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FORMATION OF DIGITAL AND RESEARCH COMPETENCES IN THE TRAINING OF IT PROFESSIONALS IN A MODERN UNIVERSITY

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The article is devoted to the formation of digital and research competences of future IT professionals by applying complex practice-oriented tasks on the example of the educational topic "Development of chatbots using free online designers". The study of this topic is recommended within such disciplines as "Office Computer Technologies", "Information Systems in the Social and Legal Sphere", "Computer Information Technologies" and corresponds to the educational programs of the first (bachelor's) educational level in "Software Engineering", "Computer Science" and "Information Systems and Technologies". The purpose of studying the chatbot development technologies is learning of modern information and communication technologies by students for their practical implementation in the development and maintenance of software, as well as ensuring the occupational activity of employees of different categories. The educational topic "Development of chatbots using free online designers", which is offered for teaching in a modern university, is aimed at generalizing theoretical knowledge and developing practical skills of students of Bachelor level majoring in design in free software environments. The use of chatbots is one of the effective modern ways of communicating with users on mobile devices, which allows companies to reduce costs and attract new customers as well as timely meet the needs of existing customers. The study of this topic by students resulted in development of a chatbot working in the Telegram platform, which consults and provides answers related to the company's activities. To create the bot the free BorisBot service was used. The experience of teaching the topic of chatbot development at Kherson State University showed that its application in the preparation of bachelors majoring in 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies" motivates students to solve profession-oriented tasks.

Key words: *chatbot, computer information technologies, research competence, digital competence, IT professionals.*

1. Introduction

Problem statement. The model of modern higher education is reoriented from the system of transfer of scientific and practical information to the system of its independent assimilation by students, search of ways to solve the tasks related to personal and professional activity through active creative research. The priority task of a modern university is to train professionals competitive in the national and international labor markets. In this regard, the dominant criterion should be the formation of competences that will facilitate the adaptation of a professional in the information society through the implementation of complex tasks of professional activity. The process of formation of such competences in students of IT specialties requires the use of modern information and communication tools in the course of the professional training; they are, in particular, design, creation and use of chatbots for providing computer support in mastering academic disciplines and professional information activities.

2. Analysis of recent studies and publications

The domestic researcher N.V. Valko notes that the development of technologies influences the formation of curricula of educational specialties [1]. Disciplines dedicated to the study of digital technologies have become part of the curriculum of all specialties in the educational field. We agree with N.V. Valko's opinion that to teach future IT-specialists and teachers, curricula should include integrative disciplines; the use of modern technology in the learning process [1]. The directions of study of students of natural and mathematical disciplines are determined by the curricula of specialties [1].

The researchers V. Osadchyi, N. Valko, N. Kushnir point out that to solve the problem of involving students in engineering and technological creativity and to increase supply of qualified personnel to the market, it is necessary to have guidelines that will contribute to the establishment of criteria for the formation of a specialist trained in technology [2]. The problem of hiring qualified personnel is common to all countries. Digital competences help solve this problem. The European Parliament and the Council of the European Union have adopted "Recommendations on key competences for lifelong learning", which are: "Knowledge of mathematics and general knowledge in science and technologies" and "Skills in working with digital media" [2]. Since 2015 there has been a gradual update of the Digital Competency Framework (DigComp 2.1) [3]. This document has become the basis for developing further documents and methodology.

Therefore, to ensure the quality education for those pursuing bachelor's degree in the specialties 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies", it is important to consider the peculiarities of the organization and course of the educational process for higher education level "Bachelor" and to apply innovative learning technologies using personal-activity and competency-based approaches. In this regard, analyzing modern approaches to professional training in high educational institutions, Professor O.V. Spivakovsky notes that most universities use traditional approaches to the organization of occupational education, in which a student feels as the object of the pedagogical influences which do not require his initiative, creativity, activation of reflection, do not contribute to solving these problems and do not provide the appropriate level of erudition, scientificity and professionalism [4, 5]. Creating proper conditions, in particular, the introduction of web technologies, interactive modes and methods of work as well as ensuring students' motivation for creative work and professional activities contribute to achieving the goal – formation of professional competence of software engineers and computer science professionals with the higher education level "Bachelor" [6].

Tasks similar in content are outlined in the Standard of Higher Education in the field of knowledge 12 "Information Technologies" for training Bachelors approved by the Order of the Ministry of Education and Science of Ukraine № 962 dd. 10.07.2019 and in the educational and professional program for training specialists at the educational qualification level "Bachelor" of the following specialties: 121 "Software Engineering", 122 "Computer Science", 123 "Computer Engineering", 126 "Information Systems and Technologies". Its educational component is the course "Office Computer Technologies".

The researchers M.P. Shyshkina [6], M.I. Sherman [7, 8], G.V. Stetsenko [9], L. Raitska [10], N.O. Kushnir, N.V. Valko [2, 5], T.V. Zaitseva [11] and others link the effectiveness of Internet technologies in education to the fact that they create an environment which contributes to the development of students' creative abilities due to stimulation of their curiosity, flexibility and diversity in learning, formation and development of divergent (non-stereotypical) thinking and growth of motivation.

Unresolved aspects of the problem. However, in the formation of digital and research competences of future software engineers and computer science professionals pursuing a bachelor's degree in a modern university, there are the following inconsistencies between the stakeholders' requirements and the actual state of professional training:

– partial consideration of the potential needs of bachelors in specialties 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies" in the

content of disciplines "Office Computer Technologies" and "Information Systems in Social and Legal Sphere" due to the high dynamics of the labor market structure and the presence of insufficiently predictable factors influencing it (for example, pandemics, natural disasters, cartels, etc.);

– insufficient formation of initial, basic skills in design and development of software products in the process of teaching these disciplines;

– insufficient motivation of applicants of higher education majoring in IT within the bachelor's programme for research and creative activities.

Partial resolution of the indicated contradictions, in our opinion, will be facilitated by the introduction of the topic "Development of chatbots using free online designers" in teaching the discipline "Office Computer Technologies" and related disciplines ("Information Systems in the Socio-Legal Sphere", "Computer Information Technologies").

The content of the modern university course "Office Computer Technologies" should correspond to the educational programs of the specialties "Computer Science", "Information Systems and Technologies" of the bachelor's degree, which is aimed at studying information and communication technologies and modern software engineering technologies for their practical implementation in real processes of software development and maintenance [12].

The discipline "Office Computer Technologies", according to the curricula of Ukrainian universities, includes the study of such topics as "Classification of software products. Service software. Operating system", "Creating and editing graphic files", "Creating text documents and working with multi-page documents", "Creating spreadsheets and calculation technology used in them", "Database design, creation of tables and forms in MS Access", "Creating MS Power Point presentations package", "Internet technologies and free web 2.0 services" [5, 12, 13, 14]. Such a content of the academic discipline for the preparation of students majoring in 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies" neither fully contributes to the development of creative and research components of the professional competence of future IT professionals nor entirely meets the needs of their practical professional activity. Despite the significant number of scientific papers covering the use of information technologies in education, in our opinion, there still remain relevant issues on enhancing and updating the teaching and methodological support of the course "Office Computer Technologies" aimed at improving the quality of professional training of students studying computer specialties.

The purpose of the research is to develop and implement the topic "Development of chatbots using free online designers" in the course "Office Computer Technologies" and related disciplines as a means of forming digital and research competences of undergraduate students majoring in 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies". Achieving the outlined purpose of the research defines the following research objectives:

- to determine the extent of compliance of the content and teaching methods of the discipline "Office Computer Technologies" and related courses with stakeholders' requirements in information and communication technologies;

- to consider the expediency of updating the content of the academic discipline "Office Computer Technologies" by introducing the topic "Development of chatbots using free online designers".

3. Results of the research

The educational topic "Development of chatbots using free online designers" offered for teaching within the course "Office Computer Technologies" is aimed at generalizing theoretical knowledge and developing practical skills of students pursuing bachelor's degree in design in free software environments.

This topic is chosen due to the fact that the chatbot is one of the most promising information and communication tools to improve the efficiency of companies; working with it is of interest to students, as it is currently a high-demand and promising technology among commercial institutions.

A chatbot is a messenger application controlled by predetermined behavioral algorithms or artificial intelligence, with which a user interacts through a dialog box. Such programs are also called virtual interlocutors. This tool expands the possibilities of communication with customers and can be a channel for customer registration and identification. Users can interact with bots by sending them messages, commands and built-in queries. With the introduction of bot technologies, users have lower demand for contacting the support service to address issues, most of which are identical. In case the client needs personalized help on certain issues, the chatbot can switch him to an appropriate expert.

Each chatbot includes the following three main functions:

1. *Incoming data recognition* – the chatbot analyzes an incoming text and audio and translates the data into machine-readable code.
2. *Data analysis* – each conversational agent has an algorithm that processes data in search of instructions.
3. *Decision making* – after analyzing incoming data, the bot must give answer to the user. In fact, there is a logic that has decided how to respond to incoming data and what to do after the answer.

Chatbots can work in various areas, from FAQ customer support to optimizing the transaction process. With artificial intelligence making the use of chatbots more efficient, the demand in applying chatbots will become even greater.

The topic "Development of chatbots using free online designers" was offered to first-year students of Kherson State University of the specialties "Software Engineering", "Computer Science", 126 "Information Systems and Technologies", 051 "Economics (Economic Cybernetics)" in studying the discipline "Office Computer Technologies". The students were given the following tasks:

1. to search and systematize information on the development of chatbots on free platforms;
2. based on the conducted analysis, to choose one of the available platforms for creating bots, compiling a dictionary of terms and categories associated with this software environment;
3. to define purposes, tasks and directions of work of the created chatbot;
4. to develop the algorithm of the bot;
5. to develop questions and answer options for the bot consultant according to the developed algorithm, using free services for designing bots.

At the initial stage of studying the topic, the teacher invites students to review the available free platforms for designing chatbots, to conduct a comparative analysis and draw certain conclusions.

At the second stage, students choose a platform for creating a bot among such environments as Telegram, Facebook Messenger, Viber, CRM (for example, in Bitrix24).

At the third stage, students identify and formulate specific tasks and directions of work for the bot.

After that, they prescribe the algorithm of interaction of the bot with the user and develop menus and response templates. Online designers allow creating chatbots for free even without skills in programming, but to provide effective development of the bot it is important to correctly set the goals and scenarios of its work.

The final stage is creating questions and bot's answers with the help of free services, as also designing the bot. Depending on the chosen purpose, the corresponding services are to be used to develop bots. The most popular are: *Bot kits* (supports platforms: Vkontakte, Odnoklassniki, Facebook, Telegram, Viber, Skype; can be connected to the company's website), *Manybot* (service designed specially for Telegram), *BorisBot* (helps to create useful bots in messengers, browser, email, SMS), *Flow XO* (supported platforms: Facebook, Telegram, Slack, Twilio SMS), *Botmother* (supported platforms: Facebook Messenger, Telegram, Viber, Vkontakte, Odnoklassniki) [15].

To implement the set tasks, students of Kherson State University have developed a bot that consults customers (provides brief information) on administrative and civil law, in which the law

firm specializes. After a comparative analysis of the availability, performance and functionality of the most common platforms, students chose Telegram messenger as the platform to locate the bot.

To create a chatbot, students registered its name in the messenger so that potential customers could find it through a search or a direct link. For this purpose, we used BotFather – a bot that controls all bots in Telegram. It is used to create new bot accounts and manage existing ones. The authorization token generated by BotFather for the new bot named "pravonazahust_bot" is presented in Fig. 1.

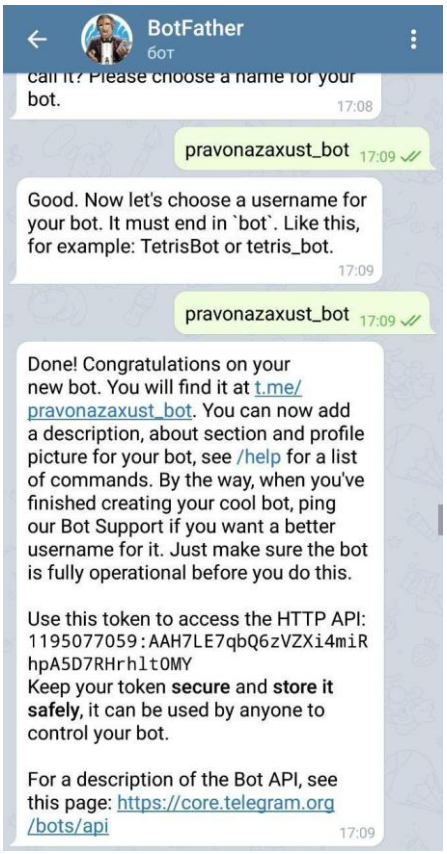

Fig. 1. Generation of the authorization token for the new bot "pravonazahust_bot"

For further work on creating a bot, the students decided to use the free service BorisBot (Fig. 2) [16]. Fig. 2 contains the text in Russian, because the students used the Russian-language interface of BorisBot.

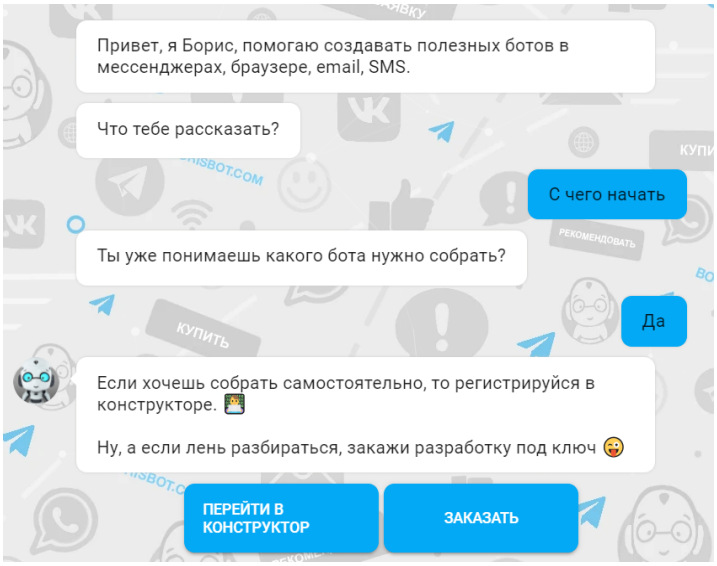

Fig.2. Beginning of work on creation of the bot in BorisBot service

A fragment of the block diagram showing the operation algorithm of the bot developed by students of Kherson State University in the process of mastering the discipline “Office Computer Technologies” is presented in Fig. 3. Figures 3–6 contain the text in Ukrainian, as they show a created chatbot designed for local use by Ukrainian consumers in Ukraine.

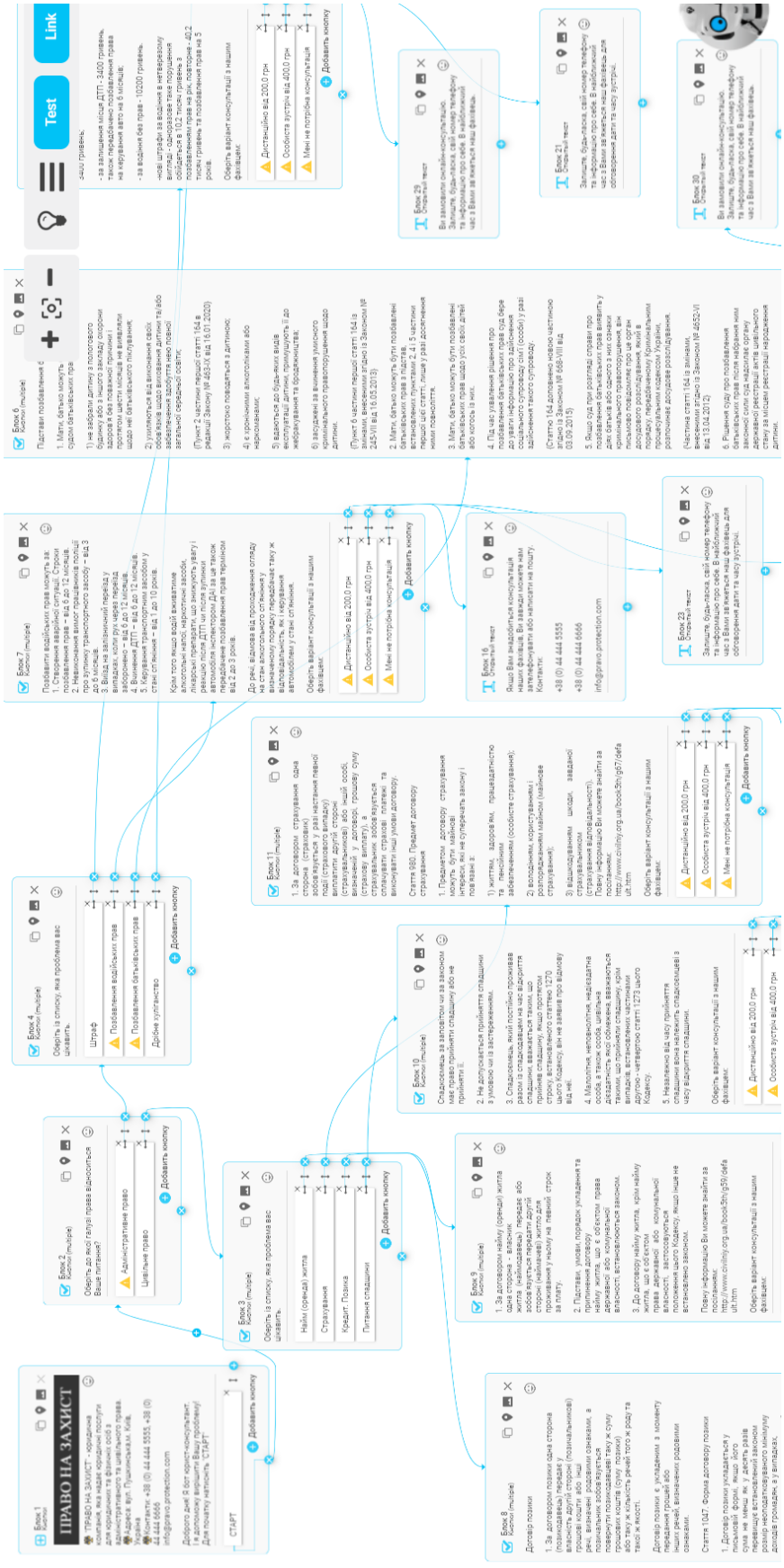

Fig 3. A fragment of the block diagram of the bot's algorithm for the law firm, developed by students of Kherson State University in the process of mastering the discipline "Office Computer Technologies"

The image of the page containing the first message sent by the bot with the description of the company and its purpose is presented in fig. 4. Also in fig. 4, there is main menu of the chatbot created by students, which consists of two buttons denoting two areas the law firm specializes in: administrative law and civil law.

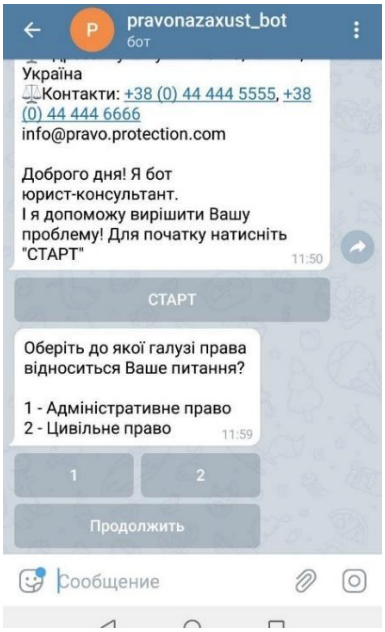

Fig.4. The first message and main menu of the created bot

If the first category is chosen in the menu of the created bot, namely "Administrative Law", the bot will send a message "Choose from the list which problem you are interested in:" along with a list of services for which the law firm provides legal support (fine, disqualification from driving, deprivation of parental rights, petty hooliganism), Fig.5.

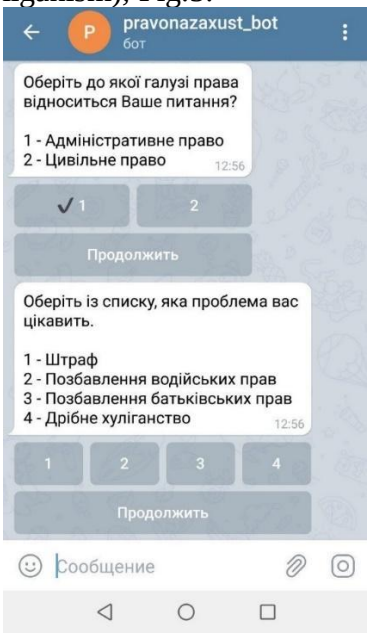

Fig.5. The first submenu of the bot on the issues relating to administrative law

After a user selects the desired topic from the submenu, the bot sends brief information on the selected category (Fig. 6).

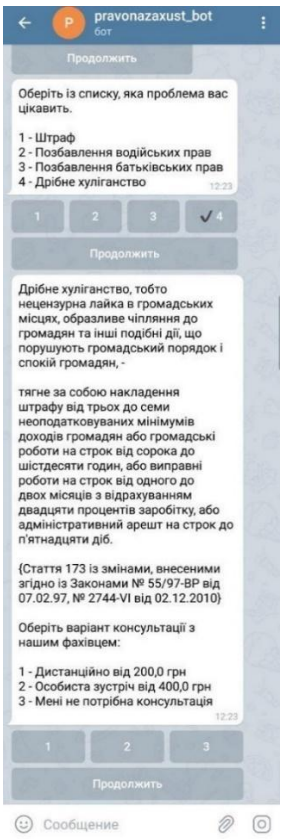

Fig.6. Example of the bot's answer on the selected category "Petty hooliganism"

The bot consultant on administrative and civil law created by the students met the requirements for operating without errors and logically performed the tasks defined by the developers.

The pedagogical experiment to motivate students for resolving practice-oriented tasks and to intensify independent research work by implementing the educational topic "Development of chatbots using free online designers" into the course "Office Computer Technologies", that had been held at the Faculty of Computer Science, Physics and Mathematics of Kherson State University of Ukraine for 2 years, witnessed positive changes in the level of development of students' professional competences and personal skills.

The experiment involved first-year students majoring in "Software Engineering", "Computer Science", "Information Systems and Technologies", "Economics (Economic Cybernetics)" with a total of 110 people.

The control and experimental groups had access to the distance course "Office Computer Technologies", which had been created by the authors in solving issues related to software and hardware and localized on the educational web resource of Kherson State University ksuonline. In addition, training materials on developing chatbots using free online designers were recommended for the experimental group. In the control and experimental groups, student performance was measured by the results of practical work and control work; and the level of personal abilities, their motivation to acquire practical skills in design and programming – by observation and survey methods [13]. According to the results of the study, in the experimental groups the level of students' independence in performing tasks is significantly increasing, the number of visits to educational web resources on open platforms is growing. In the experimental groups, students became more motivated and ready to solve creative tasks of professional orientation. An increase in performance rate by 15.5% was recorded in the students of the experimental group compared with those of the control group (Fig. 7.)

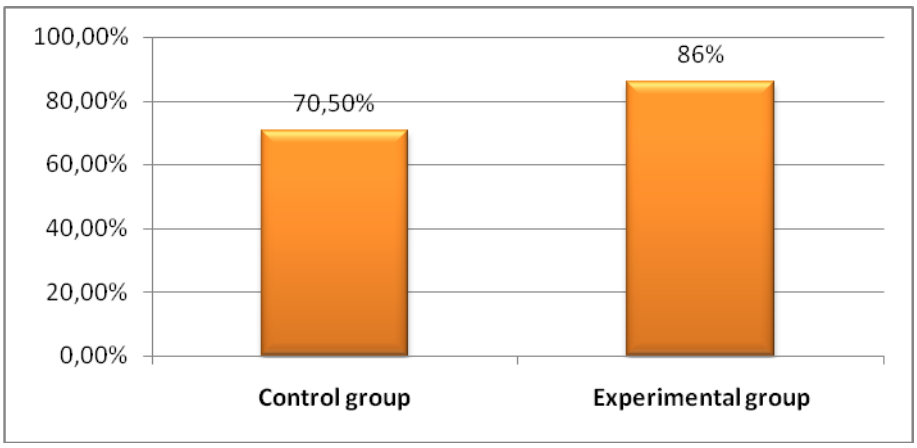

Fig. 7. Diagram of student performance in the course "Office Computer Technologies" at Kherson State University during 2017-2019. Control group vs Experimental group

To determine the students' attitude to the work on designing and creating chatbots and the effectiveness of acquiring professional, research and personal skills, a questionnaire with 11 questions was developed. According to the results of the survey, it can be concluded that the majority of students (84.5%) want to continue to study the topic of chatbot development, as well as use cloud resources and free services to enhance knowledge, skills and abilities. 67% of future IT professionals are satisfied with the opportunity of learning to develop bots and inclusion of this type of educational work in the discipline "Office Computer Technologies".

The students of the experimental group demonstrated the ability to move faster from the stage of generating ideas to the stage of their practical implementation compared to the control group, which indicates better skills in solving practical problems in software engineering and IT, team communication skills, ability to process and analyze information, the ability to participate in software design, the ability to develop algorithms and reasonably select and master tools for the development and maintenance of information technologies (Fig. 8).

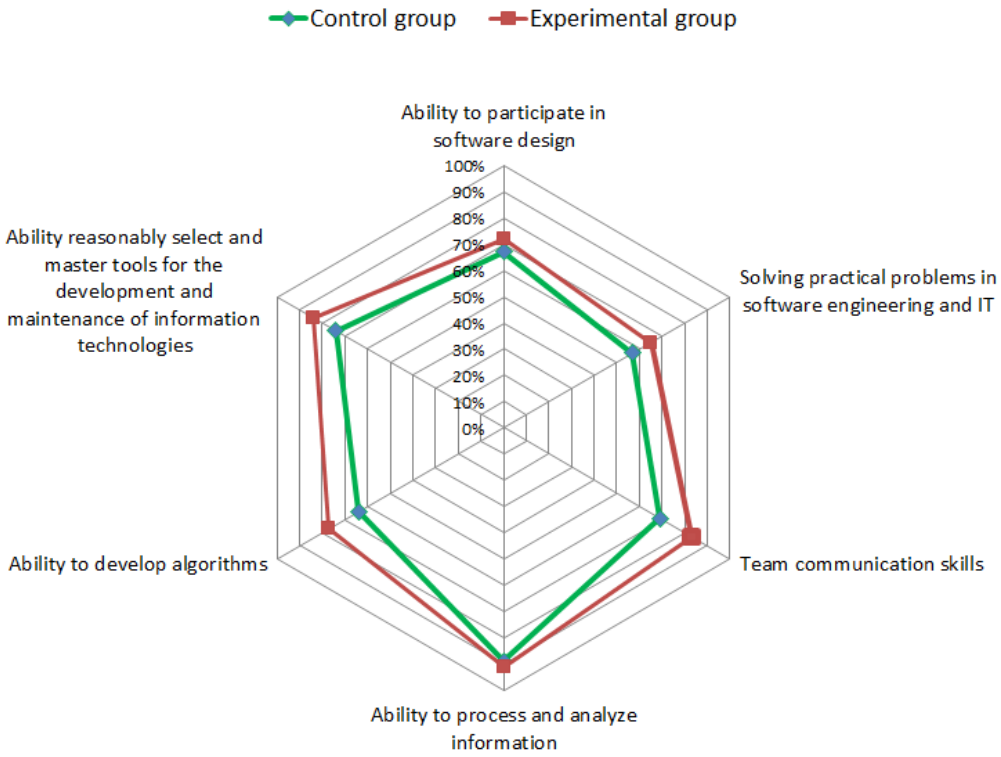

Fig.8. The results of student surveys on the subject "Office Computer Technologies"

The application of such a complex practice-oriented task as the development of a chatbot using free designers contributed to the formation of digital and research competences of future IT

professionals in the specialties 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies", 051 "Economics (Economic Cybernetics)".

4. Conclusions and prospects for further research

The academic discipline "Office Computer Technologies" is an educational component of the system of professional training of future bachelors in specialties "Software Engineering", "Computer Science" and "Information Systems and Technologies" and aims at studying information and communication technologies, modern technologies of software engineering for their practical realization in real processes on development and maintenance of software and ensuring the implementation of professional information activities of various categories of employees. It was found that the content of this discipline and related courses ("Information Systems in Social and Legal Sphere", "Computer Information Technologies") does not fully meet the current requirements of employers and individual professional communities, in particular, in terms of resolving complex practice-oriented tasks to ensure the functioning of institutions and companies [17].

It was proposed to introduce the topic "Development of chatbots using free online designers" into the content of the discipline "Office Computer Technologies", which corresponds to the main focus in the curricula of the first (bachelor) educational level “Software Engineering", "Computer Science" and “Information Systems and Technologies”. This topic is chosen due to the fact that the chatbot is one of the most promising information and communication tools to improve the efficiency of companies. The introduction of chatbots can significantly expedite the process of interaction with customers; knowledge and skills in this technology are currently a popular competence for IT professionals in the business environment. The result of studying this topic within the discipline "Office Computer Technologies" by students is the development of a bot consultant to work in the Telegram platform, which provides brief information and answers on the company's activities.

The experience of using the topic on chatbot development with the help of free online resources at Kherson State University and the results of the pedagogical experiment showed that applying such complex practice-oriented tasks in studying the discipline "Office Computer Technologies" for bachelors majoring in 121 "Software Engineering", 122 "Computer Science", 126 "Information Systems and Technologies" and related specialties motivates them to resolve profession-oriented tasks and contributes to the formation of digital and research competences of future IT professionals.

Further research can be carried out in the direction of pedagogical and empirical studies aimed at developing appropriate modern methods for teaching information technology disciplines as also development of means of their computer support at universities.

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ФОРМУВАННЯ ЦИФРОВОЇ ТА ДОСЛІДНИЦЬКОЇ КОМПЕТЕНТНОСТЕЙ У ПІДГОТОВЦІ ІТ-ФАХІВЦІВ В УМОВАХ СУЧАСНОГО УНІВЕРСИТЕТУ

Стаття присвячена формуванню цифрової та дослідницької компетентностей майбутніх ІТ-фахівців шляхом застосування комплексних практико-орієнтованих завдань на прикладі освітньої теми «Розробка чат-ботів з допомогою безкоштовних онлайн-конструкторів». Вивчення цієї теми рекомендується в межах таких дисциплін, як «Офісні комп'ютерні технології», «Інформаційні системи в соціально-правовій сфері», «Комп'ютерні інформаційні технології» та відповідає освітнім програмам першого (бакалаврського) рівня освіти «Інженерія програмного забезпечення», «Комп'ютерні науки» та «Інформаційні системи та технології». Метою вивчення технології розробки чат-ботів є вивчення студентами сучасних інформаційно-комунікаційних технологій для практичної реалізації їх у процесах розробки та супроводу програмного забезпечення, а також забезпечення професійної діяльності працівників різних категорій. Освітня тема «Розробка чат-ботів з

допомогою безкоштовних онлайн-конструкторів», що пропонується до викладання в умовах сучасного університету, спрямована на узагальнення теоретичних знань та розвиток практичних навичок студентів рівня підготовки «бакалавр» з конструювання в безкоштовних програмних середовищах. Використання чат-ботів є одним з ефективних сучасних способів комунікацій з користувачами на мобільних пристроях, що дає можливість компаніям знизити витрати та залучити нових клієнтів, своєчасно задовольняти потреби своїх споживачів. Результатом вивчення цієї теми студентами є розробка чат-бота для роботи в платформі Telegram, який консультує та надає відповіді з питань діяльності компанії. Для створення бота було використано безкоштовний сервіс BorisBot. Досвід викладання теми з розробки чат-ботів у Херсонському державному університеті засвідчив, що її застосовування в процесі підготовки бакалаврів спеціальностей 121 «Інженерія програмного забезпечення», 122 «Комп'ютерні науки», 126 «Інформаційні системи та технології» мотивує студентів до розв'язання завдань професійної спрямованості.

Ключові слова: чат-бот, комп'ютерні інформаційні технології, дослідницька компетентність, цифрова компетентність, ІТ-фахівці.