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F. Ghorbandordinejad

Başkent University
Associate Professor, Doctor
Ankara, Türkiye

A. Bolatova

L.N. Gumilyov Eurasian National University
Master of Pedagogical Sciences
Astana, Kazakhstan

INTEGRATING AI-POWERED CHATBOTS IN SECOND LANGUAGE ACQUISITION: BENEFITS AND CHALLENGES

Abstract: This article examines the advantages and disadvantages of using AI chatbots in second language practice. AI chatbots have great potential for targeted and convenient practice for language learners. On the positive side, they offer individualized feedback with less rigidity and without the stigma associated with practicing. However, there are several factors that limit their effectiveness in practice. Among the biggest drawbacks is the lack of interaction with humans, which hinders the development of social interaction skills needed to converse naturally with others. In addition, most chatbots have difficulty understanding culturally specific contexts such as jokes, satire and other nuanced cultural references. This can lead to confusion and hinder effective learning, resulting in a poor flow of information within the learning environment. Technical challenges such as access to appropriate technology and connectivity also make it difficult for learners to access knowledge. To address these challenges, the article suggests possible advances in AI technology. The authors recommend the use of advanced natural language processing (NLP) algorithms to improve contextual awareness and the quality of feedback. It is also crucial to incorporate various feedback mechanisms such as graphics or animations to provide learners with diverse learning experiences. Establishing effective learning pathways based on individual performance can provide further benefits to learners by enabling targeted practice. Ultimately, overcoming the challenges associated with AI-driven chatbots through technological advancements can significantly improve language learning and provide learners with the tools to meet and even exceed their fluency goals.

Key words: AI-powered chatbots, language learning, advantages and disadvantages, natural language processing, NLP.

Language: English

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Introduction

The integration of AI chatbots into language teaching opens up new possibilities for learning that comes very close to mastering the language [1]. These advanced technologies support real-time communication as well as real-time generation of feedback and learning materials to create unique learning experiences [2]. According to the study by Yang, the AI chatbot Ellie significantly improves

students' oral and volitional practices and scores high on the task efficiency scale (88.3%, in EFL situations).

As shown in this article, although AI chatbots help to maintain learner engagement and provide quick responses [3], there are significant problems associated with the use of chatbots in education. In analyzing the present article, one major problem can be identified: the lack of real communication with

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other people, which deprives learners of the social and emotional interactions necessary to. Although their algorithms have improved, AI chatbots are still unable to capture the kind of interactions required for conversational competence.

In addition, studies have shown that AI chatbots can improve the affective aspect of English learning and student motivation, which is similarly effective to alphabetic techniques in various educational contexts [4]. They also increase interaction opportunities and learning interest as they mimic real-life conversational situations [5].

However, the process of improving learners' speaking skills through AI chatbots poses some challenges, such as the following. It could be said to be a significant problem as they cannot express emotions like humans can, or understand para-linguistic cues that are so important for proper language acquisition [6,7]. This limits the skills required for natural conversation. The lack of differentiation impairs the learning of social skills. In addition, other practical challenges such as acquiring appropriate technology and connectivity issues such as internet connectivity can still be a barrier to service delivery, especially in remote regions [8].

To overcome these difficulties, recent studies suggest various improvements. In terms of improving NLP algorithms, the ability of chatbots to detect and respond to contextual features can be made more accurate [9]. Implementing features such as text, audio and visual feedback has the added benefit of improving the learning environment for students [10]. Furthermore, the flexible learning progression that can literally set learners on their way according to their progress creates an effective practice environment [11].

All in all, despite the great potential for transforming language teaching through flexible and individualized learning processes with the help of AI-based chatbots [12], current developments and solutions are needed to mitigate the existing problems and maximize the impact of chatbots on students' speaking performance and the language learning process as a whole.

Benefits

The use of AI technology, particularly in the form of chatbots, is highly beneficial to the second language learning process as it improves outcomes and the experience. Key benefits include actions with the learners themselves, which in traditional practice, many of the tasks that tutors have to perform in e-learning are done by avatars. It also includes accurate and unique aspects of language teaching that help educators and save time for other important tasks.

Through the use of artificial intelligence and chatbots, learners also receive personalized feedback and tailored learning paths that encourage them to have real interactions with the language. Such an

approach improves learner motivation, engagement and self-regulation, and research has shown that such technologies increase the effectiveness of learning environments [13]. For example, in the context of flipped learning, AI-based chatbots have been used to increase the number of questions, student engagement and readiness for instruction, as well as to support data-driven teaching and learning [14].

In the context of ESL/EFL teaching, chatbots are able to supplement language input, increase students' motivation and thus stimulate their interest in learning English and ultimately improve their communication skills [5]. These tools are more useful in terms of mimicking the interaction cycle for students to interact in TL, provide feedback and promote social presence in the language classroom [15]. A simple analysis of the study by Yang shows that with intelligent chatbots such as Ellie, student engagement is effectively increased and the overall task completion rate in cases involving EFL lessons is 88.3 [2].

Furthermore, the use of AI chatbots is very effective in teaching linguistic and cultural content, as cultural characteristics of the target country can be explained in addition to general language lessons, making the overall experience even more valuable [16]. By further extending the practice set, which in turn means using chatbots when practicing communication with native speakers, it will be possible to follow simple instructions and provide the learner with different types of learning [17]. ChatGPT, for example, produces high-quality dialogue materials suitable for EFL learners and helps to preserve valuable resources and avoid typical barriers [18].

In addition, the use of AI chatbots in the classroom can help reduce students' stress in learning English writing by providing immediate feedback and allowing for a self-directed approach [19]. In general, participants' experiences with the AI chatbots for practicing English utterances are positive, although there are some drawbacks, such as speech recognition and coping with a large number of utterances [20].

In summary, AI-powered chatbots offer numerous benefits for second language acquisition, from increasing learner engagement and motivation to providing personalized feedback and simulating authentic language interactions. These technologies hold great promise to transform language teaching by providing innovative, adaptable and effective learning experiences.

Challenges

While AI-powered chatbots offer numerous benefits for second language learning, there are also some significant challenges and limitations to consider. One of the main issues is the practical and financial challenges associated with using and supporting these technologies. For example, AI chatbots such as Chatbot Mission Fluent can improve the English pronunciation of vocational students, but

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encounter difficulties in implementation and cost management [21].

Nevertheless, the use of AI chatbots in language teaching raises significant privacy and data security concerns as well as ethical issues. As mentioned in the relevant literature, the proper use of these technologies requires a certain level of digital literacy as well as comprehensible ethical standards for the use of the technologies and the protection of users' privacy and data. In addition, it is also possible to increase academic dishonesty, which is in some ways detrimental to the learning experience [22].

Technical problems are another factor hampering the efficiency of the use of chatbots with artificial intelligence. Issues such as the inability to correctly recognize what is being said and problems with extensive language resulting in certain words and phrases not being understood can stand in the way of their efficiency in language learning environments [20]. In addition, the current problems with contextual awareness in AI technologies and the ability to capture humor, idioms or cultural references lead to misunderstanding of the material and less effective learning [23].

Another issue is the use of AI chatbots to replace direct communication between human clients and practitioners, which raises ethical and practical questions. For example, while chatbots can provide comprehensive feedback in response to open-ended questions and use simple inserts from real-life situations, they cannot offer nuanced critical perspectives or cultural assumptions from native speakers [24]. This limitation can slow down learners' efforts to acquire fluency and cultural competence.

In terms of the design of learning, the availability and reliability of technology is also an issue, especially for learners with little school experience in developing countries. The lack of appropriate technology contributes to educational inequality and consequently increases educational inequality and disparities [23].

To overcome these issues, it is necessary to integrate human involvement in the process of language learning with the help of AI chatbots instead of replacing it [25]. Measures to make chatbots more natural, for example by improving the interactivity of the messages and making the artificiality of the chatbot recognisable, can be useful to show the boundary between using technological assistance and providing appropriate human guidance. In addition, improving NLP algorithms that address contextual understanding can eliminate or reduce these challenges and ensure the availability of the technology for all [9,10].

Therefore, it is necessary to overcome these challenges with the help of better contextual understanding, equal access to technology and integration of AI chatbots into the language learning process to increase the value of AI and chatbots for

language learning. Future advances should aim to improve the capabilities of AI as a means to recreate more complex language interactions and ensure that the application of AI contributes to the enhancement of the learning process rather than its degradation.

Discussion

The use of AI chatbots in language learning, particularly in the area of second language practice, has certain advantages and significant limitations. A review of the literature reveals three prominent themes related to the limitations and challenges of these technologies: these are the employment challenges such as 'human interaction challenges', 'contextual understanding limitations', 'technical barriers and digital divide'

Challenges for human interaction

The development of AI chatbots in the field of language learning poses one of the biggest difficulties in terms of mimicking a human's facial expressions and gestures. Currently, chatbots are not able to mimic human-like conversations, which are very important for the acquisition of job-relevant conversational skills in a second language. Thus, chatbots can imitate dialogs, but they are not able to reproduce human emotions and social signals [26, 27]. The model would still not know the meaning of the context or how to respond when interrupted by a voice or non-verbal gestures such as eye contact and hand gestures. This limitation results in learners not being able to recognize the authenticity of their interactions during live or recorded spoken word, which is very important for improving second language acquisition skills. The limited communication with the chatbots can prevent learners from learning real-life application practice in the language and certain interactions and cultural differences [24]. This in turn can prevent learners from achieving a high level of fluency, which includes using idiomatic language and learning pragmatic rules that are important for language use. However, these difficulties can be overcome by combining the AI chatbots with other human-led interactions or with real-time feedback mechanisms. When integrating the use of AI chatbots into learning and teaching processes, educators should ensure that language learners receive appropriate natural social engagement to ensure that the positive aspects of AI chatbots are complemented by effective and healthy interpersonal interaction. Therefore, it is important to conclude that while AI chatbots are important language learning tools, their means present numerous problems regarding the lack of natural interaction. To solve these problems, AI technologies need to be integrated into the educational process along with the human factor to offer learners with complex language learning experiences. Limitations of contextual understanding

Another disadvantage of using AI chatbots in language learning is that the contextual aspect or slang

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such as humor, sarcasm and cultural references that humans use tend to be ignored by the chatbots. Today's state-of-the-art NLP machines are not able to decipher these subtleties properly, which often leaves room for interpretation and can lead to less effective learning experiences [8]. Singh and Jatain explain that in the case of the AI chatbot, jokes can be misunderstood because the chatbot interfaces contain algorithms that may not understand the cultural undertones and even tone of voice [8]. Another disadvantage which emerges from the study is that the presence of such a chatbot contributes less to the training of language skills and the appreciation of cultures by learners. In addition, Belda-Medina and Calvo-Ferrer note that while chatbot activity can mimic a real-life practice environment and evaluate performance, the interactions rarely include the best criticism and cultural differences of native speakers [24]. This lack means that learners may not appreciate aspects of language use such as idioms and ethos that make a learner a perfect speaker or a perfect oral or written communicator. Furthermore, the limitations of AI chatbots to offer culturally appropriate feedback and the lack of contextual awareness could be an obstacle for learners to have the most realistic second language experience possible. Otherwise, learners will not be prepared to use the language in different situations, real-life contexts and different variations of language use in an appropriate way [24]. If these problems are to be resolved soon, the advancement of AI chatbot technology must better understand cultural relevance and context. Improving AI chatbots by implementing machine learning algorithms that can recognize and learn cultural intelligence, as well as real-time feedback from people's teachers, can be helpful in transforming language teaching and learning [24]. All in all, it is important to realize that while AI chatbots provide language learners with useful tools, there are also problems, such as limited contextual awareness and cultural blindness. Overcoming these limitations remains a challenge in the current trends of NLP and machine learning, and making provisions for human involvement as the best complement to fully support new language learning.

Technical hurdles and digital divide

Technical barriers, including unreliable internet and limited data, are significant obstacles for many language learners in underserved areas [28]. Singh and Jatain have observed that students often struggle to access AI chatbot platforms due to these issues [8]. Inequalities in technological access highlight the inequalities in learning between different socioeconomic groups. Students of lower socioeconomic status and students of color disproportionately struggle to maintain access to technology, which correlates with lower grade point averages [29].

Learners from privileged backgrounds benefit more from the advantages of AI chatbots, such as immediate feedback and personalized learning

experiences, than their peers with limited access. To overcome these challenges, initiatives are needed to improve internet connectivity infrastructure and provide affordable, reliable devices to access AI chatbot platforms. Educational institutions and policy makers need to promote digital inclusion and reduce the digital divide through targeted initiatives and investments. By prioritizing equal access to technology and supporting learners to overcome technical barriers, stakeholders can improve educational opportunities and enable learners to achieve their language learning goals more effectively.

Technical barriers and the digital divide

Technical barriers, such as unreliable internet and limited data, are significant obstacles for many language learners in underserved areas [28]. Singh and Jatain have observed that students often struggle to access AI chatbot platforms due to these issues [8]. Inequalities in technological access highlight the inequalities in learning between different socioeconomic groups. Students of lower socioeconomic status and students of color disproportionately struggle to maintain access to technology, which correlates with lower grade point averages [29].

Trading techniques and the digital divide

One of the biggest challenges affecting language learning for many learners from disadvantaged regions of the world continues to be technical issues such as inadequate internet connectivity and limited data [28]. Singh and Jatain concluded that students find it difficult to access AI chatbot platforms due to these issues [8]. The socioeconomic status of learners is an important aspect that shows a learning gap in terms of technological exposure. Low socioeconomic status students and students of color especially face the problem of not having consistent access to technology, resulting in poor performance reflected in their GPA [29].

This research recognizes the fact that privileged learners gain more of the benefits from the use of Artificial Intelligence chatbots as compared to the others from the less privileged background. Thus, the solutions to these factors have to be searching for the possibilities of improving the infrastructure for obtaining internet connections and the costs of effective and reliable devices that allow accessing the AI chatbot platforms. Besides, the educational institutions, and policymakers play the roles of raising people's awareness about the use of the technology in the queue and minimizing the gap between the information rich and the information poor. Therefore, the stakeholders increase the educational success of learners in language learning as well as their equity in using technologies by optimizing the areas of improvement and eliminating technological challenges.

Over-Dependence on Technology

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While it holds that AI chatbots have enriched language learning practice and feedback in ways that were previously unimagined, questions have been asked about AI's over sophistication [30,31]. Accompanying numerous benefits, AI chatbots should not become the primary source of communication in the foreign language learning instead of people [32]. Nonetheless, chatbots are not as natural as the conversations carried out by humans because they cannot be as arbitrary as decisions made by human beings, and only provide as many cultural factors as possible when making a response, besides being as variable as the real-life conversations when seeking to enhance the conversational fluency and the cultural sensitivity [3, 33]. It is possible that those limitations will infringe with learner's capacity to use this knowledge and skills within another communicational situation denying them an opportunity of engaging with the chatbot.

To eliminate the vulnerability related to the over dependency on AI chatbots, the educators coupled with the curriculum developers should scale down. It only means that the integration of the edtech AI applications with lessons should not remove the actual interaction with the native speakers or the peers. This ensures that users master certain language competencies under safe contexts to obtain the confidence, and flexibility, needed to practice the competencies in real life interactions. Hence, it is necessary to go and participate in and coordinate all those events that produce 'small talk,' cultural exchanges, and social relations because it is these and other aspects of oral communication that are required in other social situations and academic situations.

Conclusion

In the case of second language acquisition, AI based chatbots, there are many opportunities and observable concerns. Thus, while these technologies give personal feedback to the learner, let the learner choose the lessons' schedule and practice in an environment that is non-critical or non-judgmental, there are still some questions to be raised in order to address the contemporary demands and improve the efficiency of the mentioned technologies. This review of the literature highlights three primary themes: challenges in people's interaction, context sensitivity, and several IT challenges including, the digital divide. It is quite possible that the primary drawback of AI chatbots in language learning is the process of copying human actions in all spheres of life. Up until now, this structure of algorithms does not let the chatbots initiate the flow of natural dialogue, which means that students learning another language also need linguistic, emotional, and social interaction, crucial for language acquisition. This limitation diminishes the learners' opportunities to practice real life use of language situations which play a significant role in development of natural, appropriate and idiomatic

language use and language mastery. The lack of the actual functional setting limits the dynamic, realistic communication that learners may lose sight of, which in turn, will deny them cultural informality and language mastery.

In this case there arise problems of capturing the context just like when using them to give funny jokes, sarcastic remarks and/or cultural references. Such tools of NLP used in the modern world do not account for such delicate distinctions, and that adds to the qualitative aberrations in the learning process and understanding of information. Regarding the limitation, the learner's spoken language and interpersonal skills are impacted because the learner does not adequately develop cultural sensitivity when speaking in communicative contexts. Learners' absence of culture towards feedback and their general understanding of situations hinders them from mastering real language. The availability of the technology, and better still, reliable technology and or connection to the internet is a factor very pesky to many languages' learners especially from the developing world. Deficiencies in technology can result into emergence of gaps in the provision of learning and thus the prevalence of learning inequalities. The rich students also want to move up the level of the uses of the AI chatbots by passing their tests immediately and being privileged while the poor student cannot do this effectively. To tackle these problems thus, there is need to bolster up the technological backing and make sure that all the people, but especially the learners, have easy access to the technologies containing artificial intelligence.

Implications and Recommendations

At the end of the current research, it is possible to put forth a few recommendations relying on the main findings of the current research on the application of AI chatbots in the given field. First, advancement in the NLP algorithms will assist the chatbots to decipher the contextually proper communication. Second, the feedback in the form of pictures or some sounds will ease the interaction between the AI and people. Thirdly, the construction of learning paths that are altered based on the learners' achievement can provide better learning experiences to the former. Also, measures should be made to improve the technological assets which can be used to level the playing field in the application of AI.

Therefore, despite the many benefits that live AI chatbots provide in language education, critical solutions suggested the following to unlock the full potential of the mentioned possibilities: It is crucial to deepen an understanding of the context of the issues mentioned above, promote situations that would pave the way to the access of technology used in the implementations of educational constructs, and to incorporate these improvements into the methods of teaching. The future work should therefore examine

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how inequality of communication in a language is managed by the AI and how best the interaction between the AI and the human being can be done for language learning. Hence, through overcoming of the aforesaid barriers, this type of AI assisted chatbots can

significantly facilitate the improvement of the overall LLT and help learners achieve the desired and, in some instances, surpass the spoken language proficiency levels.

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Article



I.R. Askarov
Andijan State University
Andizhan st.
Uzbekistan

Yu.T. Isaev
Andijan State University
Andizhan st.
Uzbekistan
yusufjon_67@inbox.ru

S.A. Rustamov
Andijan State University
Andizhan st.
Uzbekistan

A. Mamarazhapov
PC Vitabiotik
Andizhan region, Altynkul district
Uzbekistan

PHARMACO-TOXICOLOGICAL PROPERTIES OF ANTIANEMIC BIOLOGICALLY ACTIVE ADDITIVE

Abstract: This article presents the results of a study of the pharmacy-toxicological properties of a biologically active additive prepared from extracts of licorice roots and some medicinal plants, recommended for the prevention and treatment of anemia in children. As a result of laboratory experiments, it was revealed that this biologically active additive belongs to class V of safe substances, does not cause local changes on the skin, does not have an inflammatory effect on the mucous membranes of the eyes, does not cause allergic reactions, or changes in the internal organs of experimental animals.

Key words: licorice, traditional medicine, dietary supplement, anemia, pharmacological properties.

Language: English

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Introduction

Specialists from a number of leading scientific centers state the effectiveness of traditional medicine methods in the treatment of inflammatory and viral diseases [1-3].

Licorice root or licorice is a widely used herbal remedy used in folk and scientific medicine. Licorice, along with ginseng, is highly valued in folk medicine in eastern countries [4]. Based on the extract and

components of licorice roots, medicinal substances, syrups, mixtures and biologically active compositions are produced, which are widely used for the prevention and treatment of certain inflammatory diseases [5,6].

Academician G.A. Tolstikov provides information about 44 dietary supplements and 41 medicinal herbal collections containing licorice root [7].

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In this industry, scientists of Uzbekistan have achieved certain practical results. In particular, the Chairman of the Academy of Traditional Medicine of Uzbekistan, Doctor of Chemical Sciences, Prof. I.R. Askarov together with Doctor of Chemical Sciences, Prof. R. Nuriddinov, acad. I. Kalnins (Latvia), prof. University of Toronto (Canada) F. Polyak based on medicinal plants, including licorice, biologically active compositions AS-CURCUMIN¹, "ANTIVIR", "ASKAROVIR", "ANTIKOVIR", "NONI - ANTIVIR" were developed and introduced for the prevention and treatment of viral diseases [8].

As you know, anemia (anemia) is a disease resulting from a lack of hemoglobin in the blood. According to WHO, 40% of children under 5 years of age, 30% of women under 49 years of age and 37% of pregnant women worldwide suffer from anemia¹. Most of the drugs used to treat this disease are synthetic, and in most cases, they are ineffective. In addition, these drugs are relatively expensive.

Based on the above, together with specialists from the private enterprise VITABIOTK, a biologically active composition was developed and some of its toxicological indicators were studied. This product is intended to increase the body's resistance to diseases, strengthen the immune system and normalize biochemical processes occurring in the body by replenishing missing and deficient vitamins, macro- and microelements in everyday food.

Methods used.

The targeted biologically active additive is available in the form of syrup. It contains extracts of licorice roots, beets, grapes, rose hips, caraway, lemon balm, as well as succinic acid.

One of the main stages in the development of medicines and dietary supplements is determining their compliance with established toxic and hygienic requirements. The toxicological indicators of the biologically active additive developed by us were studied in the toxicological laboratory of the Center for Sanitary and Epidemiological Peace of the Ministry of Health of the Republic of Uzbekistan.

Determination of acute toxicity (LD₅₀).

Experiments to determine LD₅₀ were carried out using the Litchfield-Wilcoxon method [9,10] on 24 white outbred mice weighing 190-210 g. The animals were divided into 4 groups. For this purpose, the test substance was administered orally into the animals' bodies using a probe in single doses of 1000, 2000, 3000, 4000 and 5000 mg/kg. The condition of the animals was observed for 14 days. The appearance of signs of infection and deaths of animals were recorded as criteria for exposure to the test substance.

Study of local effects on the skin. When determining the toxicological parameters of drugs and dietary supplements, their local effects on the skin are studied. To determine this indicator, guinea pigs weighing 360-380 g were used as experimental animals. The test substance was applied to a skin area measuring 2x2 cm, in an amount of 20 mg per cm². At the same time, the main attention was paid to the possible appearance of signs of redness and swelling. Signs of redness were determined visually, and signs of tumors were determined by measuring the thickness of the skin with an electronic micrometer. Observations were carried out over 14 days. During this period, the test substance did not cause redness or swelling on the skin of animals. Therefore, a biologically active additive refers to substances that cause local changes on the skin.

Impact on the mucous membrane of the eyes. This experiment was carried out on experimental rabbits. The animals were observed for 14 days. However, no changes were noted in the eyes of the observed animals. From this we can conclude that the test substance is safe from the point of view of its effect on the mucous membranes of the eyes.

Study of allergenic properties.

These experiments were carried out on guinea pigs weighing 310-320 g, divided into 2 groups. First, the animals of the experimental group were injected with a suspension of 20 µg of the test substance in physiological solution in a ratio of 1:500. At the same time, animals in the control group were injected with saline solution.

The discussion of the results.

During the experiments carried out to determine acute toxicity in the tested doses in behavior, appearance and attitude towards food, as well as the lethal outcome of experimental animals, were not noted.

The test results showed that when administered orally, the acute toxicity indicator LD₅₀ is more than 5000 mg/kg, i.e. According to this indicator, the substance under study belongs to class 5 of safe substances [11].

At the conclusion of the experiments to identify local effects on the skin of experimental animals, no changes were noted. Thus, the test substance does not cause allergic reactions on the skin.

In the study of the properties of accumulation, i.e. accumulation of the test substance in the body, the results were used to identify the indicator of acute toxicity after oral administration. In particular, when the test substance is introduced into the stomach of animals, based on the specific time of their death, the average lethal time is calculated, and the degree of

¹ https://www.who.int/ru/health-topics/anaemia#tab=tab_1

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accumulation is determined according to a special classification (very high, high, medium weak). Since the specific indicator of acute toxicity of the test substance is above 5000 mg/kg, it was not possible to calculate the average lethal time for this substance. Consequently, the biologically active additive we developed can be classified as a substance whose cumulative property is of a functional nature.

Conclusion

Thus, as a result of the research, a biologically active additive containing extracts of licorice roots and some medicinal plants has been developed for the prevention and treatment of anemia in children. Acute

toxicity, local effects on the skin, on the mucous membranes of the eyes, allergenicity and cumulative properties of this biologically active additive were studied in laboratory conditions. At the same time, it was revealed that the studied substance in terms of acute toxicity can be classified as class 5 safe substances, i.e. to practically non-toxic substances. The results of the experiments showed that the biologically active additive we developed does not cause changes in the skin, in the mucous membranes of the eyes, does not cause allergic reactions and does not accumulate in internal organs. Therefore, the studied biologically active additive can be used for its intended purpose.

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Denis Chemezov
 Vladimir Polytechnic College
 MEng, Honorary Worker of the Education Field of the Russian Federation, Academician of International Academy of Theoretical and Applied Sciences, Lecturer, Russian Federation
<https://orcid.org/0000-0002-2747-552X>
vpc-science@yandex.ru

Grigoriy Klimenko
 Vladimir Polytechnic College
 Student, Russian Federation

Vladislav Markin
 Vladimir Polytechnic College
 Student, Russian Federation

Rodion Yurenko
 Vladimir Polytechnic College
 Student, Russian Federation

Marina Danina
 Vladimir Polytechnic College
 Student, Russian Federation

Aleksandr Popov
 Vladimir Polytechnic College
 Student, Russian Federation

Nikita Rybin
 Vladimir Polytechnic College
 Student, Russian Federation

Abubakr Khasanov
 Vladimir Polytechnic College
 Student, Russian Federation

Kirill Gureev
 Vladimir Polytechnic College
 Student, Russian Federation

ASSESSMENT OF THE DISPLACEMENT OF A CLAY LAYER DURING GEOTECHNICAL WORKS

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Abstract: The displacement of a clay layer in the zone of plane vertical loading and within 5 meters from the loading zone was graphically presented in the article. The results of the study will be useful to engineers when performing geotechnical works.

Key words: a layer of clay, displacement, pressure, model.

Language: English

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Introduction

Many engineers face the problem of a shallow clay layer when performing various geotechnical works. Clay is an elastic-perfectly plastic material [1-4]. The Mohr-Coulomb yield condition is used to calculate the compression deformation of the clay layer [5-7]. The reaction can be studied based on the associated or nonassociated flow rules of clay [8-10]. Thus, using this knowledge and powerful tools of computer engineering analysis, it is possible to determine the loads during the collapse of clay under the influence of compressive deformation on it.

Materials and methods

The method of determining the state of the clay layer in the plane loading zone consisted in creating a model of the clay layer with a length of more than 7 m and a depth of more than 3.5 m and subsequent loading with a vertical force. At the same time, the force on the clay layer model was applied at a length of 1.5 m. The reliability of the computer simulation results was ensured by setting the real properties of the clay layer model (Young's modulus – 207 MPa, Poisson's ratio – 0.3, cohesion – 0.069 MPa and angle of internal friction – 20 degrees). The

calculation of the displacement of the clay layer under the action of a vertical load was carried out in a stationary mode for the loading zone and within 5 meters from the loading zone.

Results and discussion

The deformed model of the clay layer was measured in the direction of the load action. The measurement results were presented graphically in the Fig. 1. The first graph shows the dependences of the displacement of the clay layer on the applied load. The second graph shows the dependences of the displacement of the clay layer within 5 meters from the loading zone. Each dependence (highlighted in a different color) is linear.

With an increase in the vertical load from 0 to 1000 kPa, each subsequent dependence has a larger range of values for the displacement of the clay layer. The maximum displacement of the clay layer is 32 mm. The range of displacement of the clay layer at 500 kPa is more than three times less than at 1000 kPa. At the same time, the clay layer within 5 meters from the loading zone shifts with a lower intensity (up to 10 mm when exposed to a force of 1000 kPa in the adjacent zone).

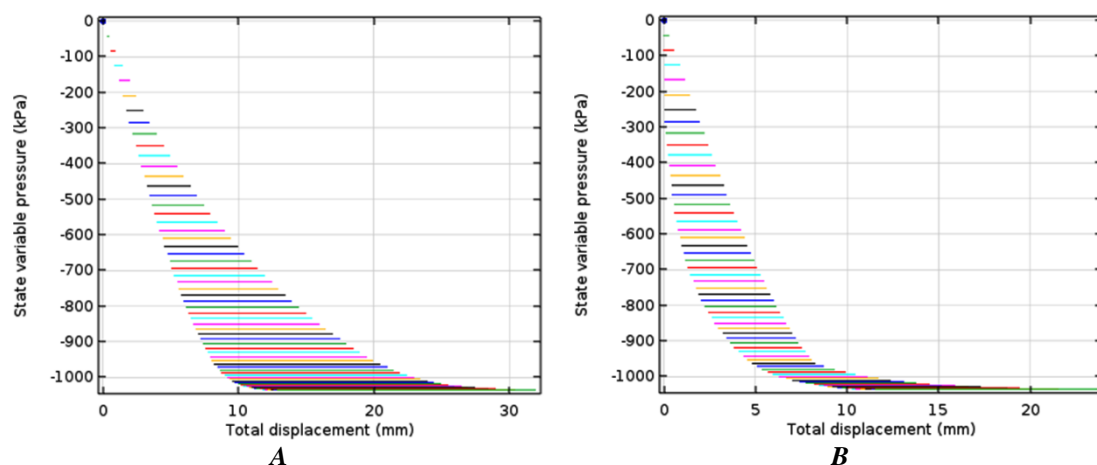


Figure 1. The dependences of the displacement of the clay layer on the effective pressure: *A* – in the action zone of the vertical load; *B* – within 5 meters from the loading zone.

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Conclusion

Based on the analysis of the experimental results, the following conclusions can be drawn:

1. In the zone of the load application from 0 to 1000 kPa, the displacement of the clay layer reaches 32 mm. Within 5 meters from the loading zone, the displacement range of the clay layer varies from 26 to 0 mm.

2. The largest range of total displacement of the clay layer from the minimum to the maximum values is observed at the highest pressure.

3. The dependences of the displacement of the clay layer in the load application zone are more proportional than the dependences of the displacement of the clay layer within 5 meters from the loading zone.

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