]Department of Oncology Department, Jinnah Postgraduate Medical Center, Karachi, Pakistan
e-mail: fazalhqureshi22@gmail.com

Today, breast cancer is the most commonly occurring cancer in women and the second most common cancer in world [1]. In Asia and other lesser developed countries, there is a lack of adequate services and treatment for breast cancer, hence a higher mortality rate is observed when compared to a developed setup [2]. In Pakistan, Karachi is supposed to have the highest incidence of BC among the Asian population [3]. Cyclin-dependent kinases (CDK) are reported to play a vital role in the progression of the cell cycle and transcriptional regulation which is frequently dysregulated in all human malignancies [4]. They are an attractive target for breast cancer therapeutic strategy. Overexpression, dysregulation and mutation of these CDK contribute to the proliferation of cancer cells, and inhibition can lead to both cell cycle arrest and apoptosis.

Few members of CDK family have been well-researched to have a vital role in therapy, but the majority of them are not researched in depth, so the present study aims to investigate the six CDK which have scanty data available (CDK 11, 12, 17, 18, 19 and 20) of mRNA expression at an early stage (II) and advanced stage (III and IV) with lung metastasis patients. The samples from two hundred pre-and postmenopausal lung metastasis breast cancer patients and healthy people were taken for RNA isolation. A quantitative PCR was done for CDKs mRNA expressions. In the pre-menopausal breast cancer group, the relative gene expression of CDK11 was found to be high in advanced stages (IV) only, with statistical significance (p=0.0001). However, in the postmenopausal group, it showed progressively increasing expression from stage III to stage IV with statistical significance (p=0.001). CDK12 was upregulated at both early and advanced stages in the pre-menopausal group, although early stage did not reach statistical significance (p = 0.06). Interestingly, in the postmenopausal group, the upregulation was observed only in advanced stages but did not show statistical significance (p=0.06). The mRNA expression level of CDK17 in the pre-menopausal group was overexpressed with a gradual increase in expression at advanced stages compared to the early stage. We also found a statistically significant increase (p=0.001) in mRNA expression of postmenopausal patients at the advanced stage (III) compared to stage IV; the early stage did not reach statistical significance

(p=0.098). The statistically significant approach was seen in CDK18 mRNA expression, which was upregulated in all stages among pre- and postmenopausal groups. CDK19 was overexpressed only in stage IV of the pre-menopausal group with p=0.002. The postmenopausal group showed a 5.52-fold increase of CDK19 expression at an advanced stage (IV) only, with statistical significance p=0.04. Whereas CDK20 showed downregulation progressively from early to advanced stages in pre- and postmenopausal groups.

In conclusion, overexpression of CDK11, CDK12, CDK17, CDK18 and CDK19 was observed in both pre- and postmenopausal groups. However, CDK20 showed progressive downregulation from early to advanced stages in both groups of patients.

Collectively, this data revealed that CDK overexpression levels may predict BC disease progression and provide further rationale for novel anticancer strategies for breast cancer treatment. It also can help in the early detection of breast cancer.

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2.3 Versatile characterization of rat kidney natural scaffold produced by decellularization techniques

S. Gasparyan[1], A. Grigoryan[2], E. Khachatryan, N. Chilingaryan[1], Z. Karabekian[1]

[1]L.A. Orbeli Institute of physiology NAS RA, Yerevan, Republic of Armenia

[2]Yerevan State Medical University, Yerevan, Republic of Armenia

e-mail: s.gasparyan1904@gmail.com

Kidney disease is a worldwide public health problem. More than 850 million people have kidney disease (KD) according to the International Society of Nephrology. The available treatment methods for chronic KD are dialysis and kidney transplantation. Both options have certain significant disadvantages. In prospect, tissue engineering approaches can solve problems with organ shortage and immune rejection of the organ by a host organism. The aim of the study was to obtain and thoroughly characterize a natural rat kidney scaffold as a first essential step in recreating a functional organ [1].

Four decellularization (DC) approaches were performed: one is with perfusion method, and two are with agitation method (Table 1). One of the agitation protocols for kidney was adopted from Sabetkish et al. 2020 (AMP1) [2]. The other one was newly developed, using decellularization of a whole rat kidney by agitation method without perfusion (AMP2). All DC approaches showed intact ECM and absence of cell

nuclei tested by H&E staining (Fig. 3) and hyperspectral imaging technique (Fig. 4). The residual DNA of the scaffold, obtained by agitation protocol 1 and protocol 2, showed 80,4% and 87% removal of DNA respectively (Fig. 1). PM and AMP2 scaffolds proved to be non-cytotoxic in MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) tests performed on human peripheral blood mononuclear cells (PBMC) (Table 2).

These results serve as the proof of the principle designed to create biocompatible kidney scaffolds with complete architecture. Therefore, our results can be adapted to human kidneys in the future to generate decellularized whole kidney scaffold as a starting material for recreation of fully functional human kidneys.

Table 1. Kidney samples used in experiments

Native kidney	Decellularized Kidney Produced by
No treatment	1. Perfusion method – whole kidney (PM)
	2. Agitation method protocol 1 – whole kidney (AMP1)
	3. Agitation method protocol 2 – kidney pieces (AMP2)

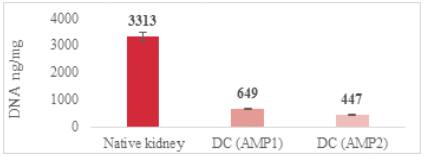

Fig.1. Residual DNA (ng) per 1 mg of dry weight

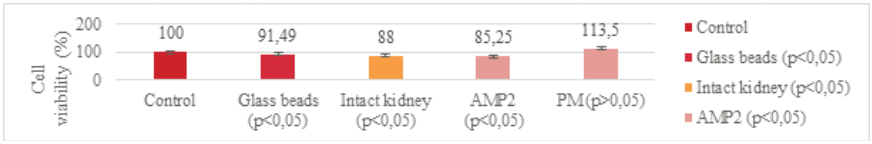

Fig. 2. Assessment of cytotoxicity of scaffolds using MTT test. Incubation of PBMC with native kidneys and DC scaffolds demonstrates similar levels of metabolic activity comparable to the activity of untreated cell

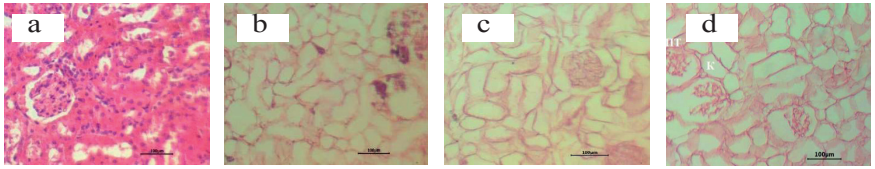

Fig.3 Representative H&E staining. (a1, a2) Native kidney; (b1, b2) Decellularized kidney (PM); (c1, c2) Decellularized kidney (AMP1); (d1, d2) Decellularized kidney (AMP2)

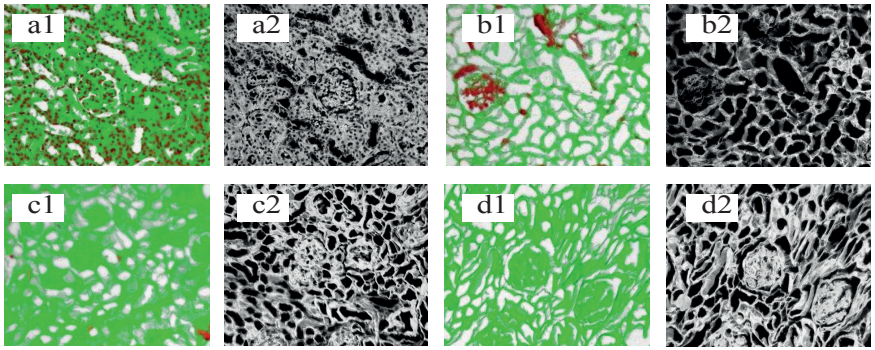

Fig.4 Hyperspectral imaging (HSI. (a1) Native kidney; (b1) Decellularized kidney (PM); (c1) Decellularized kidney (AMP1); (d1) Decellularized kidney (AMP2). HSI demonstrates clearly defined nucleus coloured red and extracellular matrix (ECM) coloured green in native sample (a1, a2) as compared to the absence of red colored structures and preservation of ECM in DC scaffolds (c1, c2; d1, d2). However, Fig. 1 (b1 and c1) scaffolds show incomplete removal of nuclear material but preservation of the ECM (b2).

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2.4 Antihyperlipidemic drugs causing increase in endogenous insulin-resistance and insulin secretion that cause onset of type 2 diabetes

Noor-ul-Ain
University of Faisalabad, Pakistan
e-mail: ananoorkhan105@gmail.com

The antihyperlipidemics are broadly used in obese and overweight patients to protect them from atherosclerotic cardiovascular events. These medications decrease the overall fat level in body but have other major adverse effects as well as side effects in patients taking these drugs regularly.

This retrospective study was conducted to see the impact of antihyperlipidemics on insulin resistance and decrease of insulin secretion; it was a major cause of type 2 diabetes onset in patients when confirmed with continuous laboratory tests like OGTT, insulin suppression test, C-peptide levels and HbA1C. In these patients the LDL and triglycerides levels were decreased, but the overall body weight was the same in all patients.

The total of 120 patients were selected: 75 female and 45 male patients in the age group of 35-55 years old. 15 of them were with familial hypercholesterolemia. Out of 120 patients taking antihyperlipidemic treatment, 80 became diabetics and 40 were pre-diabetics.

Antihyperlipidemics are the essential drugs for controlling cardiovascular atherosclerotic events, but they also cause the onset of diabetes in patients taking these drugs because of the high level of triglycerides in blood that cause insulin secretion decrease and insulin resistance, which is the key cause of this event.

2.5 Comparison of biomarkers for the early diagnosis of Alzheimer's disease

Mubashra Anis, Hamza Ghazanfar Toor
Department of Biomedical Engineering, Riphah International University, Islamabad, Pakistan
e-mail: mubashraanis92@gmail.com

Alzheimer's disease is a progressive neurodegenerative pathological condition that is, in most cases, the cause of dementia in elderly people with mild cognitive disorder. It causes severe memory loss and is often misdiagnosed as depression due to the unavailability of a proper clinical test. Alzheimer's disease can be identified with complete certainty by carrying out brain autopsy after death. As the probability of people getting affected is increasing rapidly with an increase in age, most people over 65 are more likely to suffer from Alzheimer's dementia which has badly affected the quality of life, including family, caregivers, and healthcare providers. We came up with the idea to reduce the burden on our community and improve living standards by diagnosing Alzheimer's dementia at an early stage by using Electroencephalogram or EEG as a diagnostic tool, following the numerous studies that have shown that EEG can be a useful diagnostic tool in the identification of neurological disorders. EEG setups are mobile and inexpensive in contrast to highly expensive imaging

equipment. Furthermore, EEG is a non-invasive method for obtaining brain signals and is a better approach as compared to other imaging techniques, such as magnetic resonance imaging or MRI, when a patient is exposed to extremely intense electromagnetic radiation, and the procedure may be discomforting and life-threatening for the patient in some rare cases. In this research study, EEG is used for obtaining brain signals of dementia patients. The specified EEG markers were analyzed and compared with clinical test results. A clinical diagnosis was performed by physicians using Montreal Cognitive Assessment (or MoCA) to evaluate the level of cognitive impairment of subjects. During our research, 33 dementia patients were selected, and their EEGs were recorded through 40 channel EEG setup. EEG signals were recorded under an effectively designed patient data acquisition protocol which was designed in a way that it consisted of four sessions for each patient. Each session consisted of one of the two different conditions given to the patient, with eyes closed and eyes opened. After the acquisition of the EEG data, it was visualized, interpreted and filtered by applying different algorithms designed through matrix laboratory, EEG laboratory. The filtered dataset was analyzed and subjected to different noise and artifact reduction processes by applying Fourier transform. The calculated results indicate reduced synchronization of synaptic pathways in EEG signals which manifests slowness factor in Alzheimer's patients and summarizes that the higher the power of the low-frequency band is, the slower the signal is. The resulting EEG biomarkers correlate with the results of the clinical tests score (MoCA) which shows a precise relation between EEG abnormalities of Alzheimer's neuropathy. Moreover, it segregates biomarkers between Alzheimer's and other dementia patients leading to EEG as a reliable source for early diagnosis. The further research can be performed on this study in the future to understand the impact of neuropathy in Alzheimer's disease on the EEG of the patients in its early diagnosis, as the results are very promising for making it an inexpensive diagnostic tool for Alzheimer's disease compared to other neuroimaging tools.

2.6 Synthesis of naphthol-based amide molecule and investigation of its biological activity

Fargana Alizadeh[1,2], Alakbar Huseynzada[2,3], Ulviyya Yolchuyeva[1], Mustafa Demiralp[4], Ulviyya Hasanova[2,3], Vagif Abbasov[1]
[1]Institute of Petrochemical Processes, Baku, Azerbaijan
[2]Geotechnological problems of oil, gas and chemistry, Scientific research institute of ASOIU, Baku, Azerbaijan
[3]Baku State University, Organic Chemistry, Baku, Azerbaijan
[4]Advanced Technology Research and Application Center; SCU; Sivas, Turkey
e-mail: ferqaneelizade@gmail.com

Amides are a crucial type of bond found in molecules that are pharmacologically active and amide linkages; they are the primary chemical bonds that bind proteins together. They also serve as the foundation for some of the most useful and prevalent synthetic polymers [4]. Due to the prevalence of amides in current medicines and physiologically active molecules, one of the most essential processes in organic chemistry, amide bond formation, is sometimes neglected as a contemporary issue. However, amides beneficial characteristics, namely high polarity, stability and conformational diversity, make them one of the most well-liked and dependable functional groups across all areas of organic chemistry [1].

The study of three major pharmaceutical companies found that 66% of medication candidates were synthesized via amide bond formation, highlighting the importance of this process. The development of alternative ways is attracting more attention because of the drawbacks of the current chemical procedures, such as their high prices and waste production [2]. The most often

used chemicals for acetylating amines are acid chlorides and anhydrides. When compared to the usage of activators, the synthesis of amide bonds via acyl chloride and the matching amine is one of the most atom-economic pathways that generates the least amount of waste [3].

Taking all these into account, we synthesized a new type of amide compound N-(3-(3-(naphthalen-1-yloxy)propoxy) propyl)-4-nitrobenzamide using a new synthesis method, as well as benzoyl-chloride derivative, polyamine 4,9-dioxa-1,12-dodecanediamine and naphthol-1. According to the computational analysis and in vitro/in vivo tests, it was shown that the aforementioned functions can not only increase biological activity but also enable the extraction of certain molecules under ambient conditions. Utilizing mass spectroscopy, ^{1}H, and ^{13}C NMR and elemental analysis, the structure of the generated molecule was investigated. The next step of the experiment involved employing a wide range of biological activities to ascertain the biological functions of a recently synthesized amide. *Staphylococcus aureus, Escherichia coli, Acinetobacter baumannii, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were among the gram-positive and gram-negative bacteria, against which the synthetic organic compound was evaluated for biological activity. This novel amide showed a stronger inhibitory effect than the standard antibiotics (Cefotaxime and Ceftriaxone).

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2.7 Pulsatile drug delivery system: a modern drug delivery system

Arham Ali, Muhammad Tjammal Rehman, Sufyan Arif
Department of Biochemistry, University of Agriculture, Faisalabad
e-mail: arhamali8585@gmail.com

Pulsatile drug delivery system is the most exciting time and body specific system. This system is premeditated for chrono pharmacotherapy which is based on circadian rhythm. According to the Latin literature, "circa" means "day" and "dian" means "night". A pulsatile drug release, where the drug is released rapidly after a definite lag-time, could be beneficial for many drugs or rehabilitations, as the drug is released rapidly and completely as a pulse after a lag time.

Pulsatile drug delivery is the system that, by distributing drug at the correct time, correct place and in accurate amounts, is promising for the benefit of the patients suffering from chronic problems like arthritis, asthma, hypertension, etc. A covered PDDS for theophylline can mimic the circadian rhythm of the ailment by releasing the drug at the suitable time (when symptoms are expressed). The system was found to be acceptable in terms of the drug release after a determined lag time of 6 h, and thus the dosage forms can be taken at bedtime, the content will be released in the morning hours. It summarizes the latest technical advancement design limitations and release profiles of these systems. The products based on Pulsatile release like Pulsi-cap®, Ritalin®, and Palsy's® are also covered in the review. The aim of the present study was to develop theophylline fast release enteric-coated pellets as a pulsatile drug delivery to the colon. The innovation of this work is the combination of pH and time-dependent enteric polymers as a single coating for the development of multiarticulate formulation. Theophylline pellets were optimized by applying a 2-factors 3-levels full factorial

design. Continuous dissolution studies were carried out in simulated gastric, intestinal and colonic fluid with pH 1.2 (0.1 N HCl), pH 7.4 and pH 6.8 (phosphate buffer), respectively. The lag time prior to the drug release was highly affected by combination of two factors, i.e., the percentage of Eudragit RL100 in polymer mixture, and coating level. The formulation containing Eudragit RL100 and Eudragit S100 with a ratio of 4:1 and coating level of 12%w/w was found to be optimum. The results of the serum study in New Zealand rabbits showed that the developed formulation provided a significant lag phase of 5 h. The present study demonstrates that the theophylline enteric coated pellets could be successfully colon targeted by the design of pH- and time-dependent modified chrono pharmaceutical formulation. In conclusion, the pulsatile drug release over a period of 3–12 h is consistent with the requirements for chrono pharmaceutical drug delivery.

2.8 Willingness to be vaccinated against Ebola virus among communities at risk in Kasese district, Uganda

Suudhi Bamutya
Uganda Red Cross Society, Uganda
e-mail: sbamutya92@gmail.com

In December 2018, Uganda approved vaccination of all front-line workers against Ebola virus in several districts that were designated as high-risk for Ebola outbreaks [1, 2]. Following the June 2019 Ebola outbreak in Kasese district, vaccination was extended to other people, with special attention to contacts of Ebola Virus Disease (EVD) patients. However, there was some degree of hesitancy to receive the vaccine among some communities in the high-risk areas. This study is aimed at determining willingness to receive the EVD vaccine among high-risk communities and the associated factors [3, 4].

A cross sectional survey was conducted among the general population in Kasese district to assess their willingness to receive the EVD vaccine. A univariate analysis was conducted to summarise variables in form of proportions. χ^2 and fishers exact tests were used to test for the association between knowledge and willingness. A multivariate logistic regression was used to measure the association between willingness and sociodemographic factors where odds ratios and their corresponding 95% confidence intervals were obtained.

A total of 411 respondents were surveyed, 52.55% being female, 51.1% aged 18-30 years, and 62.29% residing in rural areas. 69.83% of the respondents were willing to receive the EVD vaccine. Being female (OR; 3.3, 95% CI; 2.13-5.19, p<0.0001), being educated (95% CI; 1.66-108.25, p=0.0149), access to TV (OR; 1.8, 95% CI; 1.16-2.79, p=0.0082) and earning 500,000-1,000,000 (95% CI; 1.07-61.58, p=0.0425) were associated with willingness to receive the EVD vaccine. The knowledge on the vaccine was not associated with willingness, yet positive attitude was associated with willingness (OR; 11.86, 95% CI; 7.21-19.49, p <0.0001).

The level of willingness was over two thirds despite the vaccine being new. This was explained by the recent history of EVD outbreak in Kasese and the DRC which made communities realise the consequences of EVD and thus appreciate the need to vaccinate.

Over two thirds of respondents (69.83%) were willing to receive the EVD vaccine. Their willingness was associated with sex, attitude, education, income but not knowledge. There is a need for more sensitisation since the ring vaccination requires high acceptance rate to form an effective buffer to prevent spread of the disease.

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2.9 Biogenic synthesis of silver nanoparticles using selected medicinal flora and their potential antimycobacterial activities

Suman Mahmood[1], Sammyia Jannat[1], Asad Hussain Shah[1], Anila Fariq[1], Sajida Rasheed[1], Muhammad Habib[2], Akhlaaq Wazeer[3]

[1] Department of Biotechnology, University of Kotli, 11100, Azad Kashmir Pakistan

[2] Pakistan Institute of Medical Sciences, Shaheed Zulfiqar Ali Bhutto Medical University

[3] SRL, DHQ Hospital Mirpur, Pakistan

e-mail: sumanmehmood1@gmail.com

Tuberculosis is one of the major causes of death worldwide, and emerging antibiotic drug resistance is the biggest hurdle in the way of curing this disease [1, 3]. Noteworthy progress has been made on the introduction of nanotechnology-based medicines for preventing multidrug resistance in microorganisms. Taking in consideration the emerging antibiotic resistance and efficacy of plant-based eco-friendly drugs, the present study aimed to synthesize silver nanoparticles (AgNPs) using *Achillea millefolium, Artemisia campestris* and *Hedera nepalensis* leaves extract for the analysis of their antimycobacterial potential [2, 4]. The biosynthesized silver nanoparticles were harvested and characterized through UV visible spectroscopy, Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive X-ray spectroscopy (EDX). According to FESEM analysis, the selected plant-based silver nanoparticles were found spherical in shape with a diameter ranging from 50 nm to 80 nm. The Energy Dispersive X-ray spectroscopy revealed that major constitute elements of silver nanoparticles were Ag, C, O, Cl, and Ca. FTIR analysis indicated the functional groups for phenols, polyphenols, alkenes, aromatic groups as capping agents of silver nanoparticles. The biosynthesized AgNPs exhibited significant antibacterial potential against *Mycobacterium tuberculosis*. The antimycobacterial activity of silver nanoparticles was analyzed at different concentrations of silver nanoparticles suspension with positive control Rifampicin. At 50 µl concentration, the maximum growth inhibition was observed by *Hedera nepalensis*, i.e. 97.33 percent, and *Artemisia campestris* showed the growth inhibition of 95 percent, whereas the percentage growth inhibition of *A. millefolium* at 50 µl concentration was 72.33 percent as compared to the Rifampicin (RIF), i.e. 40 percent. The minimum percentage growth inhibition was observed at 30 µl by *Artemisia campestris*, i.e. 33 percent. The visible growth inhibition was also confirmed by Fluorescence microscopy in both experimental and controlled cultures. It is evident from the current study that the percentage of mycobacterium growth inhibition was directly proportional to the concentration of green silver nanoparticles. These biosynthesized AgNPs

hold promising potential in drug designing and discovery of nanomedicine against Tuberculosis.

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2.10 Kidney ischemic reperfusion injury: the role of toll-like receptor 4 suppressor (rat model)

Osama Mohamed Abdelmoneim, Elissia Fayek Fekry, Mariam Ashraf Diab, Khaled Ali Anas, Iyad Mohamed Anas Barakat, Maiar Mohamed Elnaggar, Nada Gamal Mohammed Seddique, Mahmoud Atef Ebeed, Mai Essam Ahmed
Medical Experimental Research Center, Faculty of medicine, Mansoura university, Dakahlia, Egypt
e-mail: elissia.fayek@gmail.com

Ischemia–reperfusion injury (IRI) is an inevitable consequence of the kidney transplantation procedure. It increases the risk of acute rejection and affect the long-term survival of the graft. It has a complex pathophysiological process, as the activation of the innate immune response.

One of the major contributors of the innate immune response is the toll-like receptors (TLRs). During ischemia, it has been found that TLR4 are upregulated in tubular epithelial cells; a strong correlation between TLR4 expression and graft dysfunction was found in a rat allogenic transplant model. TAK-242 is a small molecule suppressor of release of inflammatory cytokines that acts by inhibiting TLR-4-mediated signaling.

This study includes 56 rats randomly divided into 4 groups. Group I (Sham group); Group II (control group): rats with left renal ischemic reperfusion injury; Group III (vehicle group): ischemic reperfusion with dimethyl sulfoxide (DMSO); and Group IV (TAK 242 group): ischemic reperfusion pretreated with TAK-242. All rats in each group will be euthanized in two subgroups at day 3 (to assess tubular injury) and day 10 post-operative (to asses fibrosis). Blood, urine and tissue samples will be obtained for serology, urine analysis, and histopathology.

Therefore, the aim of this study is to investigate the role of TAK-242 in inhibiting TLR4 signaling in IRI and its effect on the subsequent tubular injury, cytokines release, sterile inflammation and interstitial fibrosis, which, in turn, would result in immediate graft function after kidney transplantation and enhances its long-term survival.

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2.11 Effect of rearing substrates on the antimicrobial activity of soluble fat extracts from Hermetia illucens (Black soldier fly) larvae

J. O. Okunola[1], E. M. Marusich[1], S. V. Leonov[1,2]
[1]School of Biological and Medical Physics, Moscow Institute of Physics and Technology, Dolgoprudny, Russia
[2]Institute of Cell Biophysics, Russian Academy of Sciences, Moscow, Russia. e-mail: okunola.o@phystech.edu.ru

Staphylococcus aureus and *Klebsiella pneumoniae* are members of the deadly antimicrobial resistant ESKAPE (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter* species) pathogens which represent a global threat to human health [1]. The emergence of multidrug resistant strains of these bacteria has triggered an urgent need to find or develop new antimicrobial therapies.

The ability of *Hermetia illucens* (Black Soldier Fly) larvae (BSFL) to convert organic waste into high-value biomass has been well documented. BSFL can accumulate up to 40% protein and 35% fats on a dry matter basis. The composition of BSFL varies depending on the substrate the larvae are grown on. Because of their nutritional value, BSFL are widely used in feed for livestock. However, free fatty acids from BSFL have been shown to have antimicrobial properties. Previously in our laboratory, we studied the antimicrobial properties of free fatty acids from BSFL against phytopathogens [2] and MDR pathogenic fish bacteria *Aeromonas spp.* [3].

Therefore, the aim of this research was to study the effect of different feed substrates on the antimicrobial properties of free fatty acids from *Hermetia illucens* larvae.

To achieve this aim, fat samples were collected from BSF larvae fed on different diets: grain mix, wheat, vegetable, fruit, and kitchen waste. Extraction of free fatty acids was carried out according to a previously established protocol in our laboratory, with an extracting solution consisting of water (90%), methanol (9%) and HCl (1%). The concentration of the free fatty acids and the extraction yield were estimated appropriately. To evaluate the antimicrobial potentials of the extracts on *S. aureus and K. pneumoniae*, disk diffusion assay method was used. The Inhibition Zone Diameters (IZD) were determined. Gas chromatography – mass spectrometry (GC-MS) analysis was carried out to identify the composition of the extracts.

Table 1 below summarizes the results of the research. The extracting solution and levofloxacin were used as a negative control and the positive control, respectively. The

concentrations of all samples were adjusted to a uniform concentration of 10 mg/ml, and 25 µl was loaded on each disc.

Table 1 – Summary of results showing the concentration and the % yield of extract from each sample, and the Inhibition Zone Diameter values on *Staphylococcus aureus* and *Klebsiella pneumoniae*.

Samples (Feed)	Concentration (mg/ml)	% Yield	Inhibition Zone Diameter (mm)	
			S. aureus	*K. pneumoniae*
Bel-1 (Wheat, Belgorod)	0.85	0.283	19.50 ± 00	19.50 ± 0.00
Bel-2 (Vegetable)	0.12	0.040	18.25 ± 0.33	17.50 ± 0.09
A (Wheat, Arkhangelsk	0.57	0.190	18.25 ± 0.00	18.10 ± 0.12
B (Grains)	0.17	0.057	22.75 ± 0.17	22.50 ± 0.18
F (Fruit)	1.14	0.047	13.00 ± 0.00	13.00 ± 0.00
G (Kitchen Waste)	1.685	0.562	11.00 ± 0.00	10.80 ± 0.08
Levofloxacin (+ve control)			29.75 ± 0.28	30.45 ± 0.33

The GC-MS analysis profiles of the samples did not show significant differences in the major components of the extracts. The extracts contained saturated (predominantly Dodeanoic acid, C12:00 and Hexadecanoic acid, C16:00), unsaturated fatty acids (9-Octadecenoic Acid (Z)-, C18:01), and fatty acid derivatives (predominantly Dodecanoic Acid, 1,2,3-Propanetriyl Ester).

In conclusion, we suggest wheat as the optimal feed substrate for BSF larvae as samples Bel-1 and A show relatively high antimicrobial activity, and also good extraction yield.

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2.12 N-Capped tripeptides as potential medicinal agents

Hunain Ali[1], Almas Jabeen[2], Asmat Salim[2], Rukesh Maharjan[1], Irfan Khan[2], Salma Nazir[1], Hibba Warraich[2], Rida-e-Maria Qazi[2], Hamza Olleik[3,4], Marc Maresca[3], Farzana Shaheen[1]

[1]H. E. J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi 75270, Pakistan

[2]Dr. Panjwani Center for Molecular Medicine and Drug Research, International Center for Chemical and Biological Sciences, University of Karachi, Karachi 75270, Pakistan

[3]Aix Marseille Univ., CNRS, Centrale Marseille, iSm2, 13397 Marseille, France

[4]Department of Biology, American University of Beirut, Beirut-1107 2020, Lebanon

e-mail: afnan.iccs@gmail.com

Peptides are important therapeutic agents due to their lower toxicity and higher specificity. Peptides and their conjugates are diverse molecules possessing great therapeutic potential. In comparison to small molecules, peptides-based drugs are more specific and less toxic, and the conjugation of such peptides with small medicinally important molecules, as well as heterocyclic moiety, has been reported to enhance the selectivity and cell permeability of the molecules. The literature analysis showed that tripeptides conjugated with a furoyl moiety at C-terminal and were reported to inhibit protease enzymes with greater selectivity and enhanced effectiveness, as well as possessed antineoplastic activity. Furan-capped tripeptides containing unusual residues such as 4- hydroxyphenylglycine were reported to exhibit protease inhibition activity against dengue virus (DENV) and West Nile virus (WNV). This work is based on the synthesis of 20-membered library of tripeptides capped at N-terminal with furoyl moiety using fmoc assisted solid-phase peptide synthesis with Rink amide resin as a solid support. All the synthesized peptidomimetics were characterized using various spectroscopic techniques and evaluated for their anticancer potential using MTT protocol. From this library, we have identified a N-capped tripeptide 4 as highly potent inhibitor of HeLa cancer cell lines (IC50=0.28±0.09 μM). On further evaluation of its activity on various cancer and non-cancerous cell lines, the selective nature of this piptidomimetic towards HeLa cancer cell lines was observed. The mechanistic study was done using atomic force microscopy (AFM) and propodium iodide and rhodamine 123 assay which showed that it exhibited a membranolytic effect. Furthermore, the peptidomimetic 4 was coupled with jeffamine and lysine linker in order to check the activity of this peptide in dendrimeric form, which resulted in the diminishing of activity showing the importance of free C-terminal for the molecule to be active. Some other activities of this peptide library were done, and it was found that non-cytotoxic peptide conjugates (9 and 11) showed adhesion property and cardiac differentiation of mesenchymal stem cells. This study revealed the medicinal importance of these peptides which may lead to the discovery of new lead molecules in future.

2.13 Photoconvertible polymer fluorescent labels for individual cell tagging and tracking

P.A. Demina[1], O.A. Sindeeva[2], A.M. Abramova[1], I.Yu. Goryacheva[1], G.B. Sukhorukov[2,3]

[1]Saratov State University, Saratov, Russian Federation

[2]Skolkovo Institute of Science and Technology, Moscow, Russian Federation

[3]Queen Mary University of London, London, United Kingdom

e-mail: polina.a.demina@list.ru

Stable photoconvertible labels are necessary for solving a number of biological problems, such as creating purified cell lines, tissue regeneration, and treatment of autoimmune diseases. Similarly, such labels may be used for observations of the small parasites' migration within the host and the unicellular taxis reaction.

Traditionally, GFP-like proteins (mEosFP, tdEosFP, Dendra, Dronpa, Kaede, KikGR, mOrange, etc.) were used for these purposes. However, despite all the advantages, this method involves the creating of new transgenic lines or modifications of primary ones. As a result, mutant cells are obtained, which calls into question the adequacy of the extrapolation of their properties to the primary cell cultures and the possibility of such cultures subsequent use in personalized medicine. In addition, some GFP-like proteins may degrade, exhibit cytotoxicity properties and propensity for aggregation.

In this work, the low toxicity organic non-protein-based photoconvertible labels based on a hybrid carbon nano-dot (CND) polymeric microcapsule platform are reported. These labels exhibit high levels of fluorescence, stability and cell uptake without the need for gene mutation.

Microcapsules made with layer-by-layer technology containing encapsulated RhB and polysaccharides incorporated in the capsule wall have been subjected to hydrothermal carbonization. The photoconvertible effect and spectral properties were studied using confocal laser scanning microscopy (CLSM). The photoconversion ability within living organisms has been evaluated on various cell lines. The polymeric labels uptake efficiency by cells was evaluated using imaging flow cytometry with visualizing objects ability.

The photoconversion of synthesized labels is carried out in a wide range of laser irradiation parameters. However, the conversion efficiency depends on the laser power density, irradiation wavelength and number of impacts [1]. Laser irradiation leads to hypsochromic shift of fluorescence peak (up to 25 nm) which is sufficient to be able to visualize photoconversion with CLSM. It is important to note, that the carbonized labels are actively absorbed by various types of cells without causing pronounced toxic effects. Photoconvertation of labels inside cells also does not lead to their death. The listed properties, as well as the high stability of fluorescence labels, makes it possible to detect a selected cell for a long period of time.

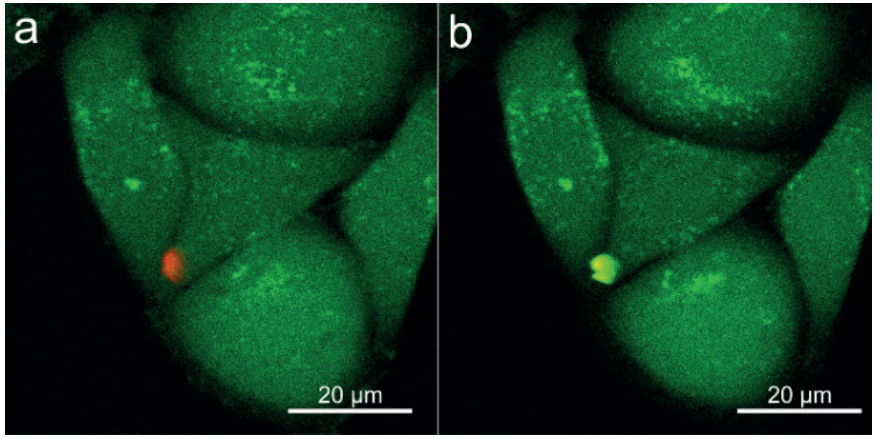

Fig.1. CLSM images of HeLa cell lines with internalized carbonized labels with RhB: a) before 554 nm laser irradiation; b) immediately after 554 nm laser irradiation.

We believe that the photoconvertible labels shown here will be useful to serve as a basis for the development of new effective methods to differentially highlight specific cells and multicellular organisms. Due to low toxicity and active cell uptake, they create a platform for more complex studies of the behavior of individual cells (cancer, stem, etc.) in genetically and phenotypically heterogeneous populations.

This work is supported by the Russian Science Foundation, grant number 22-23-00313, https://www.rscf.ru/en/project/22-23-00313/.

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2.14 Therapeutic effects of Avran extract in vivo experiments

Navolokin N.A

The study was conducted on 220 laboratory white male rats with grafted kidney cancer, liver sarcoma. It was found that GRATIOLA OFFICINALIS has antitumor activity when applied to grafted tumors of different histogenesis, and causes development of tumor pathomorphosis of 2-3 degree.

The mechanisms of antitumor activity are realized through decreasing proliferation, decreasing angiogenesis, blocking autophagy and activation of apoptosis. Activation of apoptosis in the grafted tumors under the effect of Aurum extract occurs both by mitochondrial (p53, Bax) and signaling pathway (Fas/APO-1 and Fas-ligand). GRATIOLA OFFICINALIS extract does not cause morphological signs of damage and disturbance of blood circulation in internal organs, and contributes to an increase in the true body weight of animals by an average of 15% (anti-cachectic effect).

2.15 The effect of a new adamantane derivative on the parameters of a thromboelastogram in vitro

J. A. Eltontseva
Volgograd State Medical University, Volgograd, Russian Federation
e-mail: iuliaeltontseva@yandex.ru

One of the leading causes of the formation of blood clots in the arterial and venous channels is endothelial dysfunction. The vas integrity breach leads to the activation of platelets and formation of a clot. This pathological process is the cause of a coronary heart disease, ischemic stroke, acute coronary insufficiency [1]. In the modern world, treatment and prevention of arterial and venous thrombosis and thromboembolism with antiplatelet agents is the main link in preventing the development of these pathologies [2]. Currently used antiplatelet drugs don`t fully meet the safety requirements. Among the most frequent side effects are gastropathies, bleeding, thrombocytopenia, etc. [3]. Therefore, the search for new highly effective antiplatelet agents is an urgent task today.

The aim of the study is to carry out an integral assessment of the effect of a new adamantane 14748 derivative on the hemostasis system by thromboelastography *in vitro*.

Materials and methods. The research was performed on the whole blood of 6 male rabbits. The blood from the auricular marginal vein was collected in a test tube containing a 3.8% citrate solution in a ratio of 9:1 by the method of free drop. The investigated compound was studied at a concentration of 100 microns when directly added to the test system. After incubation of the whole blood with a solution of compound 14748 (5 min, 37 °C) using a TEG5000 troboelastograph [4,5], such indicators as R (the time from the beginning of sample recording to the formation of the first fibrin strands), K (the time during which the most stable clot is observed), angle α (the rate of clot formation), MA (reflects the involvement of the platelet link in the process) were evaluated. The statistical data processing was carried out using the built-in functions of MS Office Excel 2019 software, GraphPad Prism 8.0 program.

In the course of the conducted research, it was found that the studied compound under the cipher 14748 shows a pronounced ability to suppress the processes of thrombosis. At the same time, during the integral assessment of the compound 14748 effect on the hemostasis system, it was found that it significantly reduces the activity of the platelet link. Thus, when evaluating the parameter R, it was found that the indicator did not significantly differ from the control values, which indicates the absence of anticoagulant properties in the studied compound. However, under the influence of compound 14748, there was a statistically significant decrease in the maximum amplitude of thromboelastograms, which indicates precisely the suppression of the functional activity of platelets. A significant change in the coefficient K and angle α indicate the influence of the test sample on the kinetics of clot formation. There was an elongation of the time to achieve a stable clot and a decrease in the rate of clot formation. According to the studied parameters, compound 14748 was comparable to the reference drug acetylsalicylic acid.

The conducted studies allow us to conclude that the new adamantane derivative compound 14748 has antiplatelet activity comparable to acetylsalicylic acid. At the same time, the studied samples don`t exhibit anticoagulant and fibrinolytic effects.

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2.16 A novel approach towards the treatment of dermatophyte infections based on antifungal drug delivery to hair follicles

Yu. Svenskaya, E. Lengert, M. Saveleva, R. Verkhovskii, G. Terentyuk, V. Tuchin
Saratov State University, Saratov, Russian Federation
e-mail: svenskaya@info.sgu.ru

Superficial fungal infections are of serious concern worldwide due to their morbidity and increasing distribution across the globe in this era of growing antimicrobial resistance. The delivery of antifungals to the target skin areas and sustaining the effective drug concentration are essential for successful treatment of such mycoses. Topical formulations get extra benefits here if they penetrate into the hair follicles since fungal hyphae can proliferate and produce spores in such reservoirs. We designed a novel particulate system for encapsulation and intrafollicular delivery of griseofulvin (Gf) antifungal drug, which is water-insoluble and currently commercially available in oral dosage forms. Micron-sized calcium carbonate (vaterite) carriers containing 25 ± 3% (w/w) of Gf were prepared via the wet chemical method [1]. The successful in vivo transportation of the carriers into the hair follicles of rats was demonstrated using scanning electron and confocal laser scanning microscopy. The urinary excretion profiles' study demonstrated that Gf immobilization into the vaterite matrices improved its topical bioavailability, potentiating the efficiency of this antifungal drug. This addresses the crucially important issue in the development of effective topical Gf formulations. It should be noted that the developed particulate formulation displayed sufficient biocompatibility and good cellular uptake in contact with fibroblast cells in vitro. In addition, no acute reactions, such as skin damage, inflammatory state, or erythema, were observed after topical administration of the Gf-loaded carriers in vivo in rats and rabbits. Histological investigation has confirmed the absence of dermal toxicity, even when the formulation was applied repeatedly. Importantly, a pronounced therapeutic effect was demonstrated when the carriers were tested on guinea pig model of dermatophytosis in vivo. Their use allowed us to reduce the number of therapeutic procedures by three times that should lower the side effects and facilitate protection against disease recurrence. These findings open new prospects for the efficiency enhancement of topical therapeutics. Importantly, the elaborated system can be adapted for the dermal delivery of various drugs beyond the scope of antifungal therapy [2-4].

The study is supported by Russian Science Foundation (project № 22-73-10194).

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2.17 International fight against tuberculosis

Anna R. Kalinina, Tatiana Myakisheva
Smolensk State Medical University, Russia
e-mail: KalininaAR2001@yandex.ru

The problem under study is relevant due to the fact that about 10,000,000 people become infected with tuberculosis (TB) and 1.5 million infected patients die annually. Despite the fact that over the past 15 years there has been an improvement in an epidemiological situation (the incidence rate has fallen by 7.2%, and mortality by 11.9%), the situation in the world, and especially in Russia (morbidity ranked 3d in the world) remains extremely poor. We observed the incidence in the Smolensk region in the period from 2010 to 2022, according to which the incidence rate among women decreased from 43.7 to 19.5 per 100,000 population; among men it decreased from 115.6 to 47.3. Over 10 years, men have had greater progress in reducing the incidence rate.

The aim of the study is to analyze tuberculosis epidemiological situation in the Smolensk region and assess the public awareness of opportunities to prevent the disease.

The material and methods involved in the analysis are statistical data on TB patients and anonymous questionnaire. The data were compared with those of 2015. 60 individuals took part in the survey (30 patients and 30 healthy participants in the age group of 27 - 80 years old). The statistical data processing was carried out using the program R i386 3.2.2, with the determination of the exact Fisher criterion; the values corresponding to $p < 0.05$ were considered statistically significant.

Results. We considered to combine the analysis of the statistical data obtained during the registration of tuberculosis patients with a questionnaire aimed at identifying public awareness of the aspects of this disease (transmission routes, symptoms, prevention, and treatment). The results we obtained were compared to the results of 2015. According to the results of a 2015 survey, 70% of the healthy population and 67% of tuberculosis patients were aware of the main route of the disease transmission, while in 2022 more than 90% of population knew about it. The measures for protection against tuberculosis in 2015 included regular fluorography – 17% of the healthy population and 19% of patients, maintaining a healthy lifestyle – 31% of the healthy population and 24% of tuberculosis patients. In 2022, regular fluorography - 74% of the healthy population and 51% of patients, maintaining a healthy lifestyle – 40% of the healthy population and 15% of tuberculosis patients. The majority of respondents in 2015 and 2022 noted the same symptoms of tuberculosis; more than 80% of tuberculosis patients in both years and 60% of the healthy population in 2015, and 83% of the healthy population in 2022. The optimal treatment period in 2015 among tuberculosis patients and healthy population is 2-3 months (70%), and in 2022 – a period of 3 to 12 months. The optimal methods for detecting tuberculosis in 2015 among the population were seeking medical care – 66% and undergoing a routine examination – 27%. In 2022, the results of the survey had no changes but 28.6% of the population consider it necessary to undergo a survey in contact with tuberculosis patients.

The incidence of tuberculosis in 2015-2022 corresponds to the survey data (with better awareness of the population (one of the factors of tuberculosis prevention), the incidence rate decreases). The incidence of tuberculosis for the period 2015-2022 in the Smolensk region decreased by almost 2 times, in the Russian Federation – by 1.8. The incidence of tuberculosis for the period of 2015-2020 in the Smolensk region decreased by almost 2 times, in the Russian Federation - by 1.8 times. There is no significant difference

between the Smolensk Region and the Russian Federation (CI1 [30, 19;62,64] CI2 [34,64;57,79], p>0.05). The prevalence of tuberculosis in Smolensk region has decreased significantly by 2.2 times, and in the Russian Federation by 1.6 times, so there is no significant difference in this indicator (CI1 [62.25; 131.91] CI2 [79.80;130.29], p>0.05).

Conclusions. There is a significant improvement of the epidemiological situation in 2015-2022. The population is better informed about the disease of tuberculosis (symptoms, prevention, transmission routes). To improve the situation, further education of the population is required.

2.18 Ruthenium artificial metalloenzyme: a new tool for therapeutic in vivo chemistry

I. Nasibullin[1], I. Smirnov[1], A. Kurbangalieva[1], K. Tanaka[1,2,3]
[1]Alexander Butlerov Institute of Chemistry, Kazan Federal University, Kazan, Russian Federation
[2]RIKEN Cluster for Pioneering Research, Wako, Japan
[3]Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, Tokyo, Japan
e-mail: ionasibullin@kpfu.ru

The modern medicinal chemistry faces many challenges in the drug design process, especially for antitumor therapies. The severe side effects or poor pharmacokinetic profiles are the most frequent limitation factors, and many promising drug candidates fail to pass the preclinical trials due to the mentioned problems. One of the possible ways to address this problem is to perform a targeted drug administration, thus medicine acts in a desired area and side effects are minimized. However, the local injection is not applicable for many diseases and new solutions are needed. Researchers have looked for techniques that allow to achieve targeted drug activation. The idea is to use biologically inactive form of the drug (prodrug) which could be activated by external impact, such us Near-infrared light, X-Ray, enzymes, nanoparticles etc.

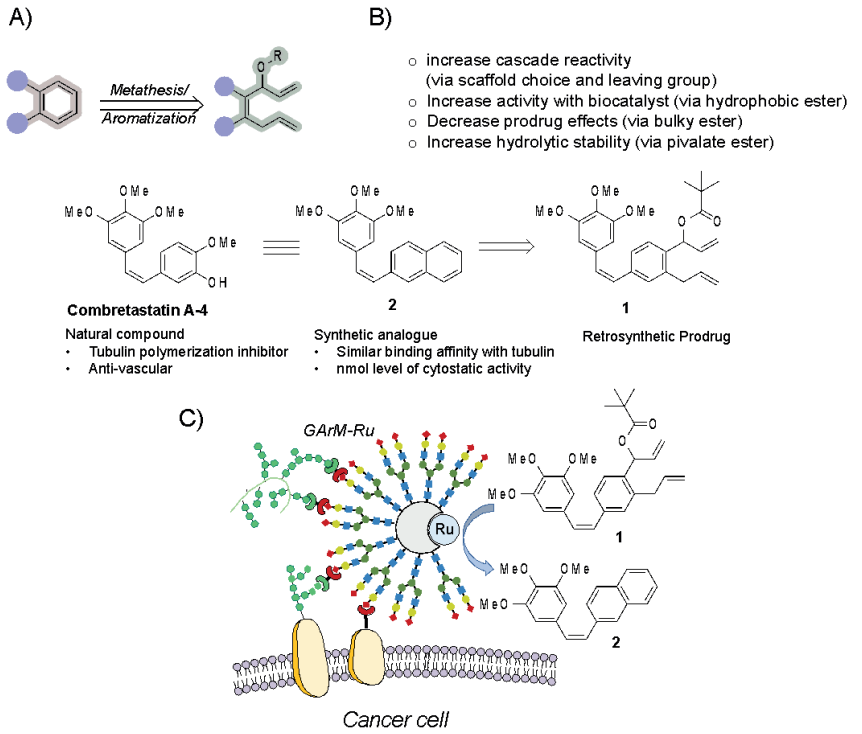

Fig.1. Retrosynthetic prodrug design and optimization. A) Finding a reaction suitable for drug synthesis in vivo; B) Steps of substrate structure optimization; C) In vivo prodrug activation by glycosylated Alb–Ru enzyme

In our work we are focused on the development of biocompatible transition metal catalysts and their application for in vivo prodrug activation. In particular, this report will be about artificial metalloenzyme which can catalyze olefin metathesis reaction in live system. The mentioned enzyme is prepared by incorporation of modified Grubbs catalyst into the binding pocket human serum albumin (AlbRu). Protein scaffold brings a protection of metal from the outer impact, and catalyst keeps activity even in biological environment [1, 2]. This feature allows us to use AlbRu complex for antitumor therapy via in vivo synthetic chemistry approach. Moreover, by protein surface modification, we can achieve cancer targeting properties for site-selective prodrug activation which can increase the effective drug concentration and reduce side effects [3–5].

In addition, the retrosynthetic approach for prodrug design also will be discussed in detail (Fig. 1a). By taking a natural antitumor agent (Combretastatin-A4) as a parental drug (Fig. 1b), after optimization studies, we finally came up with a prodrug (1) and tested its therapeutic potential in reaction with glycosylated Alb-Ru complex (GArM-Ru) (Fig. 1c). A series of biological experiments, first on cells, then on mice, demonstrated the high therapeutic efficacy of prodrug/GArM-Ru system in suppressing tumor growth.

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2.19 Reaching clean operating margins in breast cancer surgery by using 1,3-dipolar cycloaddition

E.Sh. Saigitbatalova[1], A.R. Pradipta[2,3], A.R. Kurbangalieva[1], K. Tanaka[1,2,3]

[1]Alexander Butlerov Institute of Chemistry, Kazan Federal University, Kazan, Russian Federation

[2]RIKEN Cluster for Pioneering Research, Wako, Japan

[3]Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, Tokyo, Japan

e-mail: essajgitbatalova@kpfu.ru

Acrolein, a highly toxic α,β-unsaturated aldehyde, has long been known as a biomarker associated with a range of disorders related to oxidative stresses, including cancers. It is produced through the enzymatic oxidation of threonine or polyamines and is also generated during reactive oxygen species (ROS)-mediated oxidation of highly unsaturated lipids. It is sometimes generated on a few 100 μM scale in oxidatively stressed cells and is more toxic to cells than ROS such as hydrogen peroxide (H_2O_2) or hydroxyl radicals (•OH), the major oxidative stress factors associated with a variety of disorders. In fact, mass spectrum analysis of the liquid-phase extracts of cell lysates has shown that cancer cells produce acrolein.

Recently we have found, that phenyl azide 1 is highly reactive towards acrolein in mild conditions [1, 2]. The experiments were carried out both in an organic and in an aqueous solution under physiological conditions. The reaction leads to the formation of 4-formyl-1,2,3-triazoline 2 and 4-formyl-1,2,3-triazole derivatives 3 (Fig. 1a).

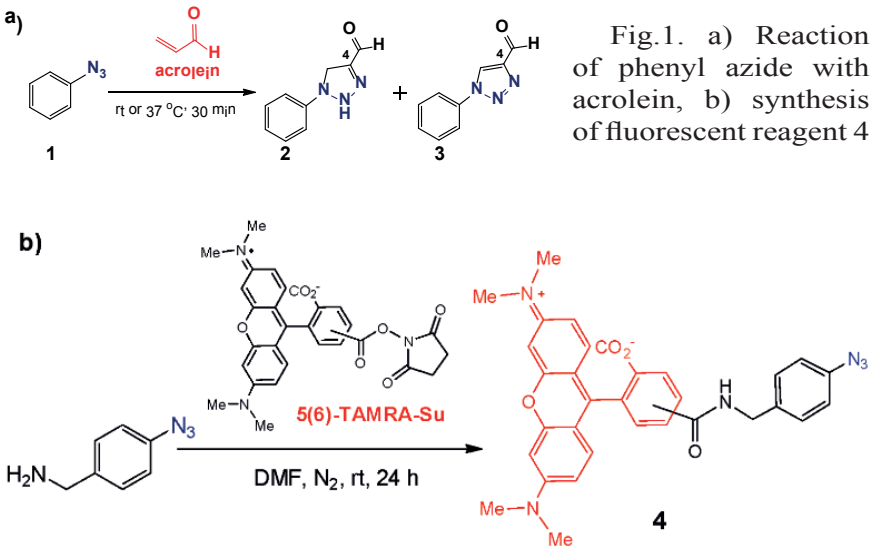

Fig.1. a) Reaction of phenyl azide with acrolein, b) synthesis of fluorescent reagent 4

It should be noted that the uncatalyzed azide cycloaddition reaction was selective to the unsubstituted acrolein. No products formed through the reaction with the β- or α-substituted acrolein, e.g. crotonaldehyde, *trans*-2-octenal, methacrolein and styrene, even after an incubation period of 1 day at room temperature. Thus, we had an idea that the azide-acrolein reaction could be involved for the selective and highly sensitive detection of acrolein produced by cells under oxidative stress. For the living cells visualization study, we have synthesized a fluorescent phenyl azide 4 containing a fragment of tetramethylrhodamine (TAMRA) (Fig. 1b). Further investigations of various oxidative stressed cell models were conducted by using fluorescence microscopy.

In vitro experiments have shown that reagent 4 clearly visualizes the acrolein released by cancer cells and makes it possible to distinguish cancer cells from normal cells (Fig. 2A–C). Eight different cancer cell lines showed different fluorescence intensity after treatment with reagent 4 [3].

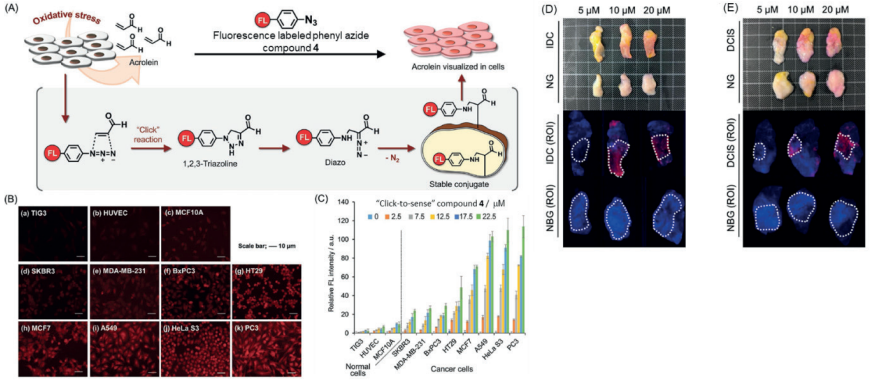

Fig.2. A) Method and mechanism of labeling cancer. Fluorescently labeled azide smoothly reacts with acrolein generated by cancer cells; B) discrimination of cancer cells from normal cells by "click-to-sense" compound 4; C) fluorescence intensity observed for each cell lines; representative pictures and double-staining microscopic images of (D) IDC and NBG, (E) DCIS and NBG

The next step in our research was provided at Osaka University Hospital with tissues from breast cancer patients who underwent breast cancer surgery with invasive ductal carcinoma (IDC) or ductal carcinoma in situ (DCIS). According to these studies we have established, that our compound could rapidly discriminate between cancer cells and normal cells (Fig. 2D, E), requiring only the staining of live tissues for 5 minutes, and that it can clearly visualize cancer morphology and localization [3].

Thus, we developed a new approach that has the potential to become a new margin management method of live tissues with high selectivity, and could be used as a discriminative, low-cost, and easy to perform method for cancer sensing during surgery. The method is going to be confirmed in a clinical prospective study including intraoperative assessment of resection stumps in breast cancer patients.

This work was financially supported by the Kazan Federal University Strategic Academic Leadership Program («Priority–2030»).

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2.20 Recognition of conformationally exposed cancer specific NaPi2b epitope by monoclonal antibodies depends on lipid-assisted folding

D. Savenkova[1], L. Bulatova[1], R. Vlasenko, D. Reshetnikova[1], R. Kiyamova[1], M. Bogdanov[1,2]

[1]Research laboratory Biomarker, Institute of Fundamental Medicine and Biology, Kazan Federal University, Kazan, Russia

[2] McGovern Medical School at The University of Texas Health Science Center at Houston, TX 77030, USA

e-mail: darina.sava1@gmail.com

The conformational epitope of the large extracellular domain (ECD) of the sodium-dependent phosphate transporter NaPi2b is recognized by therapeutic monoclonal antibodies [1]. Transporter NaPi2b is overexpressed on the cell surface of several tumors. The folding of membrane proteins is dependent on a specific lipid profile [2], so our postulation is that the folding of NaPi2b ECD is supported structurally by a dynamic process that is driven by the interplay of individual lipids, which in turn contributes to epitope recognition. OVCAR-4 ovarian cancer cells were exposed to an Eastern-Western blot analysis in order to determine the ECD epitope recognition using in-house conformation specific and commercial monoclonal antibodies (Cell Signaling, USA). This was done in the presence of the following phospholipids: 1-palmitoyl-2-oleoylphosphatidyl ethanolamine (POPE), Dipalmitoylphosphatidylcholine (DOPC), Dio (DOPE). The lipid binding motifs were found by using the Muscle software to search for conserved unique contiguous amino acid patterns within the sequences of proteins belonging to the SLC34 family that had been aligned for multiple times. The query sequences used for this search were known lipid-binding signatures. The influence of the phospholipids on the signal intensity is decreased in the row of DOPE>POPE>DOPS>>DOPC preblotted to PVDF membrane support (Eastern blotting) prior Western-blot analysis and immunostaining with in-house conformation sensitive antibodies. The presence of a putative PS/PE binding motif in the region of the ECD proximal to the membrane interface was discovered through the use of bioinformatics. This motif was found to ensure both the affinity and selectivity of interactions between aminophospholipids and the ECD. According to the research that was funded by the Priority-2030 Strategic Academic Leadership Program at Kazan Federal University, aminophospholipids have been shown to have the potential to contribute to the foldability of the ECD, which in turn ensures the availability of the epitope for monoclonal antibodies. The changes in the conformation of ECD could have an effect on the formation of the potential cancer-specific epitope. These changes would be caused by ECD's interaction with the plasma membrane, which was facilitated by the putative PS/PE binding motif. The findings contribute to a better understanding of the dynamic structural and functional features of membrane proteins, which present an excellent target for therapeutic antibodies that are specific to cancer cells.

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2.21 Alternative delivery systems for Puumala virus proteins: immunogenic features of microvesicles and plasmid constructions

[1]Shkair L., [1]Garanina E.E., [1]Kolesnikova A.I., [1]Rizvanov A.A., [1]Khaiboullina S.F.
[1]Kazan Federal University, Kazan, Russian Federation
e-mail: Shkair.layaly.94@gmail.com

Hemorrhagic fever with renal syndrome (HFRS) is an emerging infectious disease that is endemic in multiple countries. Most cases of HFRS are reported in the Volga region of Russia, which identifies the Puumala virus "PUUV" as a pathogen. Our goal was to analyze the immunogenic properties of microvesicles (MVs) carrying PUUV nucleocapsid (N) and glycoproteins (Gn/Gc), and of plasmid construction pBud-PuuM-EGFP encapsulated in polyamidoamine (PAMAM) dendrimeric complexes. We have found that MVs could elicit a specific humoral and cellular immune responses in vivo. Activation of humoral response after plasmid administration was also observed. Female C57Bl/6 mice received subcutaneous injection of MVs. Intramuscular delivery of plasmid pBud-PUUM-EGFP within PAMAM was selected. Humoral immune response after *in vivo* administration of MVs and plasmid was analyzed by ELISA. Activation of cytotoxic lymphocytes was analyzed using ELISpot. Upregulated levels of anti-orthohantavirus IgG were found in mice treated with MVs carrying a combination of PUUV N and Gn/Gc at 14-days and lasted to 28-days after treatment. Also, administration of pBud-PUUM-EGFP within PAMAM resulted in significant augmentation of anti-orthohantavirus IgG after 14 days ($p=0.0235$) and 28 days ($p<0.0001$). In addition, we found that MVs carrying PUUV proteins could stimulate the memory $CD8^+$ T-lymphocytes. In summary, our data provides evidence that both MVs and plasmid constructions carrying orthohantavirus proteins can induce a specific humoral immune response. PUUV-specific T cells were generated after MVs treatment. The obtained data indicate that MVs and PAMAM could become alternative vehicles for delivery PUUV antigens for vaccination.

2.22 The antimicrobial effect of natural oils on the *S. aureus* and *C. albicans* cells

Elena Trizna[1], Ruba Mahmoud[1], Svetlana Lisovskaya[2], Olga Ostolopovskaya[1], Liliya Nikitina[3], Airat Kayumov[1]
[1]Institute of fundamental biology and medicine, Kazan Federal University, Russia
[2]Department of microbiology, Kazan State Medical University, Russia
[3]General and Organic Chemistry, Kazan State Medical University, Russia
e-mail: trizna91@mail.ru

The spread of antimicrobial resistance among clinically significant bacteria and fungi is a public health problem [2]. For some natural oils, the ability to interact with antimicrobials

synergistically has been shown [4]. A similar effect is provided by a damage to the membranes of microorganisms caused by terpenes [1,3]. MIC was determined by the serial microdilution approach. Biofilms were quantified by CV-stain, the synergy of antimicrobials was evaluated in checkerboard assay. 11 clinical strains of *S. aureus* were investigated: 4 of 11 were methicillin-susceptible strains, 7 of 11 were methicillin-resistant strains, with ATCC 29213 as a control. The membrane potential was evaluated in situ by measuring DioC2 fluorescence.

Bisabolol and eucaliptol exhibited moderate activity on *S. aureus* (MIC 512-1024 µg/ml) while exhibited synergy with amikacin on 4 of 11 clinical isolates (FICI 0.31-0.5) and additive effect on 7 of 11 strains with FICI 0.75. The synergetic and additive effect was distributed between the methicillin susceptible and resistant strains. Both terpenes suppressed *C. albicans* at 12.5 and demonstrated synergy with Fluconazole (FICI 0.37 and 0.5 respectively). Since the membranotropic properties of terpenes were reported, we investigated their effect on cell membranes. The presence of both bisabolol and eucaliptol led to a dose-dependent drop of the membrane potential of *S. aureus* cells, similarly to Benzalkonium chloride, suggesting that the membrane damage could be the possible mechanism of terpenes action.

In conclusion, the observed synergy of bisabolol and eucaliptol in combination with amikacin on a wide range of clinical isolates proposes synergy on other aminoglycosides to be investigated and open promising perspectives to increase the antimicrobial treatment efficacy.

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2.23 A modern approach to guided tissue regeneration of bone tissue

Aigul Khairutdinova
Institute of Fundamental Medicine and Biology, Kazan Federal University, Russian Federation
e-mail: ajgele4ka@mail.ru

Recently, various methods have been used to increase and optimize the parameters of the alveolar processes. The build-up of the bone tissue in the area of a jaw defect using osteoconductive materials saturated with the stromal-vascular fraction of adipose tissue is a promising technique for increasing bone volume [1].

Transplantation of human autologous tissues for plastic replacement of body tissue defects is a surgical technology that is legally approved in specialized medical organizations of the Russian Federation. In our case it is the Scientific and Clinical Center for Precision and Regenerative Medicine of the Institute of Fundamental Medicine and Biology, Kazan Federal University, on the basis of which it is possible to perform extremely complex tasks in the field of medicine, including in

tissue-deficient conditions in the maxillofacial region [2]. The informed consent was obtained from patients on a voluntary basis, which is necessary for performing adipose tissue sampling and guided tissue regeneration surgery.

The selection of osteoconductive material as a carrier supplier for the purposes of our study is also important. The difficulty related to suspension of the stromal-vascular fraction of adipose tissue lies in the fact that in the absence of any carrier material, it spreads into the surrounding tissues. The osteoconductive nickel-titanium porous powder, which we used in the study, has a structure characterized with a high degree of open pores; it has a high biological, biomechanical compatibility [3].

As a result of clinical testing, the requirements, as well as methodological and technical approaches to the use of the stromal-vascular fraction for guided bone tissue regeneration in jaw defects were developed. The viability of this fraction with porous osteoconductive materials demonstrated a high level of proliferation, being an ideal substrate that creates favorable conditions for both cell growth and proliferation [4].

The period of bone tissue restoration was reduced to 6 months, and the performance of implants in 6 months after prosthetics was 0.9-1.0, which indicates the effectiveness of the immediate results of orthopedic structures functioning based on intraosseous implants [5].

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2.24 Destruction of Staphylococcus aureus biofilms by a new serine proteinase PAPC from *Aspergillus ochraceus* VKM-F4104D

Diana Baidamshina[1], Aya Rafea Nasr[1], Sergey Komarevtsev[2]; Alexander Osmolovskiy[2]; Airat Kayumov[1]

[1]Kazan Federal University, Department of Genetics, Kazan, Russia;
[2]All-Russian Scientific Research Veterinary Institute of Pathology, Laboratory of innovative drugs of recombinant proteomics, Voronezh, Russia C.I.S.;
[3]Lomonosov Moscow State University, Department of Microbiology, Moscow, Russia C.I.S.
e-mail: dianabaidamshina@yandex.ru

Staphylococci are common colonizers of the human microbiota, but many virulence factors result in the major causes of hospital-acquired infections worldwide. One of these virulence factors is the ability to form biofilms [2]. Biofilms are complex microbial communities attached to surfaces and surrounded by a matrix of extracellular polymeric substances (EPS). The EPS is composed of polysaccharides, proteins and extracellular DNA, and is finely regulated in response to environmental conditions [3]. This structured environment protects the embedded bacteria from the human immune system and decreases their susceptibility to antimicrobials, making infections caused by staphylococci particularly difficult to treat [1]. With the rise of antibiotic-resistant staphylococci, together with the difficulty in removing biofilms, there is a great need for new treatment strategies.

The recombinant fibrinolytic protease-activator of protein C of blood plasma from micromycete *Aspergillus ochraceus* VKM-F4104D (PAPC) was expressed in *E. coli* BL21 (DE3) and purified on Ni-NTAresin. Two-day-old biofilms of *Staphylococcus aureus* (ATCC 29213) were treated with PAPC protease for 24 hours in the presence or absence of antimicrobials. To assess the suppression of biofilm formation by PAPC, a CV-stain and Congo-Red stain were applied. PAPC-treated biofilms were quantified in the presence or absence of antimicrobials by CFUs count and metabolic assays, including Resazurin and MTT assays. Additionally, the LIVE/DEAD BacLight assay was applied to assess the bacterial viability.

The treatment of 48-h old S. aureus biofilms with PAPC protease (100 μg/mL) reduced the biomass by half in both CV-and Congo-Red stain. The combination of PAPC with vancomycin and amoxicillin increased the efficiency of the latter by 10-fold as judged by MTT-assay, Resazurin stain, and CFUs count. The results of LIVE/DEAD BacLight assay have matched the results of the previous methods.

The serine protease PAPC appears as a promising agent for combined antibiotic-enzymatic therapies for the external treatment of *S. aureus* biofilm associated infections.

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2.25 Sodium-dependent phosphate transporter NaPi2b in OVCAR-4 ovarian cancer cells: transmembrane topology

L. Bulatova[1], D. Savenkova[1], V. Skripova[1], A. Nurgalieva[1], A. Timonina[1], D. Reshetnikova[1], M. Bogdanov[1,2], R. Kiyamova[1]
[1] Research laboratory Biomarker, Institute of Fundamental Medicine and Biology, Kazan Federal University, Kazan, Russia
[2] McGovern Medical School at The University of Texas Health Science Center at Houston, TX 77030, USA
e-mail: minigulovalf@gmail.com

Phosphate homeostasis in humans is mainly controlled by the sodium-dependent phosphate transporters family SLC34, which is principally responsible for the regulation of phosphate levels, and with NaPi2b glycoprotein. NaPi2b

is overexpressed in several different cancers, so it is an appealing target for treatment of the disease. Although the topology of NaPi2b was predicted *in silico* [1], there are currently no direct experimental data available that can be used to determine the orientation of the extracellular domains of NaPi2b. NaPi2b includes various transmembrane domains, N- and C-terminal domains, and largest extramembrane domain (EMD). Discovering new, possibly beneficial targets to produce therapeutic monoclonal antibodies will require conducting research into the precise locations of the transporter's various domains. During our research, a variety of methodologies, such as in silico and in vitro approaches, were applied. The CCTOP server was used to make a prediction concerning the number of transmembrane domains that are present in NaPi2b as well as the topology of those domains. The localization of these domains in live or fixed and permeabilized ovarian cancer line OVCAR-4 cells was determined using fluorescent confocal microscopy and flow cytometry with mouse polyclonal antibodies against the extramembrane domain (EMD) of NaPi2b [2], mouse polyclonal antibodies against the N-terminal domain of NaPi2b [2], and rabbit monoclonal antibodies against the C-terminal domain of NaPi2b (Cell Signaling, USA).

CCTOP algorithms suggest that the number of predicted transmembrane (TM) domains ranges from eight to thirteen membrane-spanning sections, with the N-terminal, EMD, and C-terminal domains having the capability of facing either the cytoplasm or the outside of the cell. We were able to detect the orientation of all three domains of NaPi2b in OVCAR-4 cells by confocal microscopy, and our findings showed that the N- and C-terminal domains of NaPi2b are located intracellularly, while the EMD is found outside of the cell. The presence of a fluorescent signal that is green in color during Z-stacking provides evidence that NaPi2b is located within the membrane. In furthermore, we used flow cytometry to establish the localization of these domains and revealed that the N- and C-terminal domains have an intracellular orientation, whereas the large extramembrane domain, which may now be termed the largest extracellular domain (ECD), has an extracellular orientation.

Our findings, which were made possible by the Priority-2030 Strategic Academic Leadership Program at Kazan Federal University, provides the first experimental evidence for the intracellular location of the N- and C-termini, as well as the extracellular location of the largest extracellular domain of untagged NaPi2b transporter, which was shown to be primarily localized to the plasma membrane by confocal microscopy and flow cytometry.

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2.26 Characterization of antibacterial spectrum of bacteriocins from *L. fermentum* AG8 and HFD1

Monyr Nait Yahia, A. R. Kayumov
[1]Kazan Federal University, Department of Genetics, Kazan, Russia
monyraniir@gmail.com

Bacteriocins are natural peptides secreted by many varieties of bacteria for the purpose of killing other bacteria. This provides them with a competitive advantage in their environment,

eliminating competitors to gain resources. *Lactobacilli* belong to normal microflora of human intestine and vaginal tract and are known producers of bacteriocins. Among *Lactobacilli*, a lot of *L. fermentum* strains have been isolated from various habitats such as human faeces, sourdough, traditionally fermented milk, and sausages. But the examples of antimicrobial agents produced by *L. fermentum* are still rare and attracting increasing attention. In the present work, a study on antibacterial activity of bacteriocins from *L. fermentum* HFD1 and *L. fermentum* AG8 was carried out. Furthermore, the effect of pH, heat treatments and proteolytic enzymes on the antibacterial activity was also investigated.

To determine bacteriocin-producing ability, 5 ml of the activated culture of *L. fermentum* was separately inoculated into 100 ml of MRS broth under anaerobic conditions. The cells were harvested by centrifugation at 4,000 rpm for 45 min at 4 C. Bacteriocin-producing culture was adjusted to pH 3.0 by adding HCl-1N. The cell-free supernatant containing bacteriocin extract was sterilized by using a 0.22 µm pore membrane to eliminate the viable cells. The antagonistic activity of the cell-free supernatant was determined against *Serratia marcescens, Pseudomonas aeruginosa, Staphylococcus aureus* ATCC 29213, and Escherichia coli ATCC 25922 by agar well diffusion assay. MRS medium (pH 3) was used as a control. After overnight incubation, the zone of growth inhibition was determined.

The influence of different temperatures (25, 37, 80, and 100 °C for 30 min, and 121 °C for 15 min) on the antagonistic activity of the cell-free supernatant was also tested. After incubation for 2 h, the samples were cooled to room temperature. The effect of the pH on the stability of the antagonistic substances was investigated by adjustment of cell-free supernatant to reach a range of pH values from (2.0 to 8) followed by incubation for 2 h at 37 °C. To determine and confirm the peptide nature of the antibacterial agents, the cell-free supernatant was treated with ficin, papain, pepsin, trypsin, chymotrypsin, and proteinase K, at final concentrations of 5 mg/mL The test tubes with and without the enzyme were incubated at 37° C for 2 hours, and then heated at 80° C for 5 min to inactivate the enzyme; the remaining antagonistic activity of samples was determined using an agar well diffusion assay against *S. marcescens* and *P. aeruginosa*. After incubation at 37 °C for 24 h in anaerobic conditions, the size of the growth inhibition zone was evaluated. Sterile MRS broth treated with the particular enzyme, pH, and temperature, and untreated samples were used as controls. Bacteriocins from both strains *L. fermentum* AG8 and HFD1 exhibited a strong inhibitory effect on *S. marcescens, P. aeruginosa, S. aureus* ATCC 29213, and *E. coli* ATCC 25922 belonging to both (Gram-positive and Gram-negative) genera suggesting their antagonistic activity. The sensitivity of bacteriocins to different pH values revealed their stability over a wide pH range (2, 3 and 4). Regarding the effect of temperature on the stability, *L. fermentum* AG8 and HFD1 bacteriocins were heat resistant to the treatment at 100 °C for 30 min and 120 °C for 15 min. The activity of bacteriocin was completely insensitive to the treatment with proteolytic enzymes. The antibacterial metabolites, apparently bacteriocins, from the two *lactobacilli* AG8 and HFD1 have been evaluated for their antagonistic proteolytic activity. Compounds are heat-stable, active in a pH range of 3.0 to 6.0, also resistant to proteolytic enzymes. However, their further identification and evaluation of their beneficial health effects on human beings will boost the application of the strains in the food and pharmaceutical industry.

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2.27 Genome-wide sequencing of the novel probiotic strain *Lactiplantibacillus plantarum* FCa3L

Karaseva O.S., Ozhegov G.D., Akhatova F.S., Anisimova E.A., Fakhrullin R.F., Yarullina D.R.
Kazan (Volga Region) Federal University, Kazan, Russia
e-mail: olkakarp66@gmail.com

Lactobacilli are widely used in food industry and probiotic therapy because of their preservative properties, antagonistic activity against pathogens and beneficial effects on human health. However, a large number of potentially probiotic strains still need to be explored. The aim was to establish probiotic status of *Lactiplantibacillus plantarum* strain FCa3L by whole-genome sequence analysis and in vitro experimental studies.

L. plantarum FCa3L was isolated from sauerkraut in 2014. Taxonomic identification was performed using MALDI Biotyper (Bruker, Germany) and 16S rRNA gene sequencing on ABI Prism 3730 (Applied Biosystems). The genomic DNA was sequenced by Illumina MiSeq (Illumina, USA). Genome assembly by the Unicycler v. 0.4.8 gave coliphage phi-X174 and 61 contigs corresponding to a 3.3 million bp scaffold. EggNOG and RAST annotation uncovered multidrug resistance genes and genes encoding synthesis of biotin, thiamine, riboflavin, and vitamin B. No pathogenicity factors have been identified in *L. plantarum* FCa3L genome.

Antagonistic activity of *L. plantarum* FCa3L examined by the agar block test exceeded that of the reference strain *L. plantarum* 8PA3 isolated from the probiotic preparation "Lactobacterin dry" (Biomed, Russia). *L. plantarum* FCa3L was able to inhibit the growth of Morganella morganii, *Bacillus cereus, Micrococcus luteus, Enterococcus faecalis, Escherichia coli, Klebsiella pneumonia, Serratia marcescens, Staphylococcus aureus, and Pseudomonas aeruginosa*. The inhibitory effect of *L. plantarum* FCa3L was associated with the acidification of the medium (total titrated acidity was 1.46±0.24 mM/g) and production of hydrogen peroxide.

According to the results of the MATS (microbial adhesion to solvent) method, *L. plantarum* FCa3L had hydrophilic cell surface with basic and electron-donor properties, which corresponded to the low adhesive ability. Yet, FCa3L was significantly more adhesive to the buccal epithelial cells and showed higher cell autoaggregation when compared to the reference strain 8PA3.

Using disc-diffusion method, we demonstrated that *L. plantarum* FCa3L bacteria exhibited resistance to vancomycin, ciprofloxacin and aminoglycosides, and were sensitive to ampicillin, rifampicin, clindamycin, chloramphenocol, erythromycin, and tetracycline.

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2.28 New *Lactobacillus* strains with antagonistic potential

Elizaveta Gavrilova[1], Elizaveta Anisimova[1], Elena Nikitina[2], Airat Kayumov[1]
[1] Kazan Federal University, Kazan, Russian Federation
[2] Kazan National Research Technological University, Kazan, Russian Federation
e-mail: Alalila@yandex.ru

Lactobacillus bacteria are widely distributed in the intestinal microflora of many organisms. These microorganisms prevent pathogenic microorganisms' growth due to the production various metabolites like organic acids, hydrogen peroxide and bacteriocins. *Lactobacillus* are widely used in various branches of the food industry, agriculture and biotechnology. They are used in the production of fermented milk products, baking, agriculture for siloing feed, as additives to feed. They are also used to create medicine probiotics and biologically active food additives.

Probiotics improve the composition of the intestinal microbiota. Due to the increased adhesion to the mucous membranes, as well as the development of antibacterial substances, they are able to suppress the growth of pathogenic microflora. They

also support the intestinal barrier function by modulating the expression of epithelial genes, which prevents toxic substances from entering the host body [Cornforth et al, 2013]. Probiotic bacteria can interact with epithelial and dendritic cells, as well as monocytes and lymphocytes. They interact, for example, with toll-like receptors and thereby participate in the modulation of the host immune system [Bermudez-Brito et al., 2012]. The production of probiotics supplement such as *Lactobacillus* is promising.

Six novel LAB strains isolated from the clover silage exhibiting antibacterial activity against pathogens were identified as *Lactiplantibacillus plantarum* (AG1, AG9, AG10, AG15) and *Lactobacillus fermentum* (AG8, AG16) based on the 16S rRNA gene sequence.

The aim of the work was to evaluate the antagonistic activity of Lactobacillus grown in post-alcohol bard and whey and subjected to temperature exposure.

The viability of LAB after drying was evaluated. For that, 1.5 ml of LAB culture grown in either post-alcohol bard or milk whey was centrifuged, the supernatant was drained, and the precipitate was dried in a thermostat at a temperature of 50, 55, 60 or 65°C. A progressive decrease in the viability of all strains has been observed with an increase in temperature in the post-alcohol bard. There was a sudden decrease in viability up to suppression in the whey. Strains were also screened for ability to repress the growth of *Escherichia coli* and *Staphylococcus aureus* after being exposed to temperatures. LAB grown in whey kept their antagonistic properties at higher temperatures than those grown in post-alcohol bard. Strains grown in post-alcohol bard loused antagonistic properties with temperature increase, completely losing them at 60°C. The most resilient strains were *L. plantarum* AG9 and *L. plantarum* AG10 grown in whey. They maintained their antagonistic activity at 65°C.

Thus, new strains of lactobacilli are of interest for use in the agricultural industry.

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2.29 Assessment of the sodium-dependent phosphate transporter NaPi2b expression in different human cancer cell lines

D.A. Firsova[1], I.S. Levashov[1], D. Reshetnikova[1], A. Nurgalieva[1], L. Bulatova[1], M.V. Bogdanov [1,2], R.G. Kiyamova[1], V.S. Skripova[1]
[1] Research laboratory Biomarker, Institute of Fundamental Medicine and Biology, Kazan Federal University, Kazan, Russia
[2] McGovern Medical School at The University of Texas Health Science Center at Houston, TX 77030, USA
e-mail: firsovada15@mail.ru

Sodium-dependent phosphate transporter NaPi2b is a membrane glycoprotein, which is required for maintaining phosphate homeostasis [1]. Numerous tumours, including ovarian, breast, and lung cancers, expressed NaPi2b at higher levels [2]. NaPi2b might be a possible target for monoclonal antibody-based cancer therapy. For the examination of NaPi2b structure in tumour cells and creation of new NaPi2b-specific medications, the search for practical in vitro models is still important. The aim of the study was to evaluate the protein expression level in human tumour cell lines, namely pancreatic cancer AsPC-1, BxPC-3, MIA PaCa-2, Capan-2, CFPAC-1, PANC-1, HPAF-II, lung cancer H441, H460, A549, ovarian cancer Caov-3, SKOV-3, A1847, OVCAR-3, OVCAR-8, OVCAR-4, and breast cancer MDA-MB-436, T-47D, MDA-MB-231.

The NaPi2b expression level evaluation was performed by Western Blotting with the primary mouse monoclonal antibody targeting NaPi2b N-terminal domain and secondary HRP-conjugated antibodies. The detection of the chemiluminescent signal was made by gel imaging system ChemiDoc XRS+ (Bio-Rad, USA). Quantification of the signal intensity was conducted using Image Studio Lite software (LI-COR Biosciences, USA) and normalized by GAPDH loading control.

In the cell lines, the NaPi2b transporter protein expression was heterogeneous and ranged from 0 to 4.5 relative units. The ovarian cancer cell lines OVCAR-3 and OVCAR-4, as well as the lung cancer cell lines H441 and A549, all expressed NaPi2b. NaPi2b expression was discovered for the first time in pancreatic cancer, specifically in the pancreatic cell lines PANC-1 and CFPAC-1. The protein expression levels of all the other cell lines either indicated no expression or need more research.

The results of the work supported by the Kazan Federal University Strategic Academic Leadership Program (PRIORITY-2030) and Russian Science Foundation project №20-14-00166 show that cell lines expressing NaPi2b, to wit OVCAR-3, OVCAR-4, H441, A549, CFPAC-1 and PANC-1 can be used for structural and functional research on the endogenous NaPi2b, whilst others without NaPi2b expression might be involved in structural and immunogenic features of recombinant NaPi2b including mutant variants.

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2.30 Evaluation of cytotoxic activity of immune cells after interaction with tumor-derived membrane vesicles

Filin I.Y., Gorodilova A.V., Kharisova C.B., Mayasin Y.P., Kitaeva K.V., Chulpanova D.S., Solovyeva V.V., Rizvanov A.A.
Institute of Fundamental Medicine and Biology, Kazan Federal University, Kazan, Russia
e-mail: filin.ivy@gmail.com

Cytochalasin B induced membrane vesicles (CIMVs) are membrane-bound structures of various sizes that contain proteins, lipids, nuclear and mitochondrial components. CIMVs are able to fuse with recipient cells via endocytosis. Dendritic cells (DCs) are professional antigen-presenting cells along with macrophages and B cells since they have major histocompatibility complex (MHC)-II molecules on the membrane surface. But only DCs, due to the ability to migrate to the lymph nodes, could activate T-killers, the main participants of antitumor immune response. Therefore, CIMVs from tumor cells can be used to present antigens to the immune system cells.

Genetic modification of human melanoma M14 cells was carried out with recombinant lentiviruses LV-IL-GM-CSF to obtain stable cell lines with overexpression of GM-CSF. Peripheral blood monocytes (PBMCs) were isolated by Ficoll gradient

centrifugation (1,077 g/cm3). CD14$^+$ monocytes were isolated from healthy donor PBMCs by adhesion. 5 million cells per well were seeded and incubated in a humid incubator at 37°C and 5% CO2 for 1.5 hours. After that, non-adherent cells were collected from the medium, and a new culture medium RPMI-1614 was added. Differentiation of Dendritic cells (DCs) from CD14$^+$ monocytes were reached by cultivation of CD14$^+$ monocytes with a cocktail of cytokines for 7 days. Co-cultivation of DCs and CIMVs was carried out for 24 hours, and then PBMCs were added. Afterward PBMCs were stained with the antibodies containing a fluorescent label. The results were analyzed by flow cytometry. Thereafter, activated T-cells were added to melanoma cells for 24 hours and also analyzed on annexin V by flow cytometry.

We analyzed the interaction of activated mature DCs with PBMCs. Co-cultivation of dendritic cells loaded with CIMVs from M14-GM-CSF with PBMC resulted in an increase in CD38$^+$ T-killers by 32% relative to PBMCs that were cultured with native mature DCs (control cells), as well as an increase in T-helper 2 cells by 17% relative to control cells. Besides, it was shown that apoptotic M14 cells after co-cultivation with activated T-cells increased by 21% relative to control M14 cells.

Thus, due to the ability of CIMVs to present tumor antigens to DCs and activate the antitumor immune response, CIMVs of tumor cells are a promising object for the development of therapeutic antitumor vaccines. However, further studies are needed in this area to study possible ways of modulating the immune response.

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2.31 Tissue reactions in the ventral horns with distance from the site of spinal cord contusion

I. M. Kabdesh[1], Y.O. Mukhamedshina[1,2], S.S. Arkhipova[1], D.K. Sabirov[1], M.S. Kuznecov[3], A.A. Rizvanov[1], Y.A. Chelyshev[2]
e-mail: ikabdesh@gmail.com
[1]OpenLab Gene and Cell Technologies, Institute of Fundamental Medicine and Biology, Kazan (Volga Region) Federal University, Kazan, Russia
[2]Department of Histology, Cytology and Embryology, Kazan State Medical University, Kazan, Russia
[3]Department of Epidemiology and Evidence-based medicine, Kazan State Medical University, Kazan, Russia

In rat contusion model of severe spinal cord injury at the Th8 the number of NG2$^+$ cells, as well as the expression of NG2 proteoglycan and marker molecules of astrocytes and axons was studied in ventral horns (VH) at different distances in caudal direction from the epicenter of injury (3-5 mm, 6-8 mm, and 10-12 mm, what correspond to the Th9, Th10, and Th11). At a distance of 3-5 mm the number of NG2$^+$/Olig2$^+$ cells increased by 7 days post injury (dpi) and remained elevated at 30 dpi. The spatiotemporal dynamics of NG2$^-$/Olig2$^+$ cells is similar to that of NG2$^+$/Olig2$^+$ cells, but with smaller deviations. A decrease in NG2 proteoglycan mean intensity correlates with a decrease in the number of NG2$^+$ cells at a distance of 6-8 and 10-12 mm.

The western blot shows an increase in the astrocyte marker GFAP at 7 dpi at a distance of 3-5 and 6-8 mm, as well as 30 dpi at a distance of 10-12 mm. The same method showed that the glutamate transporter GLT-1, expressed predominantly in the perisynaptic processes of astrocytes, paradoxically increases only in the area remote from the epicenter, namely at a distance of

10-12 mm, which was traced both at 7 dpi and 30 dpi.

The immuno electron microscopy revealed the presence of NG2 proteoglycan in connection with the membrane and in the cytoplasm of $NG2^+$ glia and in large amounts in myelin membranes. In the VH of intact spinal cord double-label immunoelectron microscopy for studying the colocalization of NG2 proteoglycan and the astrocyte marker aldehyde dehydrogenase 1 (ALDH1L1) showed the presence of the weak NG2 proteoglycan immunoreactivity along the plasma membranes of intact astrocyte processes, including those adjacent to the neuron. In $NG2^+$ glia, the ALDH1L1 immunopositive reaction was not observed. By 30 dpi at a distance of 3-5 mm from the epicenter, the expression of NG2 proteoglycan appears to be increased both in $NG2^+$ cells and in reactive astrocytes.

Confocal microscopy showed a significant decrease in the number of $5\text{-}HT^+$ axons at a distance from the epicenter in the caudal direction, which is consistent with a decrease in β3-tubulin in these areas of the VH. The results indicate significant cell reactions not only in the area of the gray matter damage, but also in adjacent and remote areas, which is important for assessing the possibility of long distance axonal growth.

2.32 Feedforward inhibition in dentate granular cells during the first two postnatal weeks

A. V. Lukoyanova[1], E. R. Juzekaeva[1], R. N. Khazipov[1,2]
[1] Laboratory of Neurophysiology, Kazan Federal University, Kazan, Russia
[2] INMED - Institut National de la Santé et de la Recherche Médicale, Aix-Marseille University, Marseille, France
e-mail: anvfrolova@gmail.com

Granular cells of dentate receive major excitatory input through the perforant path from L2 neurons of entorhinal cortex. In adults, this excitatory input from EC is rapidly curtailed by fast and powerful feedforward inhibition which provides only few milliseconds long "opportunity window" for the integration of excitatory inputs, thus supporting sparce coding. However, ontogenesis of the perforant pathway related feedforward inhibition in the dentate gyrus remains largely unknown. We explored developmental changes in the feedforward inhibition of dentate granular cells using whole-cell patch clamp recordings from entorhinal-hippocampal slices of mice through the first postnatal month. Excitatory and inhibitory postsynaptic responses were evoked by L2 or perforant path electrical stimulation, and were voltage separated using low-chloride pipette solution. Perforant path-evoked responses in granular cells were typically characterized by a sequence of excitatory postsynaptic currents (EPSCs) followed by inhibitory postsynaptic currents (IPSCs). Both perforant path-evoked EPSCs and IPSCs were suppressed by the ionotropic glutamate receptor blockers CNQX and APV, indicating that generation of IPSCs involves glutamatergic excitation of interneurons. A temporal "opportunity window" was measured as a time lag between EPSC and IPSC onset. During the first postnatal week, the onset of EPSCs occurred, on average, 4.7±0.6 ms after the stimulus, and the onset of IPSCs occurred 44.3±14.8 ms after the stimulus (n = 5 rats). Thus, the time lag between GABA- and glutamate-mediated response onsets attained 39.6±15.1 ms. During the second postnatal week, postsynaptic response onset occurred 4.5±0.7 ms and 12.1±0.9 ms after the stimulus for EPSCs and IPSCs, respectively (n = 6 rats), and the size of opportunity window attained 7.6±1.1 ms. Therefore, the time lag between IPSC and EPSC response onsets shortened by 32±14 ms (n = 11 rats, $p<0.05$) by the second postnatal week. In conclusion, we showed that feedforward inhibition in the entorhinal-dentate perforant pathway is delayed in development that is in keeping with late maturation of intrinsic properties of perisomatic projecting fast spiking interneuron and their synaptic circuit involved in the feedforward inhibition of

dentate granular cells. Delayed development of the feedforward inhibition enables wide, in the range of tens of milliseconds, temporal window of summation of excitatory inputs from entorhinal cortex during the neonatal period. We hypothesize that due to delayed development of feedforward inhibition, neonatal granular cell operate as integrators of multiple inputs during entorhinal cortex-driven early sharp waves in contrast to sparse coding in adults.

2.33 Changes of neuronal survival after oxygen-glucose deprivation – induced anoxic depolarization in the rat barrel cortex in vitro at different postnatal ages

Elvira Juzekaeva[1], Azat Gainutdinov[1,2], Marat Mukhtarov[1], Rustem Khazipov[1,2]
[1]Laboratory of Neurobiology, Kazan Federal University, Kazan, Russia; [2]INMED-INSERM UMR901, Aix-Marseille University, Marseille, France

Anoxic spreading depolarization (aSD) is a hallmark of ischemic brain injury [1]. However, the developmental aspects of neuronal death following aSD remain largely unknown.

We explored age-dependence of neuronal death as a function of the reperfusion delay after oxygen/glucose deprivation (OGD) - induced aSD in slices of rat barrel cortex during the first postnatal month. The duration of OGD varied according to the delay in reperfusion from aSD peak. We sampled cells using short-term (~ 1 min duration) patch-clamp recordings in control conditions and during reperfusion following OGD starting 20 min after reperfusion. Survived neurons displayed negative resting membrane potential, high membrane resistance and ability to fire action potentials in response to depolarizing current steps. Dead cells lacked resting membrane potential and action potentials, and had low membrane resistance.

Short OGD episodes without aSD were not associated with neuronal death at all ages. If aSD occurred, the number of live neurons progressively decreased with the delay of reperfusion onset after aSD in an age-dependent manner. With an increase in the OGD duration, neuronal death rate attained [median (Q1 – Q3)] 1.3 (0.9 – 1.6) % / min in slices from the postnatal days [P] P1-14 rats and 2.4 (1.9 – 2.6) % / min in P15-32 rats ($p < 0.05$). The level of 90 % death was achieved at post-aSD reperfusion delays of 47 and 32 min at P1-14 and P15-32, respectively.

Thus, (i) the OGD-induced aSD is not a terminal event, (ii) the delay of reperfusion after aSD is critical for neuronal survival, and (iii) the rate of neuronal death during post-aSD period increases with age.

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2.34 Sputnik-V-Light Repeated Dose Triggers T-Cell Response

S. Hamza[1], E. Martynova[1], N. Blat[1], A. Rizvanov[1] and S. Khaiboullina[1],
[1] Kazan Federal University, Kazan, Russia,
e-mail: Shaimaa.hamza@mail.ru

In 2019, an outbreak of «pneumonia unknown etiology» was registered in the Chinese province of Wuhan. Soon, the new strain of coronavirus was isolated from samples selected from patients, which was later named coronavirus-2 of Severe Acute Respiratory Syndrome (SARS-CoV-2). This virus is a new member of the beta-coronavirus family containing multiple human pathogens. The World Health Organization (WHO) has declared Sars-Cov-2 coronavirus disease 2019 (COVID-19). Although COVID-19 was often asymptomatic, it could be fatal in some patients. The mortality rate was higher in elderly patients and patients with a concomitant disease. It appears that recovery from COVID-19 depends on activation of antibodies and T-cell immune response to Sars-Cov-2 [W.H.O., 2020].

The immune response of T-cells is necessary to protect against viral infections. The most effective T-cells in the Sars-Cov-2 virus clearance are cytotoxic T-cells (CD8+ T-cells). These cells can identify and destroy cells infected with Sars-Cov-2. Early activation of the CTC can distinguish between mild and severe forms of the disease. This is because CD8+ T-cells can kill virus infected cells and prevent the virus from spreading from the upper respiratory tract to the lungs. These cells can also reduce human-to-human transmission by limiting the amount of circulating virus, and as a result, an infected person releases fewer viral particles. In addition to protection during acute infection, the CTC can prevent re-infection, as a recovery from COVID-19 will form a group of memory T-cells. These Sars-Cov-2-specific CTCs will be ready to remove infected cells immediately after infection. [Flemming, 2021]

Activation of the T-cell immune response is important to prevent infection of Sars-Cov-2. These cells are able to recognize various epitopes on viral protein. This makes it difficult for the virus to avoid immune recognition and counter the immune response. Therefore, the development and duration of the CTC's immune response at COVID-19 is a reliable indicator of protection against Sars-Cov-2. [Zhang, 2020]

The aim of the study: we have already conducted studies that showed the effectiveness of the Sputnik-V vaccine in activating the T-cell immune response. However, the effect of re-vaccination by Sputnik-V-light on T-cells remained unknown.

We did a study on activating the T-cell immune response in people after revaccination. T-cell immune response to revaccination by Sputnik-V-light was analyzed with the help of «Tiger-test», production of «Generium», the Vladimir region, Russia. We found that revaccination by Sputnik-V-light activates T-cell immune response. The results indicate a high probability of preventing Sars-Cov-2 infection after vaccination with Sputnik-V-light. This statement is based on the activation of T-cells that recognize antigens of the Sars-Cov-2 virus after revaccination.

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2.35 Changes in excitatory input to the nerve cell during evoked focal epileptic activity in the adult rat neocortex

Victoria Shumkova[1], Violetta Sitdikova[1], Marat Minlebaev[2]
[1] Laboratory of Neurobiology, Kazan Federal University, Kazan, Russia
[2] Institut de Neurobiologie de la M´editerran´ee, Institut National de la Sant´e et de la Recherche M´edicale, Aix-Marseille University, Marseille, France
e-mail: victshumkova@gmail.com

Epilepsy is a chronic disease of the nervous system, linked to hypersynchronization of the neuronal activity. One of the main mechanisms is the impairment of the excitation/inhibition balance due to the excitation predominance, that is clearly shown by in vitro studies. But it is still unknown whether an increase in excitation also characterizes the epileptiform activity in vivo.

To answer this question, we characterized the frequency of excitatory postsynaptic currents in control and during evoked epileptic activity. The experiments were done on maturing rats p18-27. Single whole cell recordings in vivo were done (at membrane potential fixed at -60 mV) in control and during epileptic activity evoked by the local injection of 4-aminopyridine (100 mM, 0.5-1 µl).

Our results showed that epileptiform activity was associated with increased excitation in the neural network. Comparison of glutamate currents frequency showed an increase during epileptic activity by 4 times (from 1.1±0.12/sec in control to 4.32±0.47/sec). We have equally observed that during epileptic activity, there is an increase in synchronicity of the excitatory postsynaptic currents (in control the modulation index was 0.52±0.03 and during epileptiform activity 0.67±0.04).

Although further studies are required, our preliminary data indicate an increase in the excitatory inputs and their synchronization during the epileptiform activity in vivo. It could be assumed that epileptic activity led to a balance shift towards excitation, being in agreement with data published from in vitro studies.

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2.36 Registration of the activity of individual neurons of the rat somatosensory cortex in vivo using the methods of the patch clamp technique and the superfusion chamber

Valentina Silaeva[1], Victoria Shumkova[1], Violetta Sitdikova[1], Anatoliy Loghashkin[1], Marat Minlebaev[1]
Institute of Fundamental Medicine and Biology, Kazan Federal University, Russian Federation
e-mail: 8.oktarina@gmail.com

Intracellular recording of electrical activity is the "gold standard" for describing the behavior of excitable cells under physiological and pathological conditions. Despite the fact that the technique of patch clamp dates back to the last century [1,2,3], it is still widely used in neurophysiology. Intracellular registration in vitro is a well-established procedure. However, the use of a patch clamp in vivo remains an extremely complex and little-spread technique. In this abstract, we demonstrate that the combination of a superfusion chamber (previously patented by us) facilitates in vivo patch clamp registrations.

To achieve this goal, we conducted a series of experiments on Wistar rats of the P15–P30 age. The region of the neocortex above the somatosensory cortex was freed from the bones of the skull.

To reduce the pulsations of the cerebral cortex, we used a clamping device, which has the form of a transparent mesh with many holes, with a diameter of 300 µm each. The exposed surface of the neocortex was continuously perfused with

a physiological temperature artificial cerebrospinal fluid (ACSF) solution. To record the activity of individual cells, glass micropipettes with a resistance of 4–8 MΩ were used, filled with a CsGluc solution (for intracellular recording of currents passing through the cell membrane) or ACSF solution (with 1 μM GABA, for recording GABA activated chloride channels in a cell-attached configuration).

The search for the cell was carried out by a blind method.

The results obtained showed that a superfusion chamber with a clamping device can effectively reduce the physiological pulsations of the brain and record the activity of individual neurons using the patch clamp technique.

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2.37 Neocortical neurons chloride conductance recording as a method to evaluate GABA function in the rat brain in vivo

Violetta Sitdikova[1], Victoria Shumkova[1], Valentina Silaeva[1], Marat Minlebaev[1]
1Laboratory of Neurobiology, Kazan Federal University, Kazan, Russia
e-mail: sitdikovavita@gmail.com

Epilepsy is one of the most common diseases of the nervous system, characterized by repeated paroxysmal neuronal activity, caused by increased hypersynchronous activity in the cortical network. In vitro studies demonstrated an increase in the intracellular concentration of chloride during epileptiform activity that could result in the GABA polarity function change from inhibitory to excitatory. But the question remains whether GABA changes its polarity during the epileptiform activity in vivo.

To answer this question, we characterized the intracellular chloride concentration during the epileptiform activity using single channels and local field potential recordings in adult Wistar rats in vivo. Using the Goldman-Hodgkin-Katz equation, the resting membrane potential of the cell and the reversion potential for GABA were calculated in control and in conditions of epileptiform activity evoked by 4-aminopyridine (100 mM).

Our preliminary results showed that during epileptiform activity, the neuronal resting membrane potential was strongly depolarized (-27.73±-7.94 mV, while in control -53.35±-9.29 mV). The depolarizing shift was also observed for GABA (reversion potential shifted from -60.20±-10.33 mV in control to -32.68±-0.29 mV during the epileptiform activity).

In spite of GABA reversion potential shift, it was more negative compared to resting membrane potential, meaning that GABA served as the hyperpolarizing and inhibitory neurotransmitter during the epileptiform activity in vivo. Further research is required to increase the patched cells number and the mechanisms underlying the intracellular chloride concentration increase.

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Chapter 3. PETROLEUM ENGINEERING TECHNOLOGIES

3.1 Oxidation of Organic Compounds Industrial Water in Supercritical Fluid Conditions

A.U. Aetov, F.M. Gumerov, R.A. Usmanov, S.V. Mazanov.
Kazan National Research Technological University, Kazan, Russian Federation
e-mail: aetovalmaz@mail.ru

The chemical industry occupies one of the leading roles in the modern world, however, with the development and growth of production rates, the amount of toxic emissions and waste is also growing, which causes serious environmental problems. With regard to the enterprises of organic synthesis, the most difficult from the standpoint of minimizing the impact on the environment is the disposal of liquid waste. In most cases, such wastes are multicomponent, chemically heterogeneous mixtures of substances with different physical, chemical and biological (in particular, antibacterial) properties. Due to the difficulty of isolating the useful components contained in wastewater and capable of being involved in the industrial recycling, such wastewater is usually subjected to thermal neutralization.

Such an approach to recycling is not only wasteful and costly, but also leads to environmental pollution. As a result, the identification of new and environmentally "clean" areas of deep processing of chemical waste is an important scientific and technical task.

The object of study in this work is the process stream formed at the stage of epoxidation of propylene with ethylbenzene hydroperoxide as part of the process of joint production of propylene oxide and styrene, Nizhnekamskneftekhim PJSC (plant for the production of styrene and polyester resins), Nizhnekamsk, Tatarstan [1-2]. Methods of ultraviolet and infrared spectroscopy, as well as liquid chromatography were used to establish the qualitative and quantitative composition of an industrial water waste sample.

Before the experiment, the initial flow was mixed with distilled water in a volume ratio of 1:20. An experimental study of the process of industrial water waste neutralization was carried out on a continuous installation with a flow reactor containing a catalytic section with a fixed layer of a heterogeneous catalyst located in it, and without it in a temperature range of 673–873 K at a pressure of 22.5 MPa. A distinctive feature of this installation is the use of a high-frequency induction heater, which increases the uniformity of heating and achieves its high speed. The high concentration and precise localization of the energy of the electromagnetic field ensures a short cycle and leads to high productivity of the process. Air oxygen was used as an oxidizing agent.

The degree of efficiency of the process of water runoff organic compounds oxidation was assessed using such an indicator as chemical oxygen demand (COD), which is a qualitative indicator of the degree of pollution of wastewater and industrial waste.

The results of measuring COD indicators for an array of experimental data, obtaining non-catalytic and catalytic raw materials, within the entire catalysts (Fe-Ac, Fe-OH, Mn-Al), options for the process of neutralizing water waste are shown in fig. 1.

Activation of the synthesized heterogeneous catalysts in the process of neutralization for the renewability of use. Thus, the COD values in processes using Fe-OH and Mn-Al catalysts under various conditions are lower than 1.5-3 times, primarily to the temperature dependence and oxygen

consumption in accordance with the non-catalytic reaction. In terms of the beautiful COD of industrial water runoff, among the presented catalysts, the manganese-containing catalyst exhibits the highest efficiency.

Neutralization of industrial water runoff components is carried out under SCF conditions for pure water, characterized by a pressure of 22.5 MPa and a temperature range of 673-873 K, with a moderate excess of oxygen equal to 2÷4, in accordance with heterogeneous catalysts determined by the physicochemical nature.

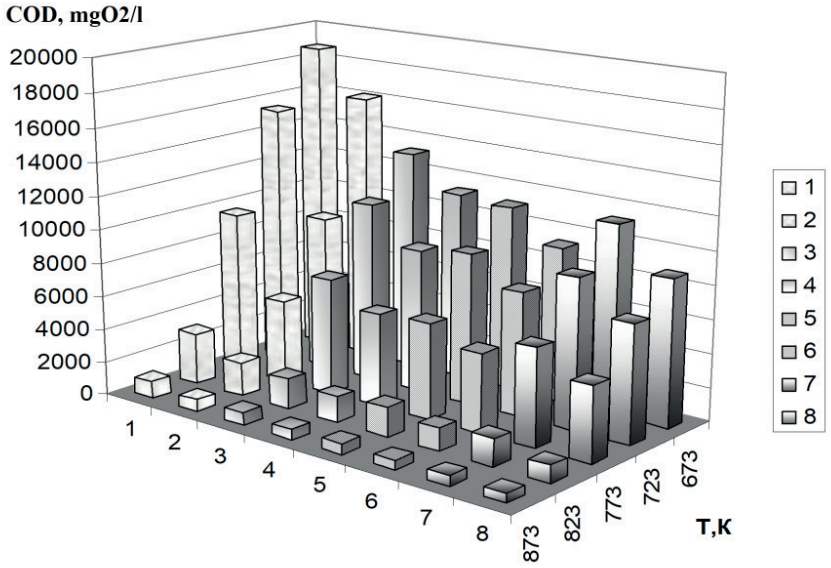

Fig. 1. COD of the reaction product of the oxidation of organic compounds of industrial water runoff carried out under SCF conditions as a function of temperature, type of catalyst and degree of oxygen excess at a pressure of 22.5 MPa: 1 - without catalyst (oxygen excess coefficient (OIC) = 2); 2– without catalyst (CIC=4); 3 – Fe-Ac catalyst (KIC=2); 4 – Fe-Ac catalyst (KIC=4); 5 – catalyst Fe-OH (KIC=2); 6 – catalyst Fe-OH (KIC=4); 7 – Mn-Al catalyst (KIC=2); 8 – Mn-Al catalyst (KIC=4)

The manganese-containing catalyst turned out to be the most effective in terms of the degree of neutralization of the organic components of the waste water relative to the COD values.

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3.2 An inferable machine learning approach for stratigraphy prediction using geochemical data

Amagada Paul
Kazan National Research Technological University, KNRTU.
e-mail: paulubi22@gmail.com

The study of stratigraphy and sedimentology is of utmost importance as it provides useful information about the types of resources found in a geological region. Sedimentary rocks are the ones where petroleum deposits are found. Sedimentology is tied to stratigraphy, which studies the relationships between rock layers and the way they can shift and move [1]. This also affects the area where petroleum deposits can be found, as well as how the extraction of petroleum affects the sediment around the deposit. Simulation of a geostratigraphic unit is of vital importance for the study of geoinformatics, as well as geoengineering planning and design. A traditional method depends on the guidance of expert experience, which is subjective and limited, thereby making the effective evaluation of a stratum simulation quite

impossible. The purpose of this study is to apply machine learning techniques to develop models that satisfactorily predict geostratigraphic units using geochemical data.

The geochemical dataset used in this research is the Regional Geochemical Survey Dataset, which is a program that has been conducted in British Columbia, Canada, since 1976 to aid exploration and development of mineral resources. This dataset consists of stream sediments, which are the sediment samples that are collected from a stream or body of water for geochemical analysis. Stream sediment sampling is a well-established geochemical tool for mineral exploration. The Quest area was chosen as the area of focus as it has the most data of any region in the dataset. The Quest area lies within the broad interior plateau of central/northern British Columbia, near the town of Prince George. The geology of the area is characterized by Cretaceous to Oligocene aged sediments of the Nechako Basin, which is bound by the coast mountains to the west and the Rocky Mountains to the east. A thick veneer of extrusive volcanic rocks and quaternary sediments overlie the sedimentary rocks of the Nechako basin [2]. Data cleaning and exploratory data analysis (EDA) were carried out on the data. The selected data consisted of 1729 data points. The data consisted of 40 features ranging from longitude, latitude, rock types, and the composition of several minerals measured in parts per million. Some examples of the minerals were Copper, Zinc, Magnesium, Aluminum and Scandium. Feature selection was done using expert domain knowledge. The data was split into 67% for training and 33% for testing. The six major geologic formations captured by the data include coral patch seamount CPSm, Chilcotin LTQCh, cache creek MTrCc, takla TrJTK, KTpg and the Nicola uTrJNC groups. Intelligent models are algorithms designed to learn from large volumes of data and draw valuable insights from them [3]. In this study, we are majorly interested in deterministic prediction. The problem was treated as a classification problem using XG Boost, Decision trees, Extra trees, and Random Forest models. The performance of the models was evaluated using their accuracy score on the test data. The higher the accuracy score is, the better the ability of the model to predict the dominant catchment

lithology or stratigraphy is. The XG Boost, Decision trees, Extra trees, and Random Forest models achieved accuracy scores of 0.685, 0.608,0.639 and 0.630 respectively. As shown by the results, the XG Boost model outperformed the other models achieving the highest accuracy of 68.5%. The results reveal the feasibility of applying machine learning models for stratigraphy prediction using geochemical data with a satisfactory degree of accuracy.

This study resulted in the application of machine learning techniques to develop models capable of predicting stratigraphy and geological units of an area using geochemical data. The models were developed by fitting XG Boost, Decision trees, Extra trees, and Random Forest machine-learning algorithms to a geochemical dataset. The results revealed that the models performed satisfactorily in determining the stratigraphy. The XG Boost model had the highest performance. Therefore, with the aid of sufficient geochemical data of a geographical region, the model can predict the dominant lithology catchment or stratigraphy of that region. It was observed that the use of more data helps to improve the models thereby increasing accuracy scores.

The results also show that more work can be done to investigate the usage of intelligent models in determining the stratigraphy of geographical regions. The methods presented here are not limited to geochemical data. They can be extended to other forms of geological data with appropriate modifications of the algorithm. This work has far-reaching practical significance for the accurate description of the spatial distributions of geological features, the guidance of site selection, engineering construction, and environmental assessment. This study directly shows that machine learning is feasible and reliable in geostratigraphic simulation. Additionally, our research provides new ideas for the popularization of machine learning in other fields of geology and engineering. Md. Robiul Hussain Robin. "*Importance of Studying Stratigraphy and Sedimentology*". University of Chittagong, Bangladesh. 1-3.

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3.3 Analysis of the Oil and Energy Complex of the Russian Federation

E. Poletaeva
Downstream Project Coordinator, BGS Group, Yekaterinburg, Russian Federation
e-mail: eugina.poleateva@gmail.com

The oil and energy complex of the Russian Federation includes oil, gas, petrochemical, coal and peat industries, electric power and heat supply. This complex makes a significant contribution to the socio-economic development of the country and is becoming a third part of the federal budget revenues. At the same time, the contribution of the oil and energy complex to the country's GDP is about 26%, with only 3.7% of people employed in the complex out of the total number of employed people in the economy.

Oil. In 2020, the oil and gas condensate production in the Russian Federation decreased by 2.3% compared to 512.68 million tons in 2014. Continuous production growth in 2014-2019 is associated with the start of large-scale development of fields in Eastern Siberia and the Republic of Sakha, as well as the fields located in the Caspian Sea, and the development of the Prirazlomnoye field that has begun on the Arctic continental shelf. The decline in oil production and refining compared to the corresponding figures in 2019 is explained by the fall in external and domestic demand for oil and petroleum products in the context of the coronavirus pandemic, as well as the obligations of the Russian Federation to curb national oil production at the level of quotas established under the agreement with OPEC+ countries. Despite the ever-increasing indicators of oil production and export in 2014-2019, the issues and risk factors in the oil industry are an increase in production costs due to the predominance of hard-to-recover oil reserves and high depletion of mature fields, deterioration in the physical and chemical characteristics of produced oil, which requires introduction of new technological solutions and investments and increases the cost of oil refining.

Natural gas. Gross gas production in the Russian Federation has increased by 7.9% compared to 2014, amounting to 692.9 m3 by the end of 2020. Such growth is explained by the development of large fields on the Yamal Peninsula, in Eastern Siberia and the Republic of Sakha, the Irkutsk region, the development of deep seams and deposits of the Zapolyarnoye and Urengoyskoye fields, implementation of innovative projects for the production of methane from coal seams in Kuzbass. When comparing natural gas production figures in 2020 with 2019, there is a drop in production by 44.8 m or -6.1%, due to a decrease in demand or the coronavirus crisis. The decrease in pipeline gas exports from the Russian Federation observed in 2020 was partly offset by an increase in the supply of Russian LNG that was not tied up in infrastructure in local markets, which made it possible to maneuver resources and maintain the profitability of exports, directing it both eastward and westward. With the risk factors common to the oil and energy complex, the issues that are identified in the gas industry are: an increase in the costs of extracting and transporting gas to domestic and foreign markets due to the reduction of highly productive and shallow reserves under development, the transition to the development of fields with complex natural, climatic and geological conditions, remoteness of new production areas from gas consumption centers; the absence of a full-fledged, competitive domestic gas market, the need for which is aggravated due to the decision to create a common gas market of the Eurasian Economic Union; the incompleteness of the process of formation of the legislative and regulatory framework for the functioning of the domestic LNG market.

Coal. In the end of 2020, the increase in coal production compared to 2014 was 12%,

the export of raw materials increased by 29%, including due to the strengthening of positions in the markets of the Asia-Pacific countries, primarily Japan, South Korea, China, Taiwan, India, Malaysia and Vietnam. The increase in production is mainly due to the use of open pit mining, which accounted for 74.3% of total production in 2020. Compared to 2019, coal production decreased by 9.2% and amounted to 402.1 million tons, while open-pit mining decreased by 10.8%, underground - by 4.0%. The main reason for the decline in indicators is the long-term trend towards a decrease in demand for energy sources that pollute the environment and the subsequent replacement of coal in the energy balance by renewable energy sources, as well as a decrease in the cost of liquefied natural gas and oil against the backdrop of the global economic crisis. The reason for the decrease in gas exports in 2020 compared to 2019 by 5% is the change in the geography of coal energy. In the period of 2014-2020 there is a decrease in demand for coal in European markets and an increase in demand in Asian markets, for the development of which the Russian Federation needs new transport capacities.

3.4 CALCULATION OF POTENTIAL AND RESIDUAL RECOVERABLE OIL RESERVES IN HIGHLY WATERED RESERVES

Garayev G.T.[1]
[1]International Oil and Gas University named after Yagshygeldi Kakayev, Ashgabat, Turkmenistan
e-mail: gadam17@mail.ru

Calculation of recoverable oil reserves by the usual static method, based on the probable productivity of wells, is not applicable in heavily watered oil reservoirs. In this case, water with a low oil content is produced from wells. [1]. During the studies of the flooded deposits operation, it turned out that in the later stages of the operation a linear relationship is maintained between the total oil production from the wells and the proper percentage of oil in the liquid. Using this relation, we can determine the potential and remaining recoverable oil reserves [3] using the following equation:

$$\sum Q_o = \alpha + cn_o (1)$$

α, c – these values are correlated according to the data for the last 5 - 20 years of watered well development;

η_o – average oil-to-liquid ratio, %;

Q_o – total oil production by years, million tons.

To find the values α, c of equation (1), we use the least squares method. This is possible by compiling a first-order correlation equation or by solving normal equations [2]. Calculation of the statistics is necessary for the compilation of the correlation equation, so we will calculate the statistics according to the scheme used for small trials, in cases of unequally spaced values of random variables.

When using this scheme, it is possible to obtain a dependence equation for the studied quantities, as well as to establish a relation between them, evaluate the correlation coefficient (r), linearity and the main error.

Table 1 – Conditional values for building a mathematical model of the relation between the oil content in the liquid and the cumulative oil production

$\sum Q_o$, million tons	η_o, %
1,42	6,4
1,44	6
1,49	5,5
1,58	4,4
1,61	3,8
1,65	3

We have six paired observations of the total annual oil production and oil-in-fluid ratios (Table 1). Let's replace «Q_o» through Y, and «η_o» through X, in

order to facilitate calculations, and compile a table (2).

Having the average values of the values shown, one can easily calculate the standard deviations $\sigma^2_{X,Y}$ and the correlation coefficient r, the linearity criterion ζ and its error σ_ζ. The ratio of ζ to σ_ζ is less than one, which indicates that the relation between X and Y is linear.

Table 2 – Table of values for building a mathematical model of the relation between the oil content in the liquid and cumulative oil production

n	Y	X	Y^2	X^2	XY
1.	1,42	6,4	2,02	40,96	9,09
2.	1,44	6	2,07	36	8,64
3.	1,49	5,5	2,22	30,25	8,2
4.	1,58	4,4	2,5	19,36	6,95
5.	1,61	3,8	2,59	14,44	6,12
6.	1,65	3	2,72	9	4,95
∑X,Y	9,19	29,1	14,12	150,01	43,94
$\sum \frac{X,Y}{n}$	$\bar{Y}$ =1,53	$\bar{X}$ =4,85	$\bar{Y}^2$=2,35	$\bar{X}^2$ =25	$\overline{XY}$ =7,32

We write the correlation equality expressing this dependence as follows (2):

$$Y_x = \bar{Y} + r\frac{\sigma_Y}{\sigma_X}\left(X_i - \bar{X}\right)(2)$$

$$Y_x = 1{,}53 + (-0{,}994)\frac{0{,}087}{1{,}22}(X_i - 4{,}85) = 1{,}875 + 0{,}071X_i$$

Applying the initial conditions of notation, equation (2) will take the form (3):

$$\sum Q_o = 1{,}875 + 0{,}071 n_o (3)$$

According to equation (3), calculation results and the initial data, we build curves of actual and theoretical values of cumulative production from oil content.

With η_o=0, we obtain potential recoverable oil reserves, which will be equal to the free term of the equation, that is, with η_o=0; Q_o=1.88 mln.t. Based on the reasonable final value of the parameter (η_o), we find commercial recoverable oil reserves ($\sum Q_o$). In this case, the remaining recoverable oil reserves will be determined by the formula:

$$Q_{r.r} = Q_o` - Q_{t.p}$$

$Q_{r.r}$ – remaining recoverable oil reserves;

$Q_o`$ – industrial recoverable oil reserves;

$Q_{t.p}$ – total oil production at the date of calculation.

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3.5 Investigation of highly effective Ni containing catalyst for utilization of greenhouse gases in syngas production

A. Hassan[1, 2], V.E. Fedorova[2]
[1].Department of Natural Sciences, Novosibirsk State University, Novosibirsk, Russia
[2].Department of Heterogeneous Catalysis, G.K. Boreskov Institute of Catalysis, Novosibirsk, Russia
e-mail: a.khassan1@g.nsu.ru

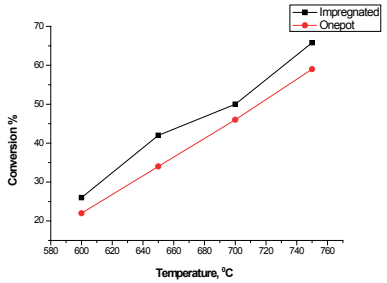
The environment and energy are closely associated due to utilization of fossil fuels. The global climate is transforming due to depletion of natural reserves and is directing the scientific community to devise new eco-friendly

methods and more efficient systems for energy imparts and protection of environment. In 2020 European Commission proposed guidelines for 2050 low-carbon economy roadmap in sector of climate change, energy, transportation and the reduction of greenhouse gases (CH_4 & CO_2) emissions 80-95% by 2050 [1]. The utilization of CH_4 and CO_2 to the carbon neutral strategy has industrial and environmental importance. It's important to explore new methodologies to replace fossil fuels; because the global-energy crisis creates serious environmental problems and hydrogen has been suggested as a clean and energy-rich fuel for the future. Hydrogen can be produced from wide range of sources and by different methods [2].

Dry reforming of methane (DRM) is one of the available economically friendly method. DRM convert the greenhouse gases (CH_4 + CO_2) into high value syngas (CO + H_2) production and then transformed into important chemicals which is suitable for petrochemical industry, chemical feedstock for methanol, dimethyl ether, ammonia, Fisher–Tropsch reactions and hydrogen supply for energy production by fuel cells.

DRM is a highly endothermic catalytic process it requires a high temperature and is also accompanied by the formation of various forms of carbon on the catalyst surface and its deactivation. High stability and activity of the catalyst can be achieved by increasing the resistance to coking. Catalysts based on noble metals such as Pt, Pd, Rh, Ru have a higher potential for resistance to coke formation and higher activity for syngas production but are not preferred due to limited availability and high cost [3].

An alternative for DRM catalysts are transition metals, such as nickel (Ni) which are close in activity to noble metals, less expensive, and are more accessible for large-scale implementation. Ni-catalysts have disadvantages due to rapid deactivation, sintering and significant formation of carbon deposits. However, the disadvantages of Ni can be minimized by supporting it on oxides with high oxygen mobility, which improve the activity and stability of the catalyst under redox conditions.



Ni based catalyst comparison by alteration of methods

Ni was subsequently added via insipient wetness impregnation and by one-pot method; and calcined at 700 °C. The catalytic reaction was performed in the fixed-bed reactor at temperature range 750 – 600 °C and several effects were been studied on $Ni/Ce_{0.75}Pr_{0.1}Zr_{0.15}O_2$ such as re-oxidation effect, Ni-addition, contact time, calcination temperature and stability. The catalysts were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), and by reaction kinetics measurements of effective activation energy (Ea) and order of reaction.

It's concluded that deposition of Ni affect the activity of catalyst impregnated sample showed highest activity than one-pot but deactivated due to carbon formation confirmed from TEM analysis. The XRD pattern showed dual cubic-fluorite phase embedded by nickel oxide; no such reoxidation effect found for one-pot sample; while increased calcination temperature showed lowered catalytic activity. Variation of contact time showed different catalytic activity and is directly proportional to rate of reaction the highest conversion of CH_4 =70.3%; CO_2= 70% occur at 11.5 ms; T 750 °C. The kinetic parameters (Ea 60±6 kJ/mol and methane order) showed that Ni- supported on modified ceria-zirconia catalyst is suitable for DRM syngas (H_2/CO) production.

The purpose of this research project was the development of a highly efficient, low-cost Ni catalyst supported on modified ceria-zirconia for dry reforming of methane.

Dry reforming of methane was studied over Ni-supported on $Ce_{0.75}Pr_{0.1}Zr_{0.15}O_2$. The support Ceria–praseodymium-zirconia oxide was prepared by supercritical method and 5 wt%

Keywords: Catalysis, Ni-based catalyst, greenhouse

gases, dry reforming of methane, syngas production,

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Scientific supervisor - Ph.D. chem. Sciences, M. N. Simonov

3.6 Seismic data interpretation and petrophysical analysis of Gujar-Khan area, Upper Indus basin, Pakistan

Hammad Ahmed, Muhammad Talha Jahan
Quaid I Azam University, Islamabad, Pakistan
e-mail: 04111813008@student.qau.edu.pk

Research problem. Pakistan is a country which is endowed with a multitude of natural resources. Pakistan's Economy is growing at a rate of 2.7% which consequently entails higher energy consumption. The current figure of Pakistan's energy resources stands at: oil (0.31 billion barrels), gas (30 TCF), coal (185 billion tons) and shale gas reserves (51 TCF). [1] Pakistan needs to discover new reserves to lower its dependence on other countries for it's fuel consumption. The purpose of the study is to locate a reservoir that has the potential to produce hydrocarbons in economical value.

Our research questions.

- Interpretation of the subsurface geology to identify hydrocarbon traps i.e. folds, faults etc.
- Identifying the Source rock, Reservoir rock and Seal/Cap rock?
- Identifying the formation which bear the largest hydrocarbon potential?
- Calculation of the volume of shale (Vsh)
- Calculation of the volume of clean (Vclean)
- Calculation of density porosity (DPHI)
- Calculation of neutron porosity (NPHI)
- Calculation of average porosity (APHI)
- Calculation of effective porosity (EPHI) and sonic porosity (SPHI)
- Calculation of the resistivity of water (Rw)
- Calculation of water saturation (Sw)
- Calculation of hydrocarbon saturation (Sh)

Methodology or methods. The main task of seismic interpretation is to characterize underground geological structures and lithology with high precision.[2] We needed seismic and well logs data for the study. The seismic data was interpretated by using Kingdom Software version 8.6. Seismic data is needed to identify the formation of our interest. It provided information about the lateral extension of the formation and location of the well. It was also used to map the subsurface geology that includes marking the horizons, folds, faults and anticlines etc. that can act as potential traps.[3] The well

log data was analyzed by the help of GVERSE GeoGraphix. Different logs were loaded in the software such as caliper log, resistivity log, sonic log and GR log etc. By the help of those logs the zones of interest were marked.

In order to make depth contour maps, the values of tow way travel time generated during TWT contour have been converted into depth by using the following formula.[4]

$$S = \frac{V * T}{2}$$

For time to depth conversion the average dix velocity has been used from velocity header.

Conclusions. Following conclusion were drawn.

· The study area lies in extreme compressional regime, as the seismic interpretation has shown repetition of strata and multiple pop-up structure with steep dip on all dip lines.

· Time and depth contour maps have also confirmed the anticlinal structure bounded fore-thrust and back-thrust.

· Zone of Chorgali Formation has shown the average value of hydrocarbon saturation 63.66 % with low shale content and good effective porosity. So, this zone can be target for hydrocarbon exploration

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3.7 Development of the technology of gas separation from groundwater in the wellbore

I.P. Kaminskii, B.A. Ovezov
Scientific Adviser – K.O. Scsherbakova
[1]Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: jankaminski1802@gmail.com

This paper presents a method of separating gas from groundwater directly in the borehole. This method will help us to solve such problems as: reducing the debit of a gas well, high energy consumption for lifting gas together with water to the surface, the use of chemical reagents, and as a consequence, pollution of formations. Possibility of its installation in the vertical position and diameter equal to that of a well will allow us to cope with gas separation from water more effectively than its ground analog of gas separator GS-1.

Russia is the world leader in natural gas reserves and ranks second in its production (annually it is about 660-670 bcm). The problem we are facing at the fields, that we have been operating for a long time at the wells, is the decrease in the volume of production [1].

Flow rate reduction can be caused not only by decrease of gas reserves in strata but also by water encroachment of wells, accompanied by water inflow up to squeezing of wells [4].

There are several reasons, and the main ones are: poor cementing of production strings, destruction of cement, well obsolescence, rise of gas-water contact.

Taking into account the fact, that there are active mining operations from them, we are going to consider the already existing methods of solving this problem and analyze their disadvantages.

1. There is a need to periodically blow holes into the atmosphere and perform overhauls (that leads to an increase in operating and capital costs);

2. Application of high-strength insulating fluids, as well as less strong fluids on a gel basis (which is harmful for ecology) [3];

3. Surface gas separator GS-1 (PJSC "Gazprom") is widely used in natural gas fields [2].

To begin with, it is worth understanding the principle of GS-1 operation: it is designed for deep purification of extracted or transported natural, associated or commercial gas from oil, gas condensate, oil, fine, aerosol moisture and mechanical impurities. GS is designed for a very high concentration of gas flow and minor liquid flow, which is in a droplet fine state. It is a vertical cylindrical vessel, the volume of which is selected depending on the amount of gas flowing through it. It is made of carbon and low-alloy steel. It consists of a body and fittings for inlet and outlet of products. Below there is an outlet for water, which takes out already separated water from gas. GS-1 is designed for conditional pressure from 1.6 to 6.4 MPa.

At present, this technology can help to save energy, flow rate, time, ecology, effort and money in gas production. This technology could become an excellent example of intensive extraction of natural gas, we would be able to rationally use energy and money during extraction and not to drill new wells unnecessarily, because every gas well costs hundreds of millions of rubles.

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3.8 Investigation of the environment by gas analyzers when drilling wells

A.D. Kosenkov, K.O. Sherbakova
Scientific adviser – B.A. Ovezov
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: alexandre.kosenkov@gmail.com

The organizational and technical issues of analyzing the gas-air environment when drilling wells activity are highlighted:

1. The gas-air mixture is transported to the GTI station via the GVL. The time from the selection to the start of the analysis is several minutes.

2. The equipment of the GTI station requires periodic prevention and maintenance. The equipment of the GTI station requires periodic prevention and maintenance.

The solution is the use of optical infrared gas analyzers. The infrared gas analyzers have a number of advantages.

Insensitivity to polymerizing and corrosive substances and catalysis poisoners is one of the most important advantages. Also, the ability to detect gases in the oxygen-free atmosphere and in the atmosphere with a low oxygen content and insensitivity to hydrogen and carbon disulfide makes this device more versatile in use [4].

And increased fault tolerance, insensitivity to the gas flow rate and long-term stability of the readings allows measurements to be carried out, where it was previously difficult [5].

Also, the gas analyzer is a small device, the weight of which is only a few kilograms [2]. MPC sensors (gas analyzers) of harmful substances should be installed at sites and facilities where there are sources of possible release of gases and vapors [1]. The measuring head should be installed in an appropriate location that provides maximum protection. Free air circulation should be provided around the gas measuring head.

The big problem of the infrared gas analyzer is that it does not have the ability to detect gases that do not absorb IR radiation. These are, for example, hydrogen, oxygen, nitrogen, chlorine and monatomic gases. It is required pay attention to the principle of operation of the thermocatalytic gas analyzer. By introducing this system into an optical detector, we get a universal gas analyzer capable of detecting various gases with the same efficiency.

Also, a significant disadvantage of the optical gas analyzer is the temperature regime, which is narrower compared to sensors of a different principle of operation [3]. The results of this study can be applied in practice in the near future, starting to provide continuous monitoring of objects.

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3.9 Prevention of intersections of boreholes by induction logging

V.V. Kostin, K.O. Sherbakova
Scientific Adviser – B.A. Ovezov
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: kostin.spe@gmail.com

Introduction. To date, the intersection of boreholes is becoming particularly relevant. This is evidenced by a large number of liquidated wells, which collisions are possible when drilling new ones [3]. This leads to a man-made accident, the consequences of which negatively affect the environmental situation of the adjacent territory [1].

The content of the development. When developing a new well, it is necessary to take into account the possibility of its intersection with the existing ones. An automated system is proposed to predict and prevent the meeting of wells. The invention relates to the cluster development of oil and gas fields using directional drilling and software. It consists in controlling the distance when drilling a well relative to the columns already drilled earlier [5]. In the deep part of the system there is an electromagnetic oscillator, made in the form of a dipole installed above the bit, providing electromagnetic communication between the sections of circuits formed by the columns of previously drilled and new wells, a signal converter amplifier and an antenna that continuously transmits a signal to the surface, to a computer. The data obtained are processed in a special program and presented in the form of graphs, according to which it is already possible to draw conclusions about the further direction of the well drilling [2].

In the process of drilling a well, an induction coil creates a primary electromagnetic field induced into the rock. As a result, eddy currents arise in the rock, which create a secondary electromagnetic field. The secondary field arising in this process depends on the conductivity of the rock and is fixed by the receiving coil. The conductivity is measured in units of conductivity Sm/m (Siemens per meter) or converted into resistance. By monitoring the change in the values of the specified electrical resistance constantly during drilling, it becomes possible to obtain information about the distance between the bit, when drilling a well, and the column of a previously drilled well [4].

Based on the information received, the value of the controlled distance is compared in real time with the a priori set maximum distance value and, when it is reached, the drilling pump is switched off and/or operational notification is made by sound and light signaling [6].

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3.10 Prevention of accidents caused by stuck pipes during drilling

D. A. Kuznetsova, K.O. Sherbakova
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: dariyakuz@bk.ru

The method of seizure elimination depends on the type of seizure. Methods for preventing and eliminating a stuck pipe are largely determined by the causes of the problem, so it is important to understand the signs and possible causes of the problem in order to take the necessary preventive measures and choose the right way to eliminate the stuck pipe [2].

Many researchers associate the occurrence of stuck pipe with a pressure drop caused by the difference between the hydrostatic pressure of the drilling fluid column and formation pressure in the intervals of permeable rocks [1].

The degree of filtration crust deformation, according to the experimental data, naturally changes depending on load and time. The greatest deformation of the crust occurs during the first 15-20 minutes of a contact with the pipe. Later, the intensity of deformation decreases, and the maximum indentation is achieved after 60 minutes of the contact. Increasing ΔP to 5 MPa and more does not significantly strengthen the crust structure. Consequently, in this region of pressure differentials, close to the limit crust compaction is achieved [3].

For quick liquidation of a stuck borehole and prevention of complications during sinking of stuck intervals, it is recommended to include a special yass in the BHA. The jars are designed for releasing a stuck downhole tool. To get maximum efficiency, the jar should be placed as close as possible to the place of expected sticking, but not less than two drill tubes (weighted drill pipes) above the top stabilizer [4].

All of this speaks to the prospect of implementing automatic decision making to activate the yass. During drilling, there are signs that can be linked to the causes of complications. These signs occur before a seizure occurs and can be used to make a decision before an emergency occurs.

FMEA (Failure Mode and Effects Analysis) is a procedure to analyze all possible system errors and determine results or effects on the system to classify all errors relative to their criticality to system operation.

During drilling, there are signs that can be associated with causes and effects of certain problems and complications, these signals occur before the problem itself and can be corrected before a dangerous situation appears. In order to associate these signals with the most probable type of the problem, we will use FMEA method; and, similarly, in order to predict complications on the basis of identified signals, we will apply ARIMA method [5].

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3.11 Research methods for karst sinkholes

V.A. Petina, B.A. Ovezov
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: vicka.petina@gmail.com

Today, there is a huge problem of karst collapses, because they cause significant damage of economic, ecological and social nature. Anyone has ever been acknowledged of landslides all over the world, and, of course, the karst processes are active in Russia [1].

Of all geological processes, karst ones (Fig.1) cannot be predicted, but to prevent destructive trouble is quite real. For example, to fill the detected cavity to 90% of its volume will help to reduce the rate of its growth and increase the safe time [2].

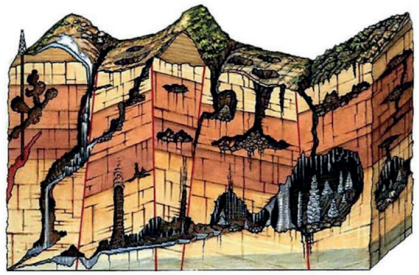

Figure 1. Karst forms

But human activity also plays an important role in the formation of karst sinkholes. First of all, it is due to various emissions into the atmosphere, forming acid rains; treatment of road pavement with caustic substances, as well as underground mining works. For example, these are the mines for extraction of rock salt, because excavations of rocks impoverish the soil. The voids that have been created by human action, eventually collapse.

This method [4] helps to study the section from the first tens of meters to 300-400 meters and more in detail. The method is used to solve geostructural problems, forecasting of mining and geological conditions, determination of decompaction zones, 4-D electromagnetic monitoring of reservoirs [5].

Not only carbonate rocks play a huge role in the development of karst, but also climatic conditions: precipitation by seasons of the year and the temperature regime; hydrological conditions; presence of vegetation; flat surface [3].

The method of sounding by the formation of the field in the near zone solves a number of problems, such as: the forecast of mining and geological conditions, identification of faults and assessment of the tectonic situation of the site. Based on the analysis of the data, the forecast of the presence of anomalous zones (which may develop karst process), as well as the definition of fault zones and identification of decompaction zones have been proposed. It also has a number of advantages: great depth (from the first tens of meters to 300-400 meters and more), high details of the resulting section, the exact location of the "point of recording", high productivity of work, good noise immunity.

Karst has been forming for several hundred million years, and when a cavity is

formed under the ground, it is considered safe for about 5 years with certain parameters of height and thickness, so the collapse of the upper layer of the earth cannot occur immediately. During this period of time, if the cavity is detected immediately, it can be prevented. For example, backfilling the detected cavity by 90% of the volume reduces its growth rate and increases the safe time.

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3.12 Application of LWD quad-combo with crossed-dipole sonic tool for improved geosteering and formation evaluation in the low-porosity oil fractured reservoir of the Riphean deposits of the Yourubcheno-Tohomskoe field

D.V. Pisarev
[1]National University of Oil and Gas «Gubkin University»
e-mail: dimapisarev2019@mail.ru

At present, the discovery of giant carbonate deposits is not possible. In this regard, much attention is paid to hard-to-recover reservoirs. To achieve the highest oil recovery factors, it is necessary to ensure excellent well trajectory in the reservoir. For this, the most modern LWD devices along with Rotary steerable systems are used, which helps to solve this problem and ensure the minimum error in the geosteering of the well.

In recent years, MWD/LWD reservoir evaluation applications have evolved to the point that many applications normally reserved for wireline logging can now be displaced from LWD data. The last area is applications resulting from LWD sonic measurements. In drilling environments, the acoustic tool has applications that go beyond standard porosity type assessments. Acoustic MWD/LWD logs can also provide real-time seismic data tie-in and help optimize drilling. Traditionally, there are two key aspects that can minimize or eliminate the use of audio technology in an MWD/LWD environment. First, it was assumed that drilling

noise exists in the range of measurement frequencies, and its minimization was considered impractical. Secondly, tool body mode interference (acoustic waves associated with receivers resulting from tool body waves) is considered to be dominant to the extent that significant manual post-processing is required to generate reasonable logs.

This paper presents an experience of using LWD quad combo (Dual gamma ray tool "DGR", Crossed-dipole sonic tool "XBAT", Azimuthal litho density tool "ALD", Compensated thermal neutron tool "CTN" and Electromagnetic wave resistivity tool "EWR"). Electromagnetic MWD system was used to provide fast data transfer speed and reliability.

This work includes formation evaluation of the reservoir according to the concept of the petrophysical model of the field. The main composition of the rocks of the Riphean deposits includes three mineral components: dolomite, quartz and clay. Identification of reservoirs in the studied deposits was carried out according to the results comprehensive interpretation of all geological, geophysical and petrophysical materials in terms of quality and quantitative traits. As the main criterion for determining the effective thicknesses in the section, the boundary value of the clay volume of 10% was used. Crossed-dipole sonic tool gave us the opportunity to calculate more accurate petrophysical model and find the most accurate values of each of the components. With the help of this tool, Shear wave and Compressional wave slowness were received, as well as diagram of coherence. These data were used to determine the secondary porosity rate. DGR allowed to calculate shale volume of the reservoir (Vsh). The determination of the coefficient of total porosity (φ) is carried out according to the system equations that allow taking into account the influence of the multicomponent composition of rocks collectors for the main types of well logging (CTN, ALD, Pe-factor, Sonic tool).

The following data were calculated:

H, effective thickness, m	φ, Porosity ratio, %	Vcl, Clay volume, %
205.0	2.53	3.75

For the success of the drilling, the geosteering of this well was provided. Drilling through the target interval was 90.45 percent. Specialists reached such good results due to applying the best technologies and software.

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3.13 Method of acid impact on bottomhole formation zone

A.D. Rumyantsev, B.A. Ovezov
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: alexeirumyantsew@gmail.com

During drilling in the productive reservoir, due to the disturbance of the stressed state of rocks in the near-wellbore zone, penetration of drilling mud and cement filtrate into the formation and their interaction with the formation gas-liquid mixture and rock, there are complex physical and chemical processes. The filtrate, penetrating into the productive formation, sharply reduces the permeability of the latter for oil and gas. In the presence of cracks in the rocks, the solid phase of drilling fluids may also penetrate into the formation. In hydraulic fracturing, a significant amount of drilling fluid enters the reservoir, blocking fluid movement to the well.

All known drilling fluids in one way or another negatively affect the BHZ due to leachate penetration into the formation; partial penetration of solid phase into pores of the formation; blocking of pore space by emulsion solutions; adsorption forces that hold water in pores, etc. [1].

Acid treatments of wells, including hydrochloric and clay-

acid treatments increase the permeability of the bottomhole zone, restoring its reservoir properties by dissolving salts and ARPD, carbonate and silicate components of the reservoir rock and expanding filtration channels. Acid well treatments are used both in carbonate and terrigenous reservoirs [3].

As a result, the bottomhole zone is cleaned and the hydraulic connection of the well with the remote part of the reservoir is improved. The highest efficiency can be achieved by hot well flushing, heating the solvents before injection or feeding the solvents together with steam [2].

The mechanism of surfactant action when displacing oil with water is to reduce capillary resistance to the movement of oil-water mixture and transformation of bound (with the rock) oil into free. When using surfactant solutions in the bottomhole formation zone, their washing and hydrophobic properties become apparent [4].

Based on all of the above, the decision to use the method of acid processing of the bottomhole formation zone is the most cost-effective and efficient.

In the acid, iron sulfides, iron oxide is almost insoluble, so the acetic acid can be found somewhere in 10% of aqueous solution.

When developing the acid treatment design, it is necessary to reasonably calculate reagent injection rate, acid composition volume, volume of self-collapsible acid system (SCS), number of cycles of working fluids injection to predict well productivity after treatment and estimate expected profit due to acid treatment. This prediction is possible on the basis of mathematical modeling of the acid dissolution of heterogeneous carbonate reservoirs using the SCS [5].

The problem of deteriorating the permeability of the bottomhole formation zone significantly worsens the development of oil fields. The described method of acid treatment with viscoelastic self-draining acid allows restoring the original permeability of the reservoir.

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3.14 Development of a system for monitoring personnel actions with radioactive radiation sources during calibration of geophysical equipment

A.R. Sadykova, B.A. Ovezov
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: alinka.99.sadykova@mail.ru

About 8000 wells were drilled on the territory of Russia in 2021 based on the analysis of Deloitte data, 75% of which carry out a GIS complex with radioactive sources [5]. Despite a serious approach to ensuring the safety of calibration of equipment, emergency situations still often occur, as a result of which the enormous damage is caused to employees and the environment.

According to the statistics, on average, service companies pay compensations for accidents in the amount of more than a billion rubles a year.

The basic calibration is carried out to assess the quality of the equipment (the suitability of its use as a measuring instrument) and to carry out a quantitative interpretation of the logging results [1, 2].

The use of these methods of monitoring the work of personnel with radioactive sources endanger employees due to time-consuming processing, notification and training processes [3].

Also, in addition to safety, there is a number of unaffected problems: a huge number of documents, inspections, reports, numerous staff, archive maintenance and time spent on preparation, search and analysis of necessary documents; the use of imported systems processing radiation dose level data [4].

Machine learning-based software allows automation of the monitoring, notification and organization process. The video surveillance system with the entered parameters of work records, conducts statistics of violations during actions with radiation sources, for further data transmission to public services, which in due time increases the safety of personnel, resulted from timely and necessary training of specialists for admission.

A unified database of specialists who have an access to work with sources of radioactive radiation, will reduce the time of document checks, improve the quality of compliance with safety standards. These employees will also monitor the radiation doses received by employees.

The database of specialists composing accounting documents before inspections of controlling organizations will reduce the time required to fill in the necessary documents and acts. Also, qualified specialists will be able to direct personnel to the training required individually for everyone, which in general will allow companies to reduce the risk of emergencies.

Thus, the implementation of the project will allow public authorities to reduce the risks of emergency situations and increase the speed of response to emergency situations, promptly notify administrative offices for decision-making. A single reliable database of employees and a module for monitoring the state of the radiation source with software will give full control over the ongoing research.

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3.15 Ways to prevent emergencies using the neutron logging geophysical instrument

S.S. Saidov, B.A. Ovezov
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: saidgoh03@gmail.com

Today, the leading oil and gas companies around the world are actively using logging while drilling technologies for both exploration of new and optimal development of already producing fields.

With technological development in recent decades, LWD (Logging While Drilling) is now widely used for drilling and reservoir evaluation [7].

Modifications of radioactive logging are used with pulsed neutron sources (pulsed neutron-neutron logging, pulsed neutron gamma logging) and gamma radiation (pulsed gamma-gamma logging) [5].

The occurrence of any type of complications or accidents depends on many reasons, mainly on the compliance of the drilling technology with geological conditions, as well as on the serviceability of drilling equipment [6]. A stuck drill string is an unforeseen loss of mobility of a pipe string.

Neutron-neutron logging is based on irradiating a well and rocks with neutrons from a stationary ampoule source and measuring the density of thermal neutron fluxes [3].

NeoTron is designed specifically to work with pulsed neutron logging equipment, its design provides for the extraction of a source of gamma radiation in the event of an emergency.

There are three processes of interest in neutron logging: neutron emission, neutron scattering and neutron absorption (Fig. 1).

The goal of NeoTron development is the constant control over the process of neutron emission. The alpha particle emitted from americium enters beryllium, and it turns into radioactive carbon, which gets rid of the excess neutron [1, 2].

$Am^{241} \Rightarrow Np^{237} + He^{4}$

$He^{4} + Be^{9} \Rightarrow C^{12} + n$

Fusion reaction of carbon and neutrons

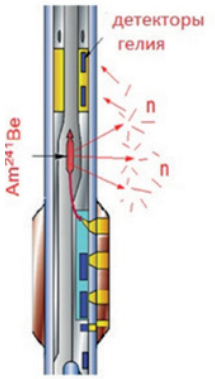

Fig. 1. Chemical reaction in reservoir testing

Thus, for every million alpha particles emitted from americium, only 30 neutrons are obtained.

NeoTron will produce 10 times more neutrons with three times the energy of the chemical source.

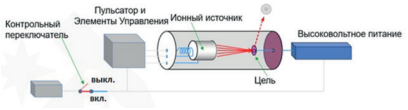

Fig. 2. Schematic representation of the NeoTron complex

This device allows minimizing the negative impact on the environment. The main advantages of NeoTron are radiation safety, high quality of the material, the absence of a chemical source of neutrons, the presence of a pulsed neutron generator and a removable gamma-ray source.

The current development will make it possible to avoid dangerous situations when using a nuclear reaction source, and when it is lost in a well [4].

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3.16 Petrophysical properties of the source rock, western South Caspian Basin (Azerbaijan)

Seymur Mirzaliyev[1], Fidan Aslanzade[2], Elshan Abdullayev[1]
[1]Department of Petroleum Engineering, Khazar University. Baku, Azerbaijan
[2]Department of Earth Sciences, French-Azerbaijani University. Baku, Azerbaijan
seymur.mirzaliyev@khazar.org

The South Caspian Basin (SCB) is one of the oldest oil and gas provenances in the world. It is bordered in the southeast by Turkmenistan, in the south by Iran, and in the southwest by Azerbaijan.

The stratigraphic interval present in the SCB are Mesozoic and Paleogene-Neogene rocks. The main oil reserves are located in the Middle Pliocene (>70%), the remaining part in the Miocene-Paleogene (~15%) and the Upper Cretaceous (~10%). The Oligocene-Miocene has the local name - Maykop Series (Azerbaijan), which is the source rock of the deep basin origin. The South Caspian deep sea basins' western continental slope contains about 300,000 tons of crude oil equivalent/km2 of hydrocarbons. The intensity of hydrocarbons in the deep parts of the basin is 100 thousand tons of oil equivalent/km2

The Miocene Maykop Series consists of a dark-grey and chocolate-coloured laminated claystone with abundant fish tracks and remains of petrified tree trunks. In general, a uniform clay composition of rocks with very rare sandy interlayers is characteristic of Maykop formations. In contrast to the older strata, almost all rocks contain more pyrite than iron oxides, indicating reduction

conditions during the Maykop period. The thickness is highly variable, ranging from 500 to 2000 m.

The purpose of our research is to study the Miocene petrophysical properties, the case-study of the Gobustan oil and gas bearing region and Islamdağ section, Azerbaijan. The project is performed in the Techlog (Schlumberger) program.

As an input data we took core samples petrophysical properties of porosity, permeability, carbonate content and calibrated with existing wireline log data of Spontaneous Potential (SP) log. The rock samples are carbonated sandstones or mudstones. The reservoir at the mentioned field is shallow. The depth of Maykop varies from 20 to 550 m depth. The porosity is changing from 9,5 to 27,7 %. The permeability from 3 to 261*$10^{-15}$$m^2$.

The study of the rock properties and existing lithofacies units helped to define the best production interval for further hydrocarbon exploration from the source rocks in western SCB, Azerbaijan.

3.17 A DATABASE FOR THE NADYM OBSERVATION POST FOR A 50-YEAR PERIOD

A. Shcherbakova[1]
[1]Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: anutkusik@yandex.ru

This report is devoted to the analysis of data collected in the permafrost zone near the gas pipeline section near the city of Nadym. The problem has occurred due to the global warming; the permafrost changes its temperature, as a result of which the properties of soils have changed. The most noticeable changes are observed in the active layer. Because of this, accidents occur on gas pipelines and the number of technical works increases.

The trend of increasing air temperature in the 1970s was 0.03° C per year, and today it is 0.1° C per year. The duration of the thawing period has increased by almost half a month. The amount of precipitation in the late 1970s reached 425 mm, now it is about 550 mm. In the 21st century, the growth of areas with non-permafrost was noticed. Such areas have not got enough attention before [Streletskiy, 2019, 3]. It is necessary to take into account the progress over a 50-year period. The main problem when compiling a database is the heterogeneity of the timing and methods of obtaining data. The first data were measured only in summer and autumn. The temperature in 1970-1991 was measured once a year with a shaded thermometer; its measurement accuracy is 0.1 ° C, so it was possible to estimate only the temperature on the soil of the annual fluctuations layer. The modern data is measured with a logger with an accuracy of 0.01 ° C. In addition, loggers measure temperatures all year round and it is necessary to make a sample for analysis.

The purpose of the work is to provide an algorithm for compiling a database for modern analysis of archival data.

We analyzed the data of geocryological monitoring and came to the conclusion that it is impossible to compare them in the available form. The archived data was transferred to an electronic form. We have compiled tables for the geocryological survey site for the period of 1970-2019. It is important to create a database for all materials [1].

To do this, we suggested using the following method of compiling a database (DB):

The proposed solution consists of three steps.

Step 1. Choose an analysis algorithm that structures the data.

Step 2. Create databases for each observation site of geocryological monitoring.

Step 3. Create evaluation maps for predictive analysis. The evaluation map shows which zones are more dangerous for construction and which are less.

Using the example of a local place on the map that contain archival materials, it is possible to structure similar data archives in the future.

This method allows structuring the source data and create a vector database. The structured geodata require further work in GIS for further analysis of changes in the properties of rocks. [Shcherbakova, 2021, 2]. The landscape map will be taken as a basis, and wells will be plotted on it.

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3.18 The use of hydraulic reamers when drilling in the presence of unstable clay intervals

M.A. Tsygankov, K.O. Sherbakova
Sergo Ordzhonikidze Russian State University for Geological Prospecting, Moscow, Russian Federation
e-mail: maxconstructor@yandex.ru

Drilling sticking in unstable clays remains a hot topic these days, because more and more attention is being paid to producing hard-to-reach deposits, which requires new technologies that will help to improve the efficiency and, therefore, the economics of most projects, and sticking can hit the time and money limits significantly.

The solution to the problem. As the well is drilling through unstable sections, the reamer will be activated by controlling the flow of flushing fluid, and once the desired interval has been overcome, the reamer is deactivated. As the activator depends on flushing fluid flow, it will be possible to control this device even below the telemetry system [3].

A special device of the activation mechanism operates on the differential pressure of the flushing fluid acting on the module, bringing it to a certain position depending on the value of the flow rate, which corresponds to three zones:

1. Low flow rate zone: it does not affect the movement of the cutting units - in this flow rate range the subsequent zeroing of the flow rate is not able to affect the activation mechanism [5].

2. Indexing zone: it affects the change in the cycle of the activation mechanism and, consequently, the extension of the cutting units - in this flow range with subsequent zeroing of the flow rate, the cycle of the activation module is changed, which allows to adjust the position of the expander units. Increasing the flow rate above the indexing zone does not affect the activation/deactivation of a block movement [2].

3. Working zone: raising the flow rate to the working zone after the intentional indexing will cause the blocks to extend to the working position. At the same time to forcibly close the blocks it is necessary to first lower the flow rate into the indexing zone, and then raise again into the working zone - only after that the cutting blocks will close when the flow rate is zeroed [1, 4].

This technology will be in demand for drilling in complicated unstable clay geological conditions. Nevertheless, there is no limit to improvement of technologies and methods of development and production of hydrocarbons.

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3.19 Research on the Development of Petroleum Engineering Technology Public Service

Nafiur Parvez
Power China Hebei Electrical Engineering Company Limited, Barguna, Bangladesh
email: nafiurparvez@gmail.com

The paper analyses the business process of the oilfield engineering technology public service market information management system through UML modelling. Then, according to the work requirements of the engineering and technical management department staff of the oilfield branch, the performance requirements and functional requirements analysis were carried out. In particular, a detailed analysis of the functional requirements of each sub-function is performed. The experiment verifies that the information system can collect, integrate and analyse the business data reported by each unit in real time and conveniently. It can quickly and accurately form decision-making opinions and management methods, which greatly avoids the process error in the establishment of production capacity. The establishment of the engineering technology public service market information system provides greater power and service.

The characteristics of the petroleum engineering service system are very obvious. From the professional point of view, the main business is geophysical exploration, drilling, logging and ground engineering, which is for the exploration, development, processing, transportation and other production and construction of oil and gas; from the main body of technological innovation On the top, there are research institutes and petroleum colleges with research and development of new technologies as the mainstay, and regional service companies with application and development of new technologies as the mainstay . So how can we make CNPC's engineering and technical capabilities improve rapidly, and can easily face the challenges of entering the WTO and be in an invincible position? We believe that the key lies in the research and development departments and regional service companies to grasp the key points and timely The land is closely coordinated to transform the advanced and practical new technological achievements into productivity, transform into scale benefits, and improve our technical level, service capability and economic strength. For this paper, petroleum engineering technology public service market system is established,

and it is expected to provide some experience for the establishment of engineering technology public service market information system.

(1) Security: Security is the most basic requirement that the system should meet when the system is completed. Due to the open nature of computers, there are many factors that can cause security threats to information management systems, including subjective and objective reasons. If a system ignores the security management content, it will cause the weakness of the computer information management system. A safe system not only guarantees the security of information, but also keeps all information records safely, while ensuring the smooth operation of the system and preventing information leakage and tampering. The main protection measures in terms of security include security configuration of the system, data locking, firewall setting, etc.

(2) Simple and easy to use: The realization of information management is to simplify the management of the staff, realize the paperless office, and facilitate the use of the user is an important principle of the information management system. Therefore, the system interaction interface logic is clear and convenient to use. The understanding of the person. System configuration, installation, use, and post-maintenance should also be simple, with a good deployment interface, and easy to transplant the system.

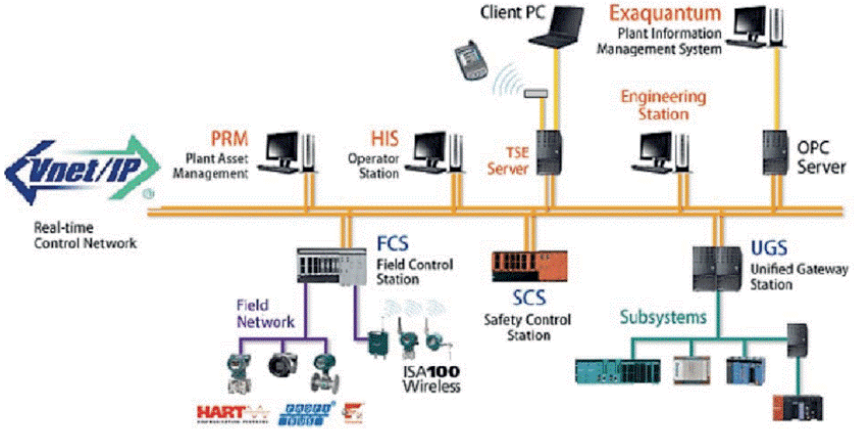
(3) Stability: When a large number of users access the server at the same time, the amount of data exchanged between the server and the client is huge, and the server will often block and cause collapse, which brings trouble and inconvenience in later maintenance. With the deepening of the application, the expansion of the scale, and the passage of time, the system operation efficiency is low and the stability is degraded. When such problems occur, the normal operation of the system can be restored in time to protect data security and reduce the impact on normal work.

(4) Scalability: The scalability of a system is multi-faceted. It covers layers, modules, data models, process modeling, and main menus. The potential value of a system lies in its scalability. For the network-based management information system operation platform, its scalability mainly lies in the expansion of functions, such as increasing the corresponding functional requirements as the company's business expands, which requires the system to design good functional components, including the expansion of the access computer scale. Business Data Function Module:

According to the long-term analysis of the business process of the oilfield branch, team qualification management, program design management, well control management, supervision and management, settlement management and system management. Each module includes several functions. The platform divides the system into 8 modules for project quality management, data and archive management. These modules basically cover the main business areas of engineering management. The system provides a relatively complete interface for easy integration with other application systems. Each related data entry interface has complete data verification function, which can be set by the user according to his own business rules.

The system will be designed based on the J2EE multi-layer architecture, using the Struts2 framework to implement the MVC mechanism. At the same time, combined with many excellent component technologies in the J2EE architecture, such as: Hibernate framework for packaging database connection operations and reverse control Spring framework, making the whole system development easier and more convenient.

The foreground presentation layer is implemented by combining JSP and HTML. The control layer uses the Struts2 framework action package to perform request jump control and page data acquisition and implements the business logic control of the system with the help of the core controller Filter. Finally, the database access layer uses the Hibernate framework technology, spring framework technology and model package (entity class) and service package (DAO class and DAO ImpI interface) for database persistence layer operations. Developing a project with MVC pattern architecture will



have to take considerable time to consider how to apply the MVC pattern to the application, and because the model and view are strictly separated, this also brings some difficulties to debugging the application. Every component needs to be thoroughly tested before it can be used. The components used in the architecture and implementation of the system are shown in Figure 1.

Based on the current situation of engineering technology management, this paper summarizes the reasons that hinder the macroscopic and real-time nature of engineering technology management. With computer network technology, digital and network management of engineering technology management business has been carried out, which has improved the dynamics of various management tasks. Real-time, use timely feedback, collect business data, quickly generate various analysis charts, intuitively reflect the progress of various businesses and safe production, and use business process reengineering to reorganize the overall business work of the engineering and technical department. Linking and integrating engineering technology management work into a whole, each business is verified and mutually based, and

the real situation of management content is restored from each index to the maximum extent. The research results solve the problem that the oilfield management department is away from the production site. The understanding of on-site difficulties and management lags, and through the workflow technology, cross-local, cross-department business declaration and approval work through the network, solving the traditional business declaration and approval work for a long time, high additional cost Problem that favours the B/S and J2EE frameworks, making The business personnel can carry out the engineering technology management business with a variety of networks and a variety of terminal devices, and get rid of the harsh on-site environment and fail to timely report data difficulties.

3.20 Assessment of the swelling capacity of clay minerals included in the sand-siltstone reservoir rocks of the Northern Berdakh field

A.R. Askhatov[1], A.S. Muminov[2]
[1]LLC «Geo-research and development company», Uzbekistan;
[2]JSC «O'ZLITINEFTGAZ», Uzbekistan.
e-mail: asxatov95@mail.ru

The granulometric composition of the sand and silty rocks of the Northern Berdakh deposit is very diverse. Sandstones are multigrained, with different sorting and rounding of mineral grains. Psammitic sandstone fractions with a particle size of 0,25-0,1 mm are 11,1-56,6 %. The content of the coarse-grained fraction does not exceed 0-12%, and fractions with a size of 0,5-0,25 mm are 9,33-48,5%. The content

of the pelitic fraction (sized less than 0.01 mm) varies from 7 to 45,47 %. The cement in the sandstones is more often clayey and, less frequently, carbonate and mixed. A distinctive feature of the sand and silty rocks of the Jurassic deposits is a very low content of carbonate formations.

An important property of some clay minerals included in terrigenous rocks is their swellability, i.e. the ability to significantly increase their volume when filling the interplanar spaces in their crystalline structures with water. According to V.N. Dakhnov, the swelling of clays leads to a significant deterioration of filtration capacity [1]. However, when interpreting the data is not always taken into account, the swelling of the clay element of polymineral terrigenous sediments, as a consequence, not entirely reliably determine their reservoir properties.

To assess the swelling ability of clay minerals, which are the part of the sand-siltstone reservoir rocks of the Northern Berdakh deposit, we use the method described in [2].

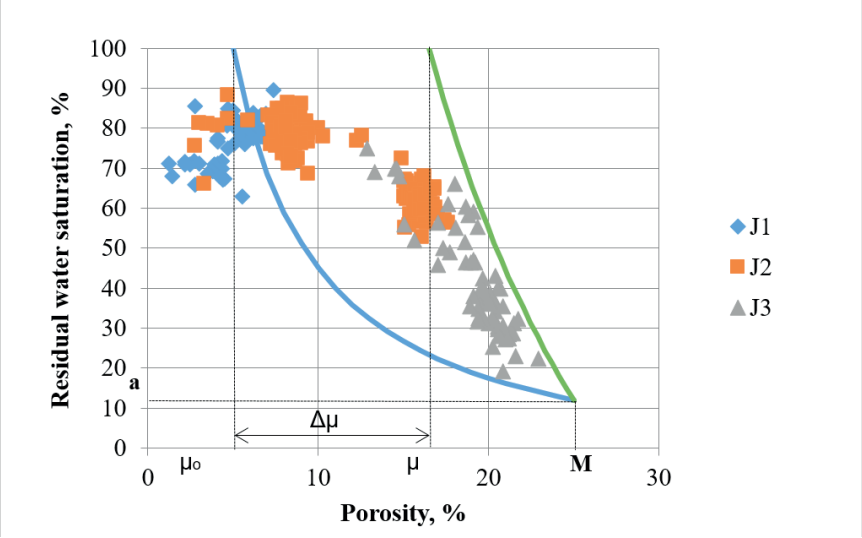


Fig.1. Comparison graph of residual water saturation with open porosity factor for sand and silty rocks

Fig.1 compares the values of the residual water saturation factor with the porosity factor for the studied field. Identifying the line of cement with zero water-holding capacity and the line of cement with maximum water-holding capacity on the graph, we determined the following parameters:

- parameter a=12%, shows us the fraction of the volume of water retained by the matrix;

- parameter Δμ=10%, fraction of irreducible volume of water retained by the matrix;

The swelling factor B is defined as the ratio of the volume of swollen cement to the volume of dry cement [3]:

$$B = \frac{K_{eff.por.max} - K_{eff.por.}}{K_{por.max} - K_{por}}$$

Based on the results of the B factor calculation, the dependence of the swelling factor on porosity (fig. 2) for sandy-silty rocks with different water-holding capacity was plotted.

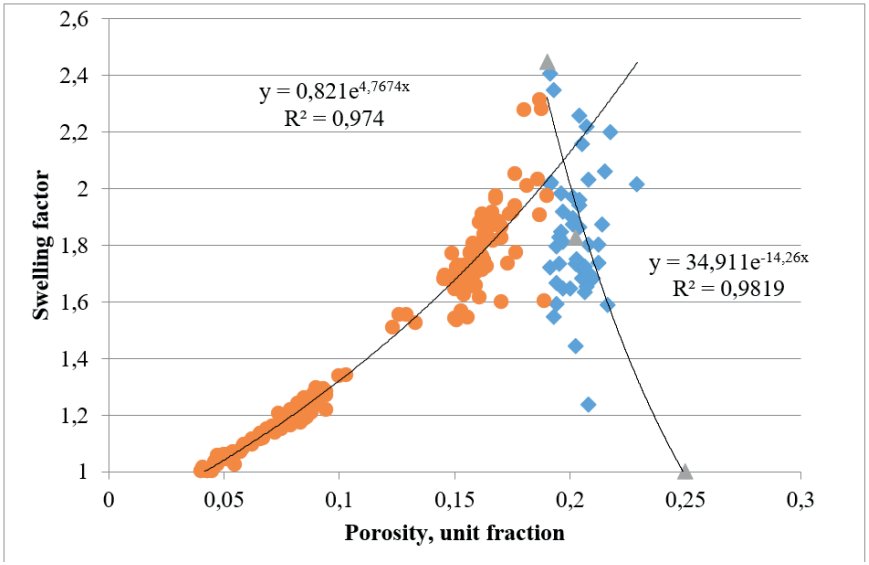


Fig.2. Relation of porosity to the swelling factor of clays for sandy-silty rocks with different water-holding capacity.

● - Rocks with high water retention capacity

◆ - Rocks with low water retention capacity

For rocks with high water retention capacity, the swelling factor varies from 1 to 2,3; and for rocks with low water retention capacity, B varies from 1,2 to 2,46. A close correlation between porosity and the swelling factor has been revealed. In numerical expression the dependences have the form:

- for rocks with high water retention capacity

$$B = 0,821 \times e^{4,7674 \times K_p}$$

- for rocks with low water retention capacity

$$B = 34,911 \times e^{-14,26 \times K_p}$$

The nature of changes in the curves of the clay swelling factor for rocks with different water-holding capacity is not the same. For rocks with high water-holding capacity with increasing porosity, B increases, and for rocks with low water-holding capacity with increasing porosity, the swelling factor decreases.

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3.21 OPTIMIZATION OF A WATERED GAS WELL DESIGN

I. Luryev[1]
[1]International Oil and Gas University named after Yagshygeldi Kakayev, Ashgabat, Turkmenistan
e-mail: ilyaluryev.edu@gmail.com

The conditions for gas deposit formations are associated with the presence of marginal or bottom waters of various activity. As a result of the introduction of water into the gas reservoir, well production is flooded, which leads to the accumulation of fluid in the wellbore and formation of a liquid column. The water column exerts counterpressure on the bottom of the well and causes a significant decrease in yield, up to a complete shutdown of the well. In this regard, the problem of removing fluid from a flooded gas well is relevant today and has great prospects for improvement in the future.

When establishing the technological mode of operation of watered gas wells, it is possible to use a hydraulic lock device [1], which prevents the accumulation of liquid at the bottomhole due to the discontinuity of the near-wall liquid layers.

The device works as follows. The liquid flowing down the walls of the tubing 1 enters the chamber 4, accumulates there until it reaches the level of the hole 9 and is carried out into the gas flow through the tube 3 due to the siphon effect. Then there is the accumulation of a new portion of the liquid. If the energy of the gas flow is not enough to carry out the fluid and it freezes, then there comes a moment when the amount of fluid in the wellbore is more than critical for the existence of the core mode. In this case, the well spontaneously switches to gas-lift supply of the gas-liquid mixture to the surface.

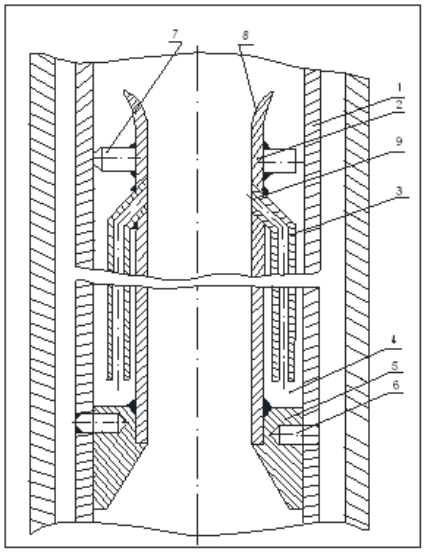

Figure 1. Hydraulic lock device for removing liquid from flooded gas wells

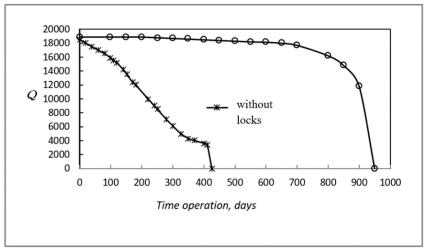

Figure 2. Dynamics of flow rates (m^3 / day)

As the performed work shows, the content of the initial information has the greatest impact on the forecast of watering of gas wells. The field material must be systematized, excluding emergency and uncharacteristic information about the operation of wells. In addition, the more reliable field data on well flow rates, daily and monthly gas production, wellhead, bottomhole and reservoir pressures is, the better it is possible to carry out statistical processing and identify the factors that are crucial in predicting well productivity and watering.

The regularities obtained by us and the adopted model of the movement of gas-liquid mixtures in vertical pipes make it possible to build physically based principles for optimizing the parameters of lift columns and increasing their efficiency.

We studied the operation of wells depending on a different number of hydraulic locks and their location along the wellbore (Fig. 2). The most successful design is with four hydraulic locks evenly spaced along the length of the well, one of which is installed at the bottomhole.

Thus, wells equipped with hydraulic locks operate much longer than ordinary wells, the mechanism of self-damping of wells with hydraulic locks is more extended. The well operation model we propose covers all aspects of their operation under flooding conditions: forecasting gas and water flow rates, reservoir and wellhead pressures, various methods for removing fluid from the bottom of wells, and allows to establish the optimal technological regime that ensures long-term trouble-free operation of flooded gas wells.

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Chapter 4.
URBAN STUDIES

4.1 The creation of ecological advertising in urban areas

Afanaseva E.K
Institute of Design and Spatial Arts, Kazan Federal University, Kazan, Russian Federation
e-mail: wavte0@gmail.com

Today advertisements are a huge part of information that people in urban areas consume on a daily basis. Modern citizens can find commercials almost everywhere: on the buildings and billboards, at the bus stations, in the underground, etc. [Demidova, 2016; P. 108-109]. It can be inappropriate, capturing too much attention or just out of place, creating extra stress for the eyes and minds, so it can really cause informational overload. The commercials are damaging the public spaces view, which is also a negative factor for the cities' representation. The big amount of annoying advertisements can also ruin the reputation of any promoting brands or products. That's why it is important to find ways to create an ecological advertising which will organically fit in the urban environment.

The main aim of this research is to study the specifics of visual commercials in the city of Kazan and its impact on its citizens. We aimed to understand why commercials might not fit in the environment, which elements attract human attention, what customers and consumers expect from advertising, how commercials can negatively affect people, and how we can minimize this effect. This research will be helpful both for local authorities (and help them to create a healthier environment for citizens and guests) and the creators of commercials (to help them to develop better associations with the brands they are promoting, without polluting the urban environment).

The key methods applied in this research are the survey that we led with different categories of people (students, elderly people, parents with kids, etc.) who live in Kazan or visit the city. Also, we interviewed the employees of advertising agencies and printing houses located in Kazan. We have collected information from the social media, during telephone interviews and on their websites. Also, we have analysed the graphical and semantical content of advertisements on billboards, pillars and poster stands in Kazan during our visits to the sites and by using internet maps and archives.

The main finding is that for most commercials too bright and saturated colours were applied, the graphical information conflicts with the environment. The citizens of Kazan described the negative effect of commercials in a different way, but all of them have agreed that certain specific elements make commercial materials unsustainable. The main aim of the advertising agencies is to attract the attention of the target audience, creating a positive image of their product. Although the perception of the citizens and companies contradict each other, it is still possible to find a compromise which will help to satisfy both sides. Taking all the above-mentioned into consideration, we have identified 7 rules for ecological advertising: appropriate placement, sober colours, less triggers, neutral or visually pleasing fonts, limited amount of colours, proper design of commercials and the context taken into account. In this work we have developed the principles of ecological commercials that can be used to create new advertisements with create positive impact on the visual perception of public spaces, buildings, etc. It may help to reduce physical and emotional stress for the citizens, still meeting the major goal of any commercial – to promote products and services and attract attention. We suggest that the results can help to create and regulate the commercials in

the city, making Kazan a more beautiful and healthy place.

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4.2 The new form of urbanization for achieving the sustainable development goals

Aimé Ludovic P. Sawadogo
Università Telematica Internazionale Uninettuno, Ecole Nationale des Travaux Publics
e-mail: ludovicsawadogo12@gmail.com

The population growth is an important factor to consider while planning sustainable cities. According to the United Nations Sustainable Development Solutions Network, more than 70% of the world population will live in the cities by 2050 [1]. In addition, more than the half of the world population is below 30 years old. Young people are moving to the cities in order to earn their living and get better opportunities.

Urbanization plays an important role in the development of civilizations. The climate change is affecting all the aspects of human settlements and life, and it is necessary to develop a better urban planning for the future generations. In terms of the urban planning, a number of challenges, faced by the cities, should be turned into new opportunities.

1 - Adaptation in terms of the city planning

The city planning should permit the population to live, work, and move freely according to the principles of the Charter of Athens 1933 [2]. The land management is crucial. In many cities across Africa, the prices of land lots have increased significantly; the population is very poor. The number of vulnerable members of society is increasing, they are obliged to settle down in non-buildable areas that face floods and natural disasters. The slums should be upgraded for vertically-oriented and more attractive constructions. The cost of the construction materials should be well-managed and available for all people. [3]. In different parts of the world, the local construction materials should be valorized for the endogenous development of the population. The constructions made of earth, rocks, compressed earth blocks, plastic wastes and other construction materials, should be implemented for circular economy [4]. Circular economy in the cities will help to meet the challenges the cities face, and transform them into opportunities. Urbanization should integrate the concept of circular economy, as in the city of Shibam in Yemen, which has been built only with local construction materials for more than 400 years [5]. The international community should update new standards of construction and update the construction standards used by the past generations.

There are other parameters to be taken into consideration when planning the cities.

2 - Water and rearing

The scarcity of water is an important issue that should be taken into consideration for urban planning. It is one of the pressing challenges of the present and subsequent centuries. Rearing is very important for sustainability. The humanity should change its habits aimed at satisfying the

basic needs. We are observing the increasing consumption by the population. The social dimension in urban planning is crucial for human development.

3 - Social dimension

COVID-19 demonstrated that solidarity is highly needed to build better cities and societies. The cities should be planned regardless of discrimination. La Confluence in Lyon in France is one of the best examples of sustainable urban planning in the world. The authorities took into consideration the public opinion in different aspects of the city in order to achieve the Paris Agreements [6]. People should be educated to be willing to work together. In schools, there should be more teamwork than competition for sustainable resilience. Students should be taught green entrepreneurship. The vulnerable communities, as well as the marginalized people, indigenous people, people with disabilities should be included at policy-making and urban planning.

Conclusions.

Nowadays, urban planning requires to consider three main dimensions which are social, economic and environmental ones. The humanity should adopt new forms of energy and innovations. The renewable energies should be promoted. No one should be left behind in order to achieve the sustainable development goals.

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4.3 Sustainable Integrated Multi-Trophic Aquaculture (SIMA) as a Solution for Mitigation and Adaptation to the Impact of Climate Change in Coastal Areas

Alvian Wardhana[1], Bima Juliansyah[2], Dhefynsa Alifia Fajrian[3], Luh Salsabila Shafa[4], Khalif Nazar Arafat[5]

[134]Urban and Regional Planning, Brawijaya University, East Java, Indonesia

[2]Architecture, Brawijaya University, East Java, Indonesia

[5]Water Resource Engineering, Brawijaya University, East Java, Indonesia

e-mail: alvianwardhana24@gmail.com

Coastal areas are the most vulnerable to the impacts of the climate change. Inundation in coastal regions is estimated to cause permanent inundation and exacerbate abrasion, affecting 50-60% of the population [1]. Globally, the

increase in the sea level has increased by about 3.1 mm/year. In the 20th century, it was only 1.7 mm/year [1]. The condition shows that the one-third of the sea level increase is due to melting glaciers caused by the global warming.

Mangrove ecosystems have a close relationship with the climate change. The existence of mangroves in coastal areas can increase resilience to the climate change in the form of blue carbon storage, coastal stabilization, sediment trapping, absorption of ocean wave energy, and protection against and minimizing the impact of natural disasters [2]. As an archipelagic country, Indonesia has the largest mangrove forest in the world, where Indonesia's mangrove area covers almost 25% of the world's total mangroves [3]. However, due to the sea level rise caused by the climate change, the existence of mangrove forests is currently threatened. In 2015, the mangrove area in Indonesia was recorded at 3,489,140.68 ha, equivalent to 23% of the world's total mangrove area, but the mangrove area of 1,817,999.93 ha has been damaged [4]. Mangroves make a potential contribution to reducing carbon emissions that cause the climate change. Based on the expert research in Cifor, carbon storage in mangroves along the Indo-Pacific coast can save 10% of emissions even though it only has 0.7% of the forest area [5].

Based on the problems, the Sustainable Integrated Multi-Tropical Aquaculture (SIMA) emerged, which is a system that combines mangrove conservation and cultivation of organisms of various levels of tropism for adaptation and mitigation of the climate change in coastal areas. Mangrove areas provide protection, such as the threat of high waves and abrasion, while many organisms will act as aquaculture service providers. In addition, a mangrove area is the area that supports a blue ecosystem that helps to reduce the impact of the climate change.

SIMA was explicitly developed for coastal areas with mangroves damages. SIMA implements organisms that are selected according to various trophic levels based on the complementary functions possessed by the ecosystem.

In addition, SIMA combines seaweed cultivation, permeable sediment structures, mangrove conservation, crab cultivation, and fish cultivation. SIMA design can be seen in the image below.

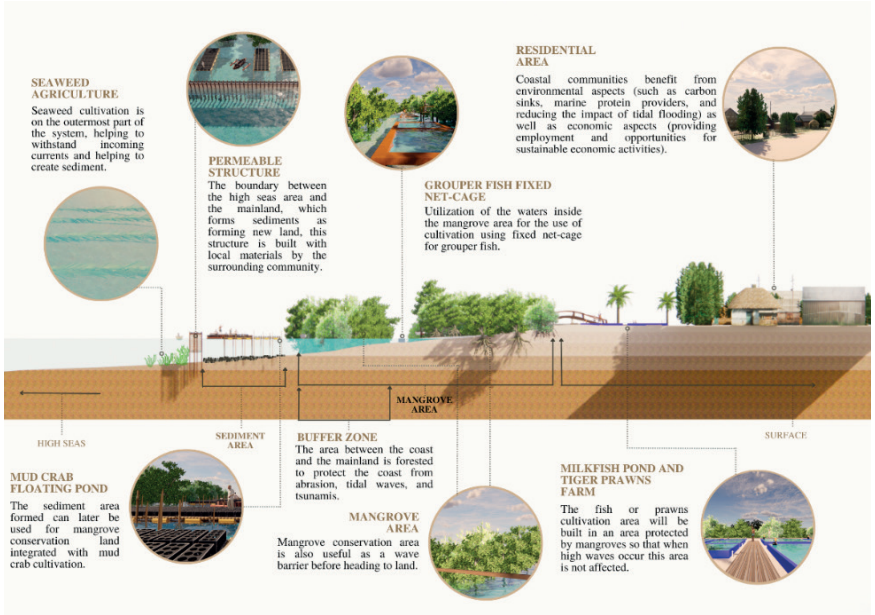

Fig.1. SIMA Cross Section

The SIMA scheme uses seaweed farming as a producer of the marine biota's food chain and an absorber of carbon dioxide. Seawater carrying sedimentary materials will pass through a porous structure. This structure holds and precipitates sedimentary materials. The marine protein from sedimentation materials can be used as nutrients for biotas. Meanwhile, the sedimentation results can be used for the mangrove conservation with the impact on reducing abrasion and tidal waves. The SIMA system provides benefits from environmental aspects (as a carbon sink, provider of marine protein, and reducing the impact of tidal flooding) and sustainable economics, such as the direct values (habitat for

crabs and shellfish), indirect values (abrasion barrier and the length of coastline), the value of existence, and also derived from the value of choice and the value of no use, namely the importance of existence.

The Sustainable Integrated Multitrophic Agriculture, in terms of its application, cannot be separated from the Sustainable Development Goals (SDGs) concept. The sustainability aspect that is applied, focuses on points 1,2,12, and 14. The SIMA's link with point 1 of the SDGs is alleviating all forms of poverty where seaweed farming, ponds or certain products produced in the mangrove areas can increase the income of the surrounding population. This point relates to SDG 2 to ensure that everyone can enjoy safe and nutritious food. Of course, this point is based on marine products resulted from the development of SIMA. Point 12 is a way to reduce environmental impacts through appropriate production and consumption patterns. The fauna is a source of protein that the community can consume. The SIMA system is also closely related to point 14 of the SDGs that covers conservation and sustainable use of marine and oceanic resources related to the efforts to protect marine or coastal ecosystems.

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4.4 Collaborative Governance for a Green City: the Analysis of a Public Green Open Space in Yogyakarta (the Robin Garden case-study)

Angga Misbahuddin
Khon Kaen University, Khon Kaen, Thailand
e-mail: angga.m@kkumail.com

Cities are the centers of growth, development and change, as well as the centers of economic, social, cultural, political, and other activities (Adisasmita, 2006). According to Ernawi (2012. P. 5), the idea of a green city has a strategic meaning because it is motivated by the several factors, including the rapid growth of the city and its implications for the emergence of various urban problems such as congestion, flooding, and the reduced area of the green open space. The development of public green open spaces is a priority for the government of Yogyakarta city, because the city environmental ecosystem is strongly supported by the existence of public green open spaces. According to Law No. 26 of 2007, the minimum size of the green open space in urban areas in order to carry out these ecological processes should be at least 30% of the total area of the city.

Table.1. Data on the Extent of Public Green Open Spaces in Yogyakarta City in 2019 (Source: BPS Kota Yogyakarta, 2019)

No	Types of Land Use Identified	Type of Green Open Space	Extents (m^2)	Percentage of the area of Yogyakarta city (%)
1	Green Open Space Public Settlement environment	Public	25.837	0.079
2	Small shade tree	Public	20.626	0.063
3	Pergola	Public	12.021	0.037
4	North square	Public	53.784	0.165
5	South square	Public	16.709	0.051
6	Field (21 locations)	Public	245.238	0.755
7	Field ceremony	Public	1.133	0.003
8	Tomb	Public	300.605	0.925
9	Embung Langensari	Public	14.031	0.043
10	Large canopy walkways and parks	Public	734.153	2.259
11	Railroad border	Public	108.811	0.335
12	River border	Public	373.911	1.150
	Total Public Green Open Space		**1.906.859**	**5.867**

On the other hand, the current condition of Yogyakarta city, namely the population that is not directly proportional to the area of the city, will cause various problems. The importance of urban open spaces, especially the Public Green Open Spaces, significantly help to increase the comfort needed by people in urban areas, but it is the fact that public green open spaces are not associated with the construction of hotels and apartment buildings.

Based on the above-mentioned data, this research aims to find how collaborative governance is carried out by the government for the development of public green open spaces in Yogyakarta with a case study of the Robin Garden as one of the public green open spaces resulting from the collaborative governance between the Environment Agency of Yogyakarta, CSR of Bank BRI and Community Pemerti Kali Code. This study uses a descriptive analysis method with a qualitative approach. The types of data used are the secondary and primary data. In the analysis of the phenomena that occur in the field, the authors use the theory developed by

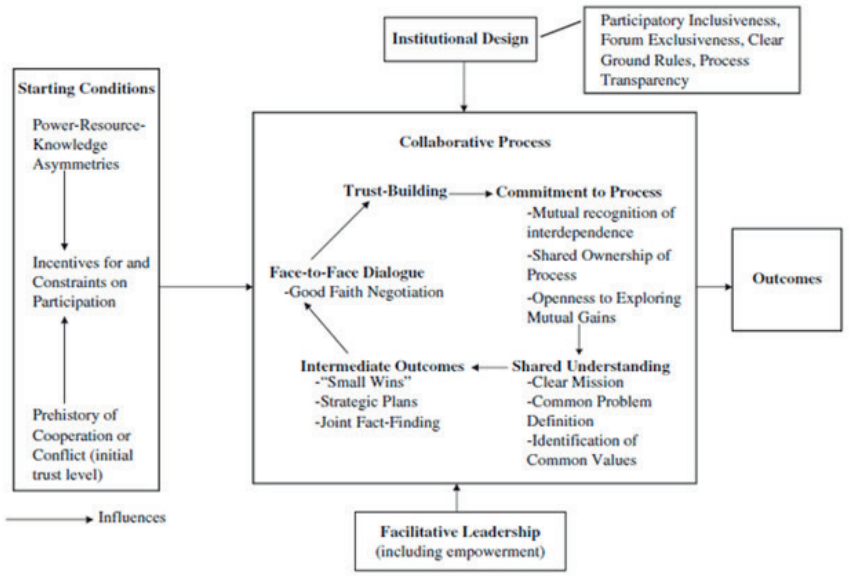

Fig.1. Model of Collaborative Governance (Source: Ansell and Gash, 2007)

Ansell and Gash (2007. P. 544) on Collaborative Governance that Collaborative Governance which is an agreement between one or more public organizations that interact directly with non-governmental stakeholders in a formal policy-making process oriented towards consensus, deliberative government and aims to make and implement the public policy, and manage specific programs and assets. Thus, it is a collaborative process that occurs not only during formulation but also in implementation and evaluation. Based on the four indicators of the collaborative governance model, the results of this study show that the starting conditions, developed by the collaborating stakeholders, have been carried out optimally to build the Robin Garden, although there are parts of human resource indicators that have not been maximized by all collaborating stakeholders. Second, on the point of facilitative leadership, the research results refute Ansell and Gash's theory of collaborative governance leadership, where it is not the

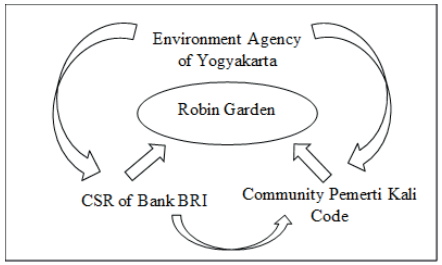

Fig. 2. Collaborative Governance Stakeholders Scheme

Fig. 3. View from Public Green Open Space (Source: Author Analysis, 2021)

government that is the leading sector but the community, namely Komunitas Pemerti Kali Code. Third, the institutional design aspect of the collaborative governance process between the three stakeholders has not been carried out properly, which is due to the lack of participation from the Environment Agency in terms of collaboration, process transparency and exclusivity in the forum. Fourth, in the aspect of the collaboration process, which is the main indicator, there is still a lack of commitment to the process, trust building, and share understanding between the stakeholders, even though the face to face dialogue process has been carried out.

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4.5 Manscapes (Manage Our Landscapes): Climate Smart Landscapes Development Strategy Based on Big Data, Cloud Computing, and Artificial Intelligence Technology for Sustainable Development

A. Fathiarahmah[1]
[1]IPB University, Bogor, Indonesia
email: auliaathirahmah@gmail.com

Cities are major contributors to climate change, producing more than 60 percent of greenhouse gas emissions [United Nations, 2022]. Climate change is an important environmental issue that affects the landscape of all countries in various sectors. Climate-Smart Landscapes is a form of landscape approach solution in dealing with climate change under the principles of Integrated Landscape Management to achieve sustainable landscape resilience [Cengiz et al., 2021].

This concept links the landscape approach to climate change adaptation and mitigation with five elements: multi-stakeholder platforms, shared understanding, collaborative planning, practical implementation, and monitoring with governance, financing, and market catalysts [WWF, 2016]. This innovative research aims to develop a climate-smart landscape concept in Indonesia, especially in urban spaces based on inclusive technology 4.0, inviting the participation of the government, stakeholders, and the community utilizing big data, cloud computing, and artificial intelligence to achieve Sustainable Development Goal 13 (Climate Action). This research used secondary data with the fishbone analysis method, benchmarking analysis, stakeholder analysis, and SMART (Specific, Measurable, Achievable, Relevant, Time-Bound) analysis. Secondary data is obtained from essential documents of the United Nations Framework Convention on Climate Change (UNFCCC), reports from the Intergovernmental Panel on Climate Change (IPCC), journals, books, and the internet for articles belonging to international and national official bodies on climate-smart landscapes, integrated landscape management, climate change, urban spaces, and technology 4.0. Based on innovation research results, Manscapes (Manage Our Landscapes) is a climate-smart landscape development strategy that can educate and encourage landscape stakeholders to interact with each other in deciding, planning, and implementing an idea with the principle of integrated landscape management based on technology accelerator in the process. The main landscape stakeholders are the central government on a macro-scale, local governments on a mesoscale, and local governments on a micro-scale. In addition, the roles of academia, companies, media, and communities can be merged into categories with their respective focuses. The platform used for Manscapes is a website and smartphone application that will display professional information, profiles, and roles in landscapes, chatbots, and survey fields that users can access. These features can provide the required information according to the user's role in the landscape. Applying landscapes in micro-scale (field) adaptation and mitigation efforts can give access to recommendations and guidelines listed on the platform for users to implement. In contrast, the use by parties at the mesoscale and macro-scale levels can support the successful implementation of climate-smart landscapes in Indonesia through coordination and integrated landscape management of each region in 37 provinces, 416 districts, and 98 cities. The first feature of Manscapes is that Knowledge Hub utilizes big data as public information to increase education, awareness, and personal capacity through technical guides, articles, and particular pages to share experiences of actual conditions in landscape phenomena. The second feature is an Artificial Intelligence chatbot called Ask The Manscapes, which provides user access to fast and targeted answer solutions. The third feature, Cornorscapes (Coordination for our landscapes), displays the profile and professional data of a person in the registered landscape to connect, coordinate, and discuss landscape management. The fourth feature, Climate-Smart Landscapes Map, spatially provides information on projects that will be, are currently, and have been implemented in real-time stored with cloud computing technology. It includes project descriptions, various forms of climate change adaptation and mitigation efforts, and an Integrated Landscape Management system with stakeholder profiles and roles in the project location. The fifth feature, Formscapes is online forms with surveys and predictions of recommendations to add data from various perspectives and user roles in multiple landscapes as well as varying specific scales and locations. The research-based funding scheme only required 0.48% of the Indonesian government's 2016-2020 budget to develop Manscapes. The development plan is divided into the short-term for the first five years and the long-term for the next five to ten years. In the short term, it begins with planning, preparing the technology system, collecting data, socializing and coordinating with the landscape stakeholders, and starting the system operation, monitoring, and evaluation. In the long-term, consider adapting new technologies, optimizing spatial data features, and evenly and thoroughly socializing, monitoring, and assessing. The implementation of Manscapes to achieve climate-smart landscapes requires synergy from various parties on a micro-

scale, mesoscale, and macro-scale.

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4.6 Formation of modern public spaces. The concept of landscaping the territory of the quarter in the city of Yelabuga, Russia

K.M. Badrutdinova, A.M. Khisamova,
Yu.P. Balabanova, M.I. Lushpaeva
Kazan Federal University, Institute of Design and Spatial Arts
e-mail: alinkahis0909@gmail.com

Yelabuga is a historical settlement of federal significance, included in the List of historical settlements of federal significance, which has not lost the integrity of the historical town-planning formation. It has retained to a high degree of the historical planning structure and public spaces, supported by historical buildings in connection with the natural relief and landscape. According to Russian experts, Yelabuga is one of the 20 most preserved historical cities in Russia.

Figure 1. Historical panorama of the city of Yelabuga.

Yelabuga, a centuries-old settlement, received the status of a city in 1780 following the Decree of Catherine II of August 13, 1784, when it received a development plan.

The development of crafts and trade turned Yelabuga into the center of the merchants of the Kama region. The heyday of the city was in the 19th century; about 10 thousand people lived there, including 12 millionaires. The most famous are the Stakheev merchants, who traded bread in many regions of Russia, as well as abroad. They had gold mines in Western Siberia, oil fields, their own shipping companies, plants and factories. Another famous family were the industrialists Ushkovs, who founded chemical production in the vicinity of Yelabuga. Other famous merchants of the Yelabuga district were the Emelyanovs, the Shabalins, the Loshchilovs, the Vavilovs, the Zaitovs [Agzamova, 2012].

Yelabuga has a distinct historical identity and cultural potential for development. At the moment, the Institute of Design and Spatial Arts is developing the concept for the sustainable development of the historical settlement of the city of Yelabuga. As part of the concept for the sustainable development, the concept for the improvement of the territory of the quarter of the former weaving factory was completed. The quarter is adjacent to on of the central streets, Kazanskaya street. According to the plan of 1796, the area adjacent to Kazanskaya Street was named Sennaya. In the 19th century, a complex of trading buildings was located there in the place where people traded fish. Since 1935 it was named the Freedom Square. During the Great Patriotic War in 1941, a spinning and weaving factory was evacuated there from the city of Vyshny Volchok. Despite the evacuation, the factory was able to produce its first products only two

years after. Years later, the factory turned into a full-fledged cotton mill. In 2000, the plant closed and was an abandoned site for 22 years. Now, there is a small square with an obelisk crowned with a bust of V.I. Lenin (by sculptor S.D. Merkurov), installed in 1925 [Khairutdinov R.R., Khuzin F.Sh., 2000].

Figure 2. Historical reference of the territory of the projected quarter.

The concept of landscaping the territory of the quarter of the former weaving factory in the city of Yelabuga is developed on the historical image of the territory. The goal is to develop the landscaping of the territory of the quarter of the former weaving factory located in Kazanskaya Street, which used to be the main shopping street of Yelabuga. Not only residential houses of wealthy merchants but also shopping arcades, shops, warehouses and cellars were located there. Such a convenient location and the history of the Yelabuga merchants gave us the idea to connect the concept of improvement with the most recognizable symbol of trade, which is a coin. The image of the coin is projected on small architectural forms and the pattern of footpaths.

Figure 3. Formation of small architectural forms

Figure 4. The concept of landscaping the territory of the quarter of the former weaving factory in the city of Yelabuga

The main center of attraction for people in the projected quarter will be a shopping center, a hotel and cafes. In addition, since a music school is located next to the projected area, children who study there, as well as students of the gymnasium and students of the university, located further down Kazanskaya Street, will walk by. For these people, the Skypark and the children's playground were designed.

The project considered the features of the public space formation in the urban environment and determined their main characteristics.

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4.7 Change for Change

Fasih Uddin
University of Central Asia, Tajikistan
e-mail: Fasihuddin51d@gmail.com

The rising city population is a cause for concern. Everyone is doing their best to get to a big city, where they can find a better job, get a higher education, and live in more comfortable conditions. This shift from the countryside to the cities is putting a strain on metropolitan areas and threatening the rich traditions of the countryside. The statistical evidence reveals that household economics have a significant effect in the decision to relocate from a countryside to a city. Our group has developed the "Change for Change" initiative as a response to this seismic shift in human social organization.

As the first step, through this project we will construct "Digital centers" in rural areas. This is due to the fact, as we all know, that the digital age has made it possible to learn anything from anywhere. These hubs will be opened in various rural locations, providing education to the locals on how to make the most of the resources at their disposal. This project would be governed by me, as the founder and leader of Sharar team (an organization aimed at improving education in Pakistan). Zconnect, a tech company that teaches people valuable online skills and provides them with opportunities to earn money, will be our partner. Zconnect and Sharar team make an excellent team to implement the Change for Change project, because both companies have already launched many projects of this kind. It is possible to explore the work of both companies by checking the available information in social media and websites; the links are given below in the references section. The digital centers will be set up by Sharar teams; the students will learn employable skills through Zconnect. They will be able to use their newfound expertise to make money staying in their own homes, through sites like Fiverr, Upwork, YouTube, Amazon, and others. First, we have an intention to launch two skill centers in Upper Chitral and Lower Chitral, where there has been a dramatic increase in migration to urban centers. The members of our team reside in these areas, so they will keep a close eye on the project development. This means that many people in rural areas won't need to relocate to the city in search for work because they can find opportunities close to their home thanks to these centers.

The second component of this initiative will be applied in urban centers aiming to decrease the climate change caused by population. We'll engage educational institutions and the youth in solving urban cities' climate change challenges. We'll tour schools and universities to inspire students to help the society. We intend to hold a climate change competition among schools, which is the Change for Climate Change (CCC) competition. Our team and Zconnect will fund the winning institution or college for further initiatives. Different schools will be able to come up with different solutions. For example, one school will plant 2,000 trees, while another one will use reusable dust bins, and a third one will go for reusable bags supplied to grocery stores. The most original and effective solutions will be awarded. After two months, we'll visit each school and college to announce the winner. Thus, educational ideas will affect society. We'll also bring in renowned speakers to talk to students about the climate change in urban cities and the ways to tackle it as educated people. We'll announce the findings at a large meeting with school and college leaders. We'll invite government and NGO partners. This event will occur annually, aiming to remove carbon footprints and unfavorable climatic changes caused by urban overpopulation.

When the project is implemented, the team will monitor the rate of migration from rural area to urban areas and see the

progress in the climatic conditions of urban cities. Accordingly, the team will promote and scale up the idea to other rural and urban cities.

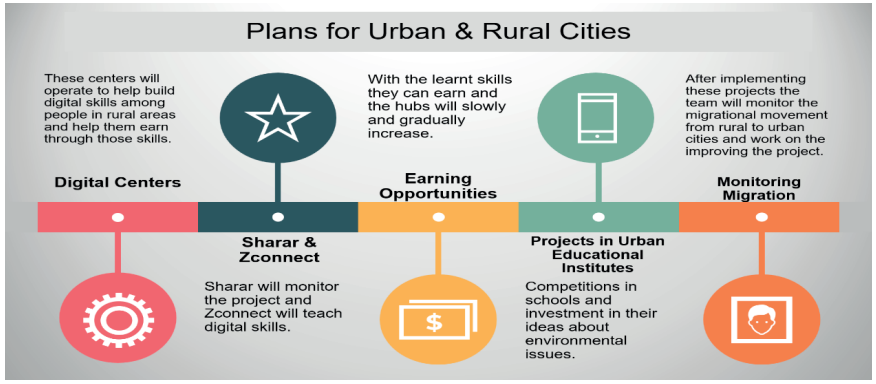

Figure 1. Project Plan

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4.8 Development of the concept of the first food mall in Kazan

D.R. Garaeva
Institute of Design and Spatial Arts, Kazan Federal University, Kazan, Russian Federation
e-mail: dilyara29065@mail.ru

Food malls, or gastromarkets, are a modern gastronomic and cultural phenomenon. These are spaces, where different concepts and cuisines of different nations are presented on the same territory, and often they are also a market with fresh farm products.

If we think about the reasons why such a concept appeared and became successful, we will probably come to the conclusion that food has ceased to be a simple way to satisfy a physical need. Food has become a cultural phenomenon: people are interested in how this or that dish appeared, how it is cooked and connected with the local culture. All this is combined with the desire to add new sensations to the meal: sitting at the bar, you can watch the process of preparing a steak or, at the master class given by a famous chef, create your own tuna tartare with fregola and raspberries.[1]

In Russia, such places began to develop not so long time ago: a pilot example of this concept is the Danilovsky market in Moscow, which took shape as a gastromarket in 2017. After its success, the restaurant market players picked up and began to develop this idea. Now, there are several dozens of food halls in the capital, one of them is the popular DEPO food mall. St. Petersburg is striving for this figure, and the trend is also moving to the regions. Food malls already exist in St. Petersburg, Khabarovsk, Voronezh, Perm, Krasnodar and other cities, but are still not developed in Kazan, the third capital of Russia. [2]

Food halls are opening in different places - they can be organized in new buildings designed for them, they are opened in shopping centers, or they can help to rethink the old city market, a tram depot, an industrial building, station or port. For example, the Ponce City Market food hall in Atlanta used to be the warehouse of a large American company, and in the Chelsea Market building in New York City they made Oreo cookies. [3]

The relevance of this topic lies in the fact that the development of the first food mall in Kazan is socially and economically needed for the city and the Republic as a whole. At the moment, there are very few publications and research papers on this topic, so one of our main goals is to be the first author.

What is the economic side of the project? First of all, this is a way to assist the small businesses in Kazan. For food

service entrepreneurs, it would be a great opportunity to launch a pilot project and a chance to offer their own unique cuisine format. It is much safer and more profitable than the opening of a new restaurant from scratch, renting large premises, hiring staff and then going bankrupt. The new food mall could help to rent a corner and, with a small investment, start developing their brand and concept.

What is the social side of the project? The future food mall would become the center of gastronomic and tourist routes, because it would accommodate many corners that provide an opportunity to try new dishes, appreciate the cuisines of the peoples of the world (including the Tatar national cuisine) and improve its gastronomic culture in general.

Also, inside the food mall, it is planned to set up a stage for an entertainment program, namely, concerts, master-classes, etc. The food mall will feature an outdoor terrace with seating, parking and a children's play area.

We had been analysing the market of gastronomic establishments and food malls for a long time, when we came to the conclusion that it would be interesting to open and develop the concept of the first food mall in the historic area of Kazan. Accordingly, the main visitors to the food mall in the central part of the city would be tourists, students, employees of office centers, and local residents.

Within our research, we aim to reveal this topic in order to understand the way the history of food malls began, the reasons why it is relevant and how exactly it is worth implementing this project in Kazan.

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4.9 PSYCHOGEOGRAPHY AND ITS SIGNIFICANCE FOR URBANIZATION IN PRESENT AND FUTURE

I, F. Kabenova[1]
[1]St. Petersburg State University of Architecture and Civil Engineering, St. Petersburg, Russian Federation
e-mail: indirakabenova@gmail.com

The main goal of urban planning is to create a comfortable, accessible and safe environment for life. Due to the fact that modern cities are of high priority, it is especially important to pay attention to this [Kabenova, 2021, p. 250]. The conducted study have shown that the quality of life in megacities has its own number of shortcomings [Kabenova, 2021. p. 360]. This is justified by spontaneous urbanization, which does not give urbanists enough time for the high-quality urban planning.

The main topic of the study is psychogeography and its significance for the process of modern and future urbanization.

In general terms, psychogeography studies the trajectory of urban routes, their directions, load, composition, speed and other characteristics. The main task of psychogeography is to study the relationship between people and the environment, to identify the motives that encourage movement in the urban space. This allows us to create a comfortable and safe environment. For example, it may help to identify the shortcomings of poorly attended spaces, which may include marginalization, social danger, lack of infrastructure, non-compliance with the principles of video ecology, unfavorable environmental conditions, inconvenient location, etc.

The main criteria are: the purpose (service in theory) and function (service in practice), location, connection with

surrounding objects, both external and internal, characteristics, audience.

According to the criteria, we evaluate spaces that can be divided into: points of attraction - places with the highest attendance; rejection points - detours, marginal spaces; dead end zones - places with limited attendance [Debor Guy Ernest, 1974. p. 28].

As for the data collected for the research, it is worth noting that the current problem is easier to solve with the help of special sites provided for in the concept of a smart city [Popov, Semyachkov, 2020. P. 126].

Social networks are an important source of data. Unlike special sites, social networks perform both the function of storing data and a motive for laying routes. This is justified by the relevance of creating a personal brand and maintaining accounts in social networks. This is especially in demand among people running business accounts. Thus, objects promoted on the Internet, attract the attention of active owners of social networks, as people, capturing the object in the format of their personal brand, giving an account to the audience.

By researching social networks, you can identify the most visited places, determine statistics on the attendance growth, and analyze these data according to such criteria as purpose and function, locality, connection with the environment, target audience, reputation, external data, improvement, impact on visitors, etc.

The literature can also be referred to as sources [Eremenko, 2021. p. 49]. So, the Parisian writer Julio Cortazar, in his works, gives a socially significant coloring to the things that, at first glance, are inconspicuous for our attention, like graffiti [Cortazar, 1980. p.3] and the metro [Cortazar, 1980. p.9].

The literature includes folklore, which can be thoroughly studied only through a field research. The phenomenon of "urban legends" cannot be hidden from the attention. It serves as the main reason for winning the reputation of the area, which can have informal, independent of the usual concepts, points of attraction and rejection.

The research in the field of psychogeography must be carried out on a constant basis, tracking changes in the needs of the population. However, if certain patterns are identified, the basic principles can be formed in order to facilitate further research activities.

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4.10 Impact of urbanization on the biosphere

A.G. Kusochkov
Institute of International Relations, Kazan Federal University, Russian Federation
e-mail: kusochkov.arsenii@gmail.com

From the point of view of ecology, a modern city is a very complex ecosystem, the peculiarity of which is

determined not only by the high concentration of a large number of people in a limited space, but also by the concentration of industrial production and services in the same space. All this leads to an increase in the anthropogenic load on the environment and intensifies its pollution.

Together with the build-up of industrial potential, the creation of new industries in large cities, the population is increasing. Modern large cities are centers of concentration of diversified industry, an extensive transport network in densely populated residential areas. Moreover, the most important source of urban population growth was, and still is, the migration of rural residents to cities.

The pace of urbanization depends on the level of economic development of the country. In most economically developed countries, where urbanization has reached a fairly high level, the process is under control, but urbanization continues to grow.

To stabilize the process of urbanization, it is necessary that there be a partial outflow of the population from the city to the rural areas, which will lead to the unloading of cities and an increase in trade between the countryside and the city.

Today, urbanization has become one of the main factors of environmental pollution. More than 75% of the total volume of pollution is associated with it [Tetior, 2007. P. 59]. However, developing countries, in conditions of an extreme lack of funds, cannot ensure not only the transition to low-waste technologies, but also the construction of recycling plants.

As the city develops, its functional zones are more and more differentiated - these are industrial, residential, forest park [Vershinin, 2014. P. 13]. Industrial zones are areas of concentration of industrial facilities of various industries. They are the main sources of environmental pollution. Residential zones are areas of concentration of residential buildings, office buildings, cultural facilities, education, etc. Forest park is a green area around the city, cultivated by man, i.e., adapted for mass recreation, sports, entertainment. Its sections are also possible inside the cities, but usually there are city parks - tree plantations in the city, occupying quite vast

territories and also serving the citizens for recreation. Unlike natural forests and even forest parks, urban parks and similar smaller urban plantings are not self-sustaining and self-regulating systems.

The environment of the urban system, both its geographical and geological parts, has been most strongly changed and, in fact, has become artificial, there are problems of utilization and reutilization of natural resources involved in the circulation, pollution and purification of the environment, there is an increasing isolation of economic and production cycles from natural metabolism and energy flow in natural ecosystems [Tetior, 2007. P. 192]. And, finally, it is here that the population density and the artificial environment are highest, which threaten not only human health, but also the survival of animals.

Under these conditions, state control over the state of the ecological situation and state environmental protection can become a real way out of a difficult situation [Chomich, 2002. P. 40]. In the conditions of a big city, all aspects of people's life support are aggravated: the supply of a sufficient amount of high-grade food and drinking water, the control and prevention of air, water, soil pollution, the disposal and disposal of accumulated hazardous industrial and domestic waste, as well as social problems associated with a sharp decrease in free living space, the growth of cities in height, the increase in diseases caused by environmental pollution and others.

The most promising way to solve the problem is the recycling of urban waste. The following main directions in processing have been developed: organic matter is used to produce fertilizers, textile and paper waste is used to produce new paper, and scrap metal is sent for remelting. The main problem in recycling is waste sorting and development of technological processes for recycling. The economic feasibility of a waste recycling method depends on the cost of alternative methods of their disposal, the position on the recyclable market and the costs of their processing.

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4.11 The impact of urbanization on the hotel development

E. S. Mangileva, O. I. Baranova
Saint Petersburg State University of Economics, Saint-Petersburg, Russian Federation
e-mail: ms.katiysha@mail.ru, oska_1965@mail.ru

The concepts of urban economy or «urbanism» and hospitality are closely interrelated, as both are intended for rendering the same idea of comfortable and convenient residence provided for their dwellers. They have been developing in parallel demonstrating the same evolution trends.

In order to understand the interrelation, we have to study the historical aspect.

Hotel business was originated in ancient Rome. However, the only purpose they were developed for was catering and accommodation for pilgrims on their way to shrines. Gradually, the cities were growing, becoming points of attraction for travelers.

The 19th century marked the industrialization era, with cities evolving rapidly and successfully, followed by the active development of hospitality enterprises. In 1889, the legendary Savoy hotel opened its doors in London. It was the first one where visitors could enjoy such services as electricity, telephones, elevators and hot water.

At the beginning of the 20th century, hospitality turned into an independent industry. But the Great Depression of the 30-s led it to a decline [3].

In the 60s, Jane Jacobs proclaimed diversity as the main thesis of urbanization. And in the meantime, the hotel industry entered its «golden age» with the development of such world's most famous brands as «Marriott International», «Accor Hotels», «Hyatt Hotels Corporation», «Four Seasons Hotels and Resorts».

Table 1. Urbanization/hospitality correlation

Time/years	Urbanization	Hotel industry
19-20 centuries	Awareness of the poor-quality urban environment, ecological problems. Prerequisites for urbanism.	The first hotel with reception, door locks, hot water supply, central heating and sewerage.
20 century, 30s	Attempts to implement urbanism and errors in urban planning	Decline in the hotel business
20 century, 60-70s	Awareness of mistakes. Urban diversity.	«Golden era» of the hotel industry - diversification
20 century, 80-00s	Urbanism in practice. Cities for people's benefits.	Diversification continued: airport hotels, convention hotels, sanatoriums, ski resort hotels, seaside hotels, the first automated control system appears
Today	Urban space to stimulate favorable climate for communication, unleashing creative and intellectual potential of residents, improving the quality of life	«Hotel as a metropolis» concept

Nowadays, a hotel represents a self-contained ecosystem resembling rather a mini-city than an enterprise. Today's tourists need more than just a comfortable place to stay. Instead, they need entertainment and recreation facilities in a hotel. So, new hotels aim to develop public areas which include such facilities as a gym, swimming pool, restaurants offering various cuisines, hairdressers, convention centers, and organize workshops for guests, children's playrooms, rooms for animals, theaters, etc. The guests don't have to go out to entertain themselves, they only need to take the elevator to another floor.

It indicates that the hospitality industry follows the major trends in urban development and planning, in cultural, educational, economic and social aspects. Today, the largest hotels and international hospitality chains, as well as those hotels that seek to be competitive in the industry, are trying to implement technologically sustainable innovations which meet the concept of a «smart hotel» or «green hotel», such as energy saving, recycling and energy sharing technologies, etc., that have already become an integral part of life for a modern tourist.

Table №1 demonstrates a correlation between the process of urbanization and the particular changes in the hotel business, showing that the development of cities for the benefit of its residents, is accompanied with the development in a hospitality sector.

These innovations resulted in mutual influence on urban economy and hotel enterprises, where cities stimulate the hospitality sector by assuming formation within the latter of similar structures, while hospitality businesses, highly developed in terms of technology and sustainability, oblige cities to implement higher standards in their urban - cultural and historical, environmental and social - amenities, actively pursuing the sustainability trend.

Therefore, by developing the hotel industry, we can expect a chain reaction in the development of the entire destination.

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4.12 AA PROTOPIAN URBAN FUTURE: A COMPREHENSIVE INSIGHT ON THE FUTURE OF URBANISM BY THE YEAR OF 2050

C.E. Arif Aiman
Muhamad Arif Aiman Bin Che Ariffin – International Islamic University, Malaysia
e-mail: aimanariffin171@gmail.com

The trajectory of our urban future has long been a focal point of debates and research amongst futurists. The pessimists predicted that our cities would be plagued by a grim dystopian reality, whilst the optimists envisioned that our cities would inevitably evolve into a flourishing utopia. Despite these contrasting viewpoints, the paper is focused on the thorough analysis of the past and current trends in urbanism and aims to determine the possibility of achieving a protopian urban future, whereby the society of the future will focus on incremental progress toward improvement, instead of unattainable unrealistic perfection. According to futurist Kevin Kelly, protopia is a state when today is better compared to yesterday. It celebrates achieving betterment whilst featuring great opportunities as well as new challenges. [1]

In order to achieve a protopian future, the research highlights

the necessity to track the mental, physical, and social health of the community as a key element in future-proofing urban design. Towards 2050, our cities will be developing prioritizing happiness and livability of the community, as well as fostering the sense of belonging through human-centric spatial design combined with a greater utilization of technologies. The rapid technological advancements will steer our cities into a new age of tech-integrated smart cities [2], whereby technologies such as blockchain, big data and the Internet of Things (IoT) will be seamlessly embedded into the urban environment which will allow the community to thrive and define their own unique urban identity [3].

Polluted air and noisy streets will be a foreign concept as the car-centric urban planning is expected to be obsolete in favour of multi-modal sustainable transportation systems [4]. Reliance on the use of private motor vehicles will ultimately be a relic of the past. The rise of the New Urbanism, for instance, will facilitate a more efficient use of adaptive space with emphasis on walkability, decentralization and mixed-use urban planning [5]. Thus, walking, and other forms of micro mobility will be a feasible travelling option for all. With the shift towards electric and autonomous vehicles, Hyperloop and Maglev systems, fossil fuels will become obsolete resulting in fresher and cleaner air and quieter mobility. Additionally, the post-pandemic cities of 2050 will emphasize in blending our physical environment to our natural one [6]. Open public realms and green spaces will be socially inclusive across all spectrums of the society in order to ensure that the cities of 2050 are designed to promote a healthy lifestyle [7]. Hence, it is a blatant observation that the vision of a protopian urban future will play a remarkable role in laying the foundations of a physically, environmentally, socially and economically inclusive society.

In conclusion, this paper provides a philosophical, economic, social, and physical illustration on the future of urbanism if the current trends in urban planning persist, which is a step in the right direction of the Urban Protopia.

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4.13 Smart Urban Waste Management: Are There still an Opportunity or Challenges? (A Case Study of Semarang, Indonesia)

M. Rauf[1].
[1]Gadjah Mada University, Yogyakarta, Indonesia
e-mail: muhammadrauf2019@mail.ugm.ac.id

Urbanization has shown a high increase in the town of Semarang, in following by a growth of the population of around 1,688,133 (on June 2022) and it will be predicted to continue to increase up to 68% in 2050 [Dispendukcapil, 2022]. According to that data, Semarang's economic activities are also enhanced, which comes from the people's demand for goods or things which it would generate public waste. Essentially, waste is the things that are residual from economy activities. If there are no a sustainable proceeding to cultivate the waste, then, it would aggravate the worse impact to urban environment.

According to data released from the Ministry of Environment and Forestry, denote the fluctuating number of entirely urban waste generation disposal in landfill approximately 456,873,35 tons (2019), 466,010,79 tons (2020), and 430,749,75 tons (2021) with the most type of the waste are plastics (17.2%) and leftovers (60.79%), and the sources of waste disposal are from households (36.6%) and other (44.88%) [SIPSN, 2022]. Hence, many studies and research has been done that involved several actors for resolving the waste problem in Semarang. One of those research are tend to use "smart" term into the urban waste management paradigm. Therefore, this paper would analyze the "smart" term that has been embedded with "urban waste" paradigm.

The smart urban waste management was born in conjunction with enhance of technology innovation in the world. Particularly, the technology that involved in waste management which has thrived in developed countries for managing the waste recycling in urban areas. The technology has been serving as important role to engage in the process of urban waste for detecting the waste bin compactor, and if it already full, it must carried into the landfill. The sensor would be directly accepted by the waste manager. Then the waste would be sorted by detecting of the color in plastic that covered the waste. Ultimately, the waste could be handily to recycle based on the type and reduce entry to the landfill. So that, its help to evade the accumulation of waste in landfill [Maryono & Hasmantika, 2019. P. 2]. However, in Semarang (as one of city in developing countries), has not compatible technology to support the waste management on recycling system. Beside the lack of technology, the behavior and human skill are arduous to adapt with a new innovation and it could need more time and space to conceive it.

Moreover, As regulated by Law No. 18 of 2008 as regard Waste Management Operational system must be non-segregated, encompassing of landfill activities to waste later disposal site [Atmanti, Sasana, & Setyaningsih, 2019. P. 2442]. Meantime, as regional regulated in Semarang No. 6 of 2011 and No. 13 of 2006 pertaining to Waste Management and Environmental Control, specified that everyone is required to reduce or minimize and take hold of waste with environmentally attitude. Moreover, the operation of waste management is not permitted incinerate in open spaces. In consequence, the role of central and regional government is very crucial in terms of waste management. Especially giving service to local worker and community. Then socialize regarding the procedure (SOP/ Standard Operational Procedure) for supporting the operation of urban waste management.

Accordingly, this paper would also like to raise two questions that could solve in further discussion regarding urban studies at Kazan: First, how we could make a collaboration both government actor and local community or worker are understands how to operate and to be familiar with the innovation of technology. Second, as an academician, how we could to conduct socialize with local stakeholder and make grand mapping of for the plan on the smart urban waste management.

4.14 Modern trends in architectural renovation of industrial enterprises and industrial complexes

Nizamieva E.
e-mail: elinanizamieva@mail.ru

Abstract. To date, the renovation of industrial buildings is one of the relevant topics. So, in many ways, industrial architecture, over time, began to transform its original function.

First of all, the building requires conceptual accuracy in the study of standards, proportions and functionality. However, despite these difficulties, modern architects have managed to combine imagination and innovation to create impressive modern projects and implement them.

Keywords: renovation, modernization, industrial architecture

Introduction. The renovation of an industrial enterprise or an industrial complex means preserving the overall appearance of the building with an emphasis on changes in its functionality. A number of issues related to housing can be addressed only in the conditions of complex renovation of unused industrial buildings, transforming the structure of the city.

Methods. To understand such a topic as modern trends in the architectural reconstruction of industrial enterprises and industrial complexes, it should be noted that all of them have individual features, but the goal is to organize residential areas out of industrial zones and make them multifunctional. After all, the major advantages of such structures are high ceilings and the open-plan design.

Each project that aims the modernization of industrial buildings should carry not only the concept, plans, zoning, but also a historical component in order not to disrupt the urban rhythm.

Conclusions. We have come to the conclusion that industrial buildings and industrial complexes allow us to re-read and comprehend the historical architecture, applying approaches that encourage designers and architects to create renovated areas. Having found a connection between a seemingly old building and a modern city, it is possible to discover a new value of the object, namely, to implement and eventually get a transformation that will create an ideal image of the visible future of architecture.

The research is the next step in understanding the national culture of renovation of industrial buildings.

Thus, rethinking the abandoned industrial enterprises will reveal the solid foundation of the urban structure, because renovation is a guide that will allow rethinking the face of the city from a different angle without changing its historical value.

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4.15 Smart green evenhanded city actions in terms of land use and urban planning in Kazakhstan, Kyrgyzstan and Tajikistan

N. Sadulloeva[1], S. S. Ismatuloevich[2], M. Jumaeva[3],
[1] Graduate of the University of Central Asia, Naryn, Kyrgyzstan
[2] Professor of Journalism and Central Asian Mass Media, RTSU, Dushanbe, Tajikistan
[3] Doctor of Philological studies, RTSU, Dushanbe, Tajikistan
e-mail: nozanin.sadulloeva@alumni.ucentralasia.org

Cities are not abstract machines of sustainable development; cities are where real people live, work, learn, and fulfill themselves. The cities are made up of people, built by people, and exist for people. Moreover, it is precisely people who are the driving force, the source and the beneficiary of sustainability. In the 21st century, the era of technologies and artificial intelligence, development is related to globalization and transition to the digital economy, as well as the growing pressures on the environment and society. As the proportion of the urban population is rapidly increasing, the number of cities is growing, the concentration of the objects of industrial and economic activity and people; it leads to ecological, social, geological and, most importantly, environmental negative consequences. Most cities, specifically in the Central Asia, such as Almaty, Bishkek and Dushanbe, are increasingly promoting smart green actions through different activities, trying to learn from the experience of more advanced cities of sustainably developed countries in this field [Ma, 2020. P. 21]. These achievements, in term of urbanization, which is particularly intertwined with sustainable actions, would be strongly linked with economic, environmental, and social factors, as the key elements for sustainable development.

A sustainable plan enhances the social and environmental relationship with less capital loss. These actions obviously affect the urban strategies and urban planning implementation, considering that all cities are to be at the peak of city reconstruction [Komendantova, 2022. P. 10]. The former Soviet countries had been struggling for reforms, and Central Asian countries started taking their first steps in urbanization only decades after gaining their independence [Bjerde, 2021]. However, these solutions alone will lead to a green and sustainable city future, and urban planning is drastically reduced. Thus, this concern raises some fundamental questions for further discussion: have the implemented smart green interventions adequately addressed the urban land use and planning objectives? How can it be estimated? In this context, the paper starts with 1) A critical presentation of the concepts of smart, green and just cities, and the complementarities and interconnections among them. Furthermore, Almaty, Bishkek and Dushanbe case studies on 'green city' activity implementations will be reviewed and analyzed to set frames for further discussion; 2) The green just urban actions 3) The role of digitalization, mainly driven by private investments, to the urban actions. Based on these three points, the interaction of the above specific actions with the land use and urban planning will be discussed; this discussion will be specified in this research.

Thus, this study focuses on the impact of land use planning in urbanization, highlighting the necessity to enhance synergies between the implementation of smart green just urban actions and urban land use planning in cities; to this end appropriate adaptations of both the actions and urban planning are necessary; a priority should be given to further support of the existing tools and procedures, developing new plans and strategies, ensuring synergies as well as promoting new ones.

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4.16 Utopian Contribution of the Extraterrestrial Architecture to the Dystopian World

Nurullah Nurullah[1], Hilal Tuğba Örmecioğlu[2]
[1] Master Degree Student, Akdeniz University, Faculty of Architecture, Department of Architecture, İnstitute of Natural and Applied Sciences. Antalya, Türkiye
[2]Prof. Dr., Akdeniz Üniversity, Faculty of Architecture, Department of Architecture, İnstitute of Natural and Applied Sciences. Antalya, Türkiye
e-mail: nurullah.bd.sasia@gmail.com / 202051061009@ogr.akden-iz.edu.tr

Although atmospheric and environmental circumstances play an active role in creating the built environment on other planets, the space architecture is thriving based on the existing architectural styles and forms in the world. However, the extreme conditions of the planets such as Earth, Moon or Mars are distinct from each other. The concepts of temperature, day and night vary according to the planet's interrelation with the Sun. Built environments or habitats are thought to be generated for human life and should be shaped by paying attention to the specified environmental factors of a planet. For this reason, concept designs are developing based on the impact of extraterrestrial atmosphere on the human life, considering the planet gravity, soil, radiation, wind, oxygen and carbon dioxide level, etc., and since the natural resources in our world do not exist in space, the waste-free, recyclable and sustainable technologies are being used to imagine a human cycle in outer-world. Foreseeing that the natural resources in the world are being depleted, the extreme situations will be experienced, our lives will be in danger. Inspiration from the space architecture will help us to design extraordinary, technologically advanced living areas for the future.

The industrial cities of the 19th and 20th centuries were considered to be designed as vehicular-friendly and congested multi-story mass housing for the city dwellers. However, in contrast, the 21st-century approach is more environment-friendly and human-centric. While frequent floods, fire accidents and droughts are endangering human lives on Earth, the sea level rise, uneven temperature fluctuations and the increasing carbon footprint could lead us to an utter digester that might have devastating effects on human health without having any permanent recovery. It is high time to seek for a remedy to a rapidly growing unhealthy urbanization, environmental pollution and energy crisis by considering that if it is not now, it is never.

The cutting-edge technologies allow us to rethink traditional design methods of city planning, enhancing human-friendly design to develop a new type of buildings. Designing instantly responsive structures for all the people who are in danger, being in distress, flood, war, or being homeless, especially in South Asian countries and other parts of the world, is a must. Unfortunately, such extreme conditions will inevitably be experienced shortly in our World, caused by natural disasters, global warming and climate change. Despite designing a built environment, considering extreme natural conditions as an eccentric approach for the world, it is likely to become a common agenda anytime soon. For example, after having to live and work in the same place for a long time during the pandemic and a quarantine period, architects started to pay attention to the development of human-friendly green spaces and sterile habitats that will have a blissful effect on human psychology. In this context, technologies developed for the extraterrestrial architecture and space habitats, will continue to have beneficial contributions to the contemporary architecture. In short, undoubtedly, the space architecture will bring utopian solutions to the dystopian world.

This article aims to draw attention to the potential of the technologies, design approaches, materials, structural systems and

proposals that make up space architecture to become a solution for the extreme conditions that will occur in our world, which is predicted to be under threat. These special technologies create habitats suitable for human beings both in the world and in outer space, despite long-term problems such as the global warming, the danger of countries being submerged under water, disasters and pandemics. For this purpose, solution proposals developed by companies or space agencies will be examined, as well as the relevant literature.

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4.17 Smart Vertical Axis Wind Turbines for Urban Areas and Highways

Rahat Uddin[1], Abdullah Al Araf[2]
[1]IDEB Research & Technological Institute, Dhaka, Bangladesh
[2]Southeast University, Dhaka, Bangladesh
e-mail: rahatuddin.dpi@gmail.com

Energy is an important aspect of our everyday life. The resources we use are limited, whereas the population consuming it is increasing day by day. Nowadays, the requirement for electricity is much higher than its generation, hence the main objective of our work is to produce electricity at low cost with no effect on the environment. The objective of the work is to design a wind turbine able to recapture the wind energy from vehicles on the highway. A considerable amount of wind energy is produced due to the pressure difference created by the moving vehicles on the highways. This wind energy can be utilized for the generation of electrical energy with the help of vertical axis wind turbines. This work aims to extract this energy in the most efficient manner. A vertical axis wind turbine can be installed on the median of the roads, so that the wind from both sides of the median will act tangentially in opposite directions on both sides of the turbine, increasing the effective wind speed acting on the turbine. This wind flow will depend on the velocity of the vehicle, size of the vehicle, and intensity of the traffic. Based on the studies made, an optimal wind turbine design has to be developed. The generated wind power can be used for street lighting, traffic signal lighting, toll gates, etc.

Niranjana S.J [1] suggested to generate power by fixing the vertical axis wind turbine on the highways. This paper indicates that the vertical axis wind turbines are able to generate 1KW of power when moving with the speed of 25m/s. Abhijit N Roy [2] et al. tried to design and fabricate an energy-saving vertical axis wind turbine. In this experiment, the shaft of the rotor is connected vertically to the wind turbine with the generator. It uses a gearbox that can be fixed near to the ground. D.A. Nikam [3] et al. reviewed the literature on the design of the blade for the vertical axis wind turbine. This paper indicates the characteristics and advantages of both HAWT and VAWT. The experimental outcomes of this paper reveal that the blade design is crucial for the performance of the turbine. A modified blade can improve the efficiency of the wind turbine. Altab Hossain [4] et al. proposed a design that investigated the development of vertical axis wind turbines. The blade and the drag devices are designed in such a way that they are at a ratio of 1:3 to the wind turbine. The calculated output

is 567W and 709W at the wind speeds of 20m/s and 25m/s, respectively.

Description of The Proposed Model

The block diagram of our model demonstrates the key working principle that can help to generate electricity effectively.

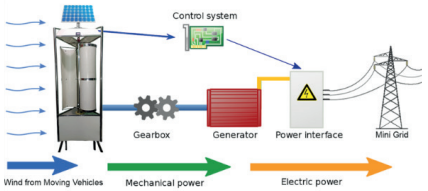

Fig. 1 – Block Diagram of Proposed Model

As the model is designed mainly for highways, we took a wind survey on Bangladesh capital city, Dhaka highway, and placed the model on highway divider. For testing purposes, by using external fans, we produced the air of a required speed and measured the turbine speed. The voltage generated is also measured with a respect to variation in wind speed. We used the gear ratio of 1:25 to achieve the rated 750 rpm of generator, when turbine rotates at 30 rpm. To get the higher speed of 750 rpm, we used a 4-gear mechanism. Here, the electrical power generated by the respective systems, is given to the switching circuit. By comparing the battery voltage with both the inputs the controller gives and the signal to switching circuit to select appropriate input, are used to charge the battery through pulse width modulation (PWM) controller.

Fig. 2 – Final Prototype of the Turbine

According to the test performed and the survey of wind generated on highway by moving vehicles, the operating time of a wind turbine on average is 4 to 5 hours a day at full rated output.

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4.18 PERSPECTIVES OF FRACTAL URBAN PLANNING

S.A. Shamanova, E.Yu. Lobanov
Institute of Environmental Design, Saint-Petersburg State University of Industrial Technologies and Design, Saint-Petersburg, Russian Federation
e-mail: shamanovasofi@gmail.com

Urban planning ideology of the industrial age is outdated, but it still serves as the basis for the formation of new urban areas in many countries, including Russia. Monofunctional standardized buildings, whether residential or industrial, creates a monotonous, depressing environment. From the point of view of videoecology by V.A. Filin, geometrically uniform spaces have a depressing effect on the mental state of each person [4].

The main problem of the standard residential areas is the lack of spaces for a diverse social life. The gaps between the blocks of flats are occupied by parking, it is not enough greenery and places for children to play there. According to the American architect and urban planner, Christopher Alexander, «high-rise living takes people away from the ground, and away from the casual, everyday society», and the «forced isolation causes individual breakdowns» [1]. As an alternative, he proposes terraced residential building height of no more than 4 floors, as well as the inclusion of various social activity centers, trade, education and other services that enables to create workplaces within walking distance of homes.

Despite the unsettled state of the urban environment in most countries, urbanization is ever increasing. As American architect Kent Larson said, «Cities will account for 90 percent of the population growth, 80 percent of the global CO_2, 75 percent of energy use, but at the same time it's where people want to be, increasingly. More than half the people now in the world live in cities, and that will just continue to escalate» [5]. Architects and urban planners have a great responsibility: to create a convenient, diverse and harmonious environment, producing beneficial effects on the health of people and their relationships.

The new urban environment should be based not only on different functional principles, in contrast to the city's modern age, but also in completely different geometric structures. According to the American mathematician and theorist of architecture Nikos A. Salingaros, «minimalist, colorless, and abstract (non-fractal) designs were found to cause the greatest increases in human stress levels» [2]. In contrast, the scenes of nature soothe and restore peace of mind. Salingaros attributes this to the fractal geometry of natural forms.

Even French mathematician Benoit Mendelbrot, the creator of fractal geometry, wrote that almost all natural objects are fractals [6]. American mathematician Ron Eglash found fractals in traditional African architecture [3], and Salingaros wrote about

fractal structure of medieval European cities. Abstract forms of Euclidean geometry make architecture inhuman. «As long as a city's structural and connective hierarchy is missing all of its lower scales, the city is not fractal», - notices Salingaros [7].

The fractal structure of the urban environment has many advantages. First, a hierarchy of communications and connectivity of urban objects in different scales. Secondly, similar functions are carried out at different zoom levels, from an individual living cell to the residential area and the city as a whole, so the fractal geometry is natural for urban development. Third, in addition to increasing building density, fractal structures give more opportunities to create diverse and aesthetic urban environment.

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4.19 Integrating Wetlands into Urban Planning – Case of Oued Maleh, Tangier

K.Touihar[1]
[1] **National School of Architecture, Rabat, Morocco**
e-mail: kaoutarth@gmail.com

Interest and contour of the subject. ” Wetlands areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.” [1]

Wetlands are among the richest and most precious natural spaces in the world. Whether permanently or intermittently in water, these environments are of great diversity. Aquatic plants adorn these environments, frogs, birds, insects, etc. find in these spaces the necessary conditions to live and reproduce there. [2]

In terms of the living environment, the wetland is a space of well-being in the city. It is a space for walking, a space for discovering aquatic environments, a healthy space combining the purity of water and air, a calm place giving way to the sounds of water, wind and wildlife, a nearby natural space giving back a place to water in the city, as well as allowing a relaxing landscape perspective from the dwellings.

Considered among the most important sites in the city of Tangier, the urban wetland of Oued Maleh is of great interest. It has significant natural potential: The forest, the lake, the proximity to the sea…As well as its proximity to the various facilities (LGV station, Shopping centers, Restaurants…).

Fig.1. Location of the Oued Maleh area

Questions:

• What is the interest of wetlands for an urban space?

• How can urban wetlands be integrated into their urban context?

• What interest do urban wetlands have for the urban landscape?

• What concepts and approaches will be able to establish a coherent and balanced vision of an urban wetland and its interaction with its urban context?

Assumptions:

• Urban wetlands constitute a source of social and educational life for the urban context in which it is inserted;

Problem:

• The Oued Maleh urban wetland is heavily degraded. Its use is poured underground and into marginal acts.

• Although this area has great urban and landscape interest, it is not integrated into its urban context.

• Urban wetlands have significant potential for improving the urban environment and enhancing urban attractiveness;

• Urban wetlands help improve the quality of urban

State of the question. This phase consists of taking stock of the most recent reflections and research carried out on the subject in question as well as the various experiments carried out at national and international level. This inventory will allow us to situate our contribution and guide our thinking in relation to the current situation of the problem of the study.

Objectives and expected result. The objective set by this work is to develop concepts and approaches capable of establishing a coherent and balanced vision of the urban wetland and its interaction with its urban context. It is also a question of promoting the opening and the development of these natural sites while integrating them into the surrounding urban landscape, which will offer the inhabitants of the surrounding districts a local space conducive to the discovery of nature.

The expected result will focus on the conceptualization of a sustainable urban project for the Oued Maleh wetland and its various variations, particularly in terms of specific actions likely to be developed into architectural projects. This project is intended to be integrated by relying on the existing landscape.

Keywords: wetlands, urban wetlands, integration into urban planning, urban quality, urban landscape

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4.20 DIGITAL TECHNOLOGIES FOR TOURIST FLOW MANAGEMENT IN THE CITY

Tsaplin T.
Saratov State University
e-mail: azalean2002@mail.ru

Abstract. The article examines two interrelated phenomena that have been characterized by the highest growth in their numerical indicators – tourism and urbanization. The constant growth of cities, the involvement of new territories in the

production of tourist products, unregulated flows of tourists to popular centers have, first of all, a huge anthropogenic impact that can lead to a high degree of pollution on the territory, as well as the burden on it and its local residents. In addition, the lack of an agreed long-term plan for creating and managing the growth of urban tourism leads to a superficial idea of the place of stay, turning historical, cultural and artistic heritage into objects of mass culture, which leads to the spread of such a phenomenon in tourism as «overtourism». This requires a reassessment of the existing management practices in the city to ensure an effective dialogue of all stakeholders on the development of sustainable tourism. Taking into account the accelerated penetration and active use of digital technologies in the field of tourism, digital marketing can become an integrating tool for all factors aimed at increasing sustainability by understanding the needs of the market, forming socially and environmentally sustainable demand, developing environmentally-balanced products and promoting the trends and needs of tourist offers. The analysis of "overtourism" on the Russian territory has resulted in a list of both large and small cities of the country, showing the highest indicators for the phenomenon under consideration in the tourism industry. Moreover, the research takes into account the fact that digitalization is a key priority for increasing the productivity and growth potential of the tourism sector; new technologies also permeate all aspects of policy development to create a more sustainable tourist space. Therefore, taking into account the importance of digitalization in modern realities, the author of the article proposes an application developed for tourist flow management. The application is a navigator for the least and most popular city attractions that contains numerous guides for creation of a sustainable tourist product or service aimed at maintaining local communities and industries, reducing the ever-increasing pressure on developing and growing territories and their local residents. Moreover, in the conditions of active reorientation of the tourist market to Arab and Asian destinations, the proposed application will have a convenient multilingual search tool (in Russian, English, Arabic, Chinese), allowing the potential tourists from other countries to select destinations

they like the most, contributing to the development of tourism in Russia, getting acquainted not only with popular, but also less visited sights of Russian cities. At the same time, the application is intended for both potential tourists and tour operators. The study aims to analyze the features and competitive advantages of the application, the benefits for tour operators that allow to modernize and differentiate the tourist product being created, as well as the social and economic significance and prospects for further development of this application in Russia and other countries of the world.

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4.21 "Smart suburbanization" as a strategic goal of the largest urban agglomerations development: a psychological aspect

R.R.Valeeva
Saint Petersburg State University, Saint Petersburg, Russian Federation
e-mail: rmmvlv5@gmail.com

The COVID-19 coronavirus pandemic has led to changes not only in the economic, political, cultural spheres, but also in personal meanings, life values, and attitudes of an individual [1]. A new social situation has arisen in the lives of a significant part of the population resulted in self-isolation and remote work. A number of consequences associated with the new life context are of a scientific interest.

Many urban residents chose to self-isolate not in their city apartments, but in other cities or in the countryside. The data of the VCIOM study indicate that when switching to a remote work format, 15% of employees moved to another locality. Thus, there was an acceleration of the previously existing processes of internal migration of the population, namely, de-urbanization and suburbanization [2]. These processes must be taken into account when planning urban development.

As part of this study, it was decided to analyze the processes of suburbanization occurring within the largest urban agglomerations and formulate recommendations on the use of these processes to ensure the socio-economic development.

A special place in our study is occupied by the mental health of people engaged in remote work. It is assumed that the level of psychological well-being is interconnected with the quality of life and has a number of features for remote workers. In addition, the higher quality of life is associated with a higher level of personal income. The zones of compact residence of high-income specialists create regional "growth points" that provide a positive impact on the socio-economic development of the urban agglomeration.

This research project presents a preparatory phase involving the initial collection of data. The study, conducted in 2021, involved residents of St. Petersburg and the Leningrad Region in the age group of 23-46 years old, a total of 251 people; with 107 females and 144 males. In order to assess the psychological well-being as an indicator of the quality of life, the method of Express diagnostics of the level of psychological health developed by Shilina A.E. has been applied. The results were calculated as the integral indicator of the psychological health level.

As part of the correlation analysis, numerous correlations were identified, most of them reached the level of statistical significance.

The strong correlation between psychological well-being and the quality of life indicator confirms the assumption that it is appropriate to single out the factor of psychological well-being as an indicator of the quality of life.

Based on the results, we can suggest that there is a relationship between the quality of life and the place of residence of a remote worker. Statistically significant intergroup differences were found: the indicators of the quality of life of residents of individual households are higher than those of the apartment buildings residents.

Based on the results of the study, we have developed recommendations [3] to be included in the strategies for the socio-economic development of cities that are the centers of the largest urban agglomerations; the strategic goal is to stimulate suburbanization processes, primarily aimed at the resettlement of highly-qualified specialists whose field of activity allows them to work remotely. These processes will encourage citizens to relocate, to urban suburbs and agglomerations.

The issue of the suburbs in the aspect of "smart suburbanization"

can shape the modern image of urban agglomerations, with a post-industrial type society and modern characteristics of the quality of life [4]. In order to achieve this, the related issues must be addressed, such as maintenance of transport, social infrastructure and leisure spaces. These issues can become the strategic tasks that will be reflected in the strategies of the largest urban agglomerations.

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4.22 The role of walkability in creating sustainable cities and communities. Case of the city of Bejaia in Algeria

Yacine MANSOURI[1], Abdelghani ATTAR[1]
[1]LGCA laboratory (Construction Engineering and Architecture Laboratory), Department of Architecture, University of Bejaia, Algeria.
e-mail: yacine.mansouri@doct.uliege.be

The increase in car traffic in recent years continues to significantly affect the quality of life in urban areas. Motorized traffic has increased so much that many important aspects of city life are increasingly hampered and the question of the sustainability of means of transport has become an important topic. On the other hand, the World Health Organization affirms that diseases related to obesity and people's inactivity have increased sharply in the last decade, to this end it suggests the promotion of sustainable access to one of the most important goals in the fight against obesity.

The creation of a sustainable transport system has therefore become the main objective of transport policies in many countries of the world. This system should encourage facilities that connect everyone and should be linked to the economic, social and environmental aspects of society. The promotion of walking and cycling is seen as the most important way to ensure sustainability especially in the most populated areas. Walking has been associated with many benefits, ranging from reducing air pollution, decongesting traffic and consuming resources, to solving obesity and other health problems [Ann Forsyth, 2020]. It has also been seen as a key factor in creating 'livable communities', encouraging interaction between neighbors and making the urban environment a more pleasant and safe place to live [Emery and Crump, 2003].

Walkability has recently been introduced as a concept that reflects the extent to which the urban environment is pedestrian-friendly [Abley and Turner, 2011]. By assessing it, planning professionals may be able to address the quality of the pedestrian environment. Research on walkability is recent and agreement on what to measure and how to measure it is still highly controversial due to the multiplicity of urban attributes that can influence walking. This prompted us to devote our present investigation to the study and evaluation of the degree of walkability within urban centers. This led us to ask ourselves the following main question:

What are the criteria that would make it possible to identify walkability within our social theatres?

The city of Bejaia in Algeria, like other cities in North Africa, does not escape the problems of urban management which generally translates into longer journeys leading to an increase in the use of motorised means of transport. This city experienced an extension in the colonial period due to the plan of Constantine and continued to expand after independence on the part of the plain. The evolution of the old city towards the plain was made on two axes, and the result of this evolution gave birth to several urban entities forming a geometric center and a hypercentre made up of a set of districts within which State buildings with private buildings thus constituting a hybrid urban fabric [Mansouri, Y., Occhiuto, R., & Hanocq, P. , 2021].

Can we qualify the hypercentral area of the city of Bejaia as being walkable? and to what extent could we gauge the quality of walkability in this area so that we can improve it eventually?

The complexity of the concept of walkability prompted us to use a variety of analytical tools, ranging from direct observation made several times and at different times and places, to cartographic and statistical analysis, as well as the use of the spatial syntax method developed by the UCL research center in London. This analysis also gives voice to the inhabitants and users of the place, through a questionnaire survey and the realization of guided tours. All of its methods are supported by the implementation and application of a walkability audit based on the indicator scoring system.

The results of this work show that if there are many studies relating to the evaluation of walkability around the world, little research has focused on Maghreb cities, especially on the city of Bejaia (Algeria). Our research question therefore makes it possible to provide empirical experience on the question of walking in Maghreb cities and indirectly opens the debate around the vivification of the city on new avenues of solutions, and lays the foundations of the argument. in favor of the theory that the concept of walkability can be applied for the proper planning of our cities.

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