Telegram Messenger for Supporting Educational Process under the Conditions of Quarantine Restrictions

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Abstract
The article is devoted to the problem of using Telegram messenger in the educational process in supporting the higher school under the conditions of forced quarantine restrictions due to the Covid-19 pandemic. Modern messengers (Telegram, Viber, Facebook Messenger, WhatsApp) are analyzed via pre-defined criteria (commerciality, functionality, architecture, security) and the range of indicators, the benefits of using Telegram messenger to support the educational process are outlined. The essence, benefits, and possibilities of using Telegram ChatBot are characterized. The main steps for creating Telegram ChatBot are described. Recommendations are provided to improve the pedagogical effect of using Telegram ChatBots. The analysis of results of educational interaction via Telegram messenger is presented (112 students' survey, evaluation of learning outcomes in experiment (112 students) and control (110 students) groups). The empirical research has shown that Telegram messenger allowed supporting the educational process in the conditions of unexpected and forced quarantine restrictions, with no loss of qualitative indicators, achieving the pedagogical goals.

Keywords
Telegram messenger; ChatBot; students; higher school; survey; quarantine restrictions.

1. Introduction

The modern stage in mankind's development is characterized by the digitalization of all spheres of life. Innovative technologies, in particular the Internet of things, neural networks, artificial intelligence, machine learning, virtual and augmented reality, etc. change the usual processes: occupational activity, professional and informal interaction, leisure and everyday decisions, training, and self-development. Digital transformation covers global economic phenomena, and the formation of the professional identity of each individual as well.

The introduction of quarantine restrictions caused by the COVID-19 pandemic made its adjustments to the current functioning of national educational systems. Online learning methods and relevant tools and apps went to the fore. As it is said, "the COVID-19 pandemic has made online learning a new normal in most, if not all, educational contexts across the globe" [4].

Many universities all over the world have found decisions on the organization and support of the educational process via various tools and technologies: e-content repositories and national virtual platforms, learning management systems, cloud solutions from companies such as Microsoft and Google, YouTube channels, Edmodo, Zoom, Skype, WhatsApp, Blackboard, e-mail, and messengers, etc. [8, 5]. UNESCO has developed a list of educational apps, platforms, resources aimed to help educators,

parents, students, and administrators facilitate the learning process and provide social care and interaction during the pandemic period. Most of these solutions curated are free and cater to multiple languages.

Along with these, the participants of the educational process are forced to face many challenges, namely: a need to support the digital divide, disrespect for the primary goal of the learning process, a negative impact on the interaction between instructors and students [3], problems concerning Internet speed, materials downloading, online exams [8], limited technological infrastructure and capacity, socio-economic factors, lack of experience to conduct assessment and supervision in an online mode, the extra workload for teachers and education staff, and incompatibility with some specific subject matters or cultures [4], decreased motivation in students, delayed feedback or help, feelings of isolation due to lack of physical presence of classmates [1], privacy and security concerns, lack of engagement in class, difficulty in maintaining their focus after attending multiple online sessions [13], etc.

The pandemic has resulted that globally, over 1.8 billion children and youth were ousted out of the classroom. Education has changed rapidly, with teaching undertaken remotely. This exacted the processes of digitalization and the search for effective solutions in training organizations, which is confirmed in recent researches.

The USA article [12] is devoted to the issue of providing a personalized learning environment to the students and discusses 7 ways in which artificial intelligence are influencing education, namely: learning through chatbots, enhanced student engagement, smart & secure feedbacks, efficient teaching assistants, instant help to students, better student support, up-to-date information for the institutions.

The study of Malaysian scientists [17] reflects how it is advisable to use Telegram in the training of postgraduate students. Several types of educational and organizational activities are noted that can be implemented using this service, in particular: visits' monitoring, discussions in small groups, exchange of educational graphics and audio files. The survey showed that postgraduates noted the increase in their creativity, the desire to generate new ideas (often spontaneous), reduction of anxiety about the fear of their ideas' rejection, capture by training, etc.

Authors from Saudi Arabia [9] examined the attitude of students of medical specialties to the organization of online training via Telegram during quarantine restrictions. Respondents defined the following advantages of service: widespread and convenient access to educational materials (lecture slides, e-books, websites, educational podcasts, forums, associative cards, articles, etc.); availability to share files, regardless of their number and size; availability to communicate with colleagues and tutors both in synchronous and asynchronous regime; high-security level, etc. In general, the vast majority of 203 students gave a positive assessment of Telegram, recognizing it as an effective tool for supporting forced online training.

The authors (Spain) present the reasons that led to the adoption of a chatbot (virtual assistant), the process of its development, the assessment of its usefulness, and the role of teachers in the implementation of this type of technological innovation [10], develop the design and implementation of a Telegram bot for training students in any subject using multiple choice question quizzes [7].

The advantages of Telegram messenger and requirements for the software product (chatbot) are highlighted in the paper of Ukrainian authors [6].

Along with this, there is a need for further studying the capabilities of using Telegram messenger tools to support the educational process.

The purpose of the article is to define the essence, benefits, and possibilities of using Telegram messenger for supporting the educational process under the conditions of quarantine restrictions.

2. The presentation of main results

2.1   Telegram messenger for supporting the educational process

At the stage of selection of a messenger for supporting the educational process, we have done the following: 1) conducted a survey among students and found out what messengers they prefer; 2) carried out a comparative analysis of the characteristics of these messengers for the election of the most appropriate, according to predefined criteria and indicators.

The results of the students' survey (112 people, aged 17-23) showed that they prefer such messengers as Telegram (98,9 %), Viber (73,7 %), Facebook Messenger (26,3 %), WhatsApp (17,9 %). According to many comparative surveys, Telegram is superior to other messengers in a number of parameters, particularly in terms of functionality and safety [14, 11, 15, 6, 16, etc.]. We have made the comparison of named messengers, defining the criteria and indicators that are in our opinion significant for easy, efficient, functional, secure usage of the app (Table 1):

- Commerciality (prize, advertisement);
- Functionality (Sending images, animation, audio, video, documents; sending text links; voice and video messages; editing messages; file replacement; mention of users; responses to the message; mass sending; creating groups; comments; chats structuring (folders/tabs etc.), audio- and videoconferencing; surveys; ChatBots support; view action history; general statistics; using cloud storage; search);
- Architecture (infrastructure; multiple accounts support; synchronization on different devices; limits of number of devices for synchronization; OS supported; strict binding to mobile clients; backup; internal memory; data import / export support);
- Security (spam protection; blocking illegal content; perfect forward secrecy; end-to-end encryption for all chats).

Although the messengers are different from each other, all of them belong to the important tools of modern networking and communication, and have many features in common: free of charge, support of different formats exchange (images, animation, audio, video, documents, etc.), creating groups, synchronization on different devices, safety, etc. Our analysis has shown that Telegram messenger leads among other similar services, both as of the results of the students' survey and as of the criteria (commerciality, functionality, architecture, security). Thus, we have chosen this messenger as a tool for supporting the educational process during forced quarantine restrictions.

Table 1.
Comparison of messengers by defined criteria and indicators

Criteria	Indicators	Telegram	Viber	Facebook Messenger	WhatsApp
Commerciality	Prize	Free	Free	Free	Free
	Advertisement	-	+	+	+
	Scores	2/2	1/2	1/2	1/2
Functionality	Sending images, animation, audio, video, documents	+	+	+	+
	Voice messages	+	+	+	+
	Video messages	+	+	-	-
	Editing messages	+	+	-	-
	File replacement	+	-	-	-
	Mention of users, responses to the message	+	+	+	+
	Mass sending	Up to 100 messages	Up to 25 massages	Needs an activation of additional functions	Up to 10 massages
	Creating groups	+	+	+	+
	Comments	+	-	-	-
	Chats structuring (folders/tabs etc.)	+	-	-	-
	Audio- and video-conferencing	+	+	+	+

Surveys	Anonymous / non-anon-ymous, sev-eral an-swers, quiz-zes	1 answer	1 answer	-
ChatBots support	+ (@BotFather and Bot API)	+ (Viber REST API)	-	-
View action history, gen-eral statistics	+	-	-	-
Using cloud storage	+	-	-	-
Search	Text, hashtags, categories (chats, me-dia, links, files, voice messages), etc.	Text	Text	Text
Scores	16/16	8/16	5/16	5/16
Architecture Infrastructure	Cloud	Cloud	Cloud	Cloud
Synchronization on differ-ent devices	+	+	+	+
Limits of number of de-vices for synchronization	Unlimited	Limited	Limited	Limited
OS supported	Android, iOS, Win-dows, MacOS, Linux, Wear OS, watchOS	Android, iOS, Windows, MacOS, Linux, Wear OS, watchOS	Android, iOS, Windows, MacOS	Android, iOS, Windows, MacOS
Backup	+	+	+	+
Internal memory	For loaded content only	Saves all content	Saves all content	Saves all content
Data import / export sup-port	+	Limited	Limited	Limited
Scores	7/7	4/7	3/7	3/7
Security Spam protection	+	-	-	-
Blocking illegal content	+	+	+	+
Perfect Forward Secrecy	Supported	Supported	Supported	Supported
End-to-end encryption for all chats	-	-	-	+
Scores	3/4	2/4	2/4	3/4
General Scores	28/29	15/29	11/29	12/29

Among the advantages of Telegram messenger for educational purposes, we define:
- Cross-platform – availability on various gadgets and platforms, in particular Android, iOS, Windows, MacOs, Linux.

- Synchronous and asynchronous format – availability both in real-time (synchronous format, e.g. via audio- and video-conferencing), and independently in time, ever, and anywhere (asynchronous format, e.g. via ChatBots).
- Sharing messages of different formats: text, voice, and video messages, photography, files of various formats, hyperlinks to external resources.
- Support for various types of interaction: audio and video calls, audio and videoconferencing, groups and channels.
- Ensuring the implementation of many pedagogical tasks, e.g. submission and learning the educational material, knowledge control, etc. In this case, it is possible to add material both in the messenger directly and by hyperlinks to external sources (video fragments, test programs, etc.).

Among the range of functions, Telegram messenger proposes the option of ChatBot creation, which is a promising tool to support the educational process.

2.2   Telegram ChatBot: essence, features, guidelines to use

In a general sense ChatBot is a program that automates communication with users according to a specified scenario. It can "communicate" with a person, respond to questions, provide information, execute requests. Communication occurs via text chat or voice. ChatBot usually runs on the site, social network, or messenger.

The main advantage of Telegram ChatBot is that programming skills are unnecessary to create it. The messenger offers an affordable toolkit that allows creating a ChatBot by any users, e.g. educators who are deeply not aware of IT.

Based on our practical experience we defined some advices on developing Telegram ChatBot for supporting the educational process:
- At the initial stage of creating a ChatBot, it is expedient to develop its general concept, that is to determine the purpose of its creation, target audience, tasks that we plan to solve via this tool. For example, a ChatBot may cover the entire training course, or a separate topic, thematic or final control, etc., it can be used regularly or in certain circumstances (for exact topics), etc.
- Consider the ChatBot identity – its avatar, name, communication style, etc. This is not a mandatory step, but it can bring your development closer to the users' features. For example, to build interaction with students in a more informal style (apply more informal statements).
- Develop a structure, carefully consider the "User Journey Map" (UJM). In other words, project the path that a student will pass using the ChatBot. This structure can be developed in the table (Excel, Google Sheets, etc.) or visualized via special Mind Maps programs (Coggle, BubblUs, Freemind, Mapul, Mind42, MindMeister, MindNode, RealTimeBoard, WiseMapping, Xmind, etc.). This would give some advantages: allow you to see the entire structure in the complex; detect and fill out gaps; consider the names for constituent blocks (buttons, commands), etc. Subsequently, this structure can be changed and supplemented, resulting in the corresponding changes in the ChatBot and thereby improve, optimize it. For the convenience of development and orientation, it is advisable to use numbers in the names of the ChatBot items (steps names).
- Consider the ChatBot reactions ("answers") on each request. ChatBot messages must be laconic (no more than 200 characters), informative, understandable. One long message is expedient to break into two or several short. It is not necessary to neglect the friendly tone and the tact, the use of Emoji is allowed.
- The options for answers are expedient to be prescribed as separate blocks. In Mind Map, it is expedient to prescribe the "answers" of the ChatBot, just what it reports to students, not options for answers. We emphasize that it is important to consider the commands (requests) names, as well as the answers to each of these commands at the initial stages. Not worth forgetting about the redirection, that is, the transferring of a student from one block to the next (for example, it may look like a ChatBot "offering" the student to repeat a certain material and redirects him/her to the necessary unit or the external resource). Consider and predict opportunities for feedback, to allow a student to receive a lecturer's advice. If possible, it is advisable to lay this opportunity in each unit.

- It is important to realize that the beginning of the creation of the ChatBot structure (Mind Map) is unlikely to be ideal. Therefore, it will require systematic viewing to be improved. It is expedient to attract students to the process of improving ChatBot. To do it, it is worth adding a feedback button so that they could express, what difficulties they meet, what changes they would provide.

Now, let's take the steps for creating a Telegram ChatBot. One can develop it via computer, tablet, or smartphone. Obviously, it is necessary to install the Telegram messenger app firstly (https://telegram.org/apps):

1. Go to the search tab, enter @Botfather and choose it. Click "Start" to activate the BotFather bot. And then click the "Start" button in the right lower corner.

2. Now you can see a range of commands. Click the "/newbot" to create a new bot. @BotFather will ask the name of your new bot. This name will be displayed on the contact list and in the chat header with this bot (e.g., in our case "Philosophy Module 1"). Later it can be changed. After that, you will be proposed to set a username for the bot. There are some rules for this: the bot's username should contain Latin letters, figures, and lower emphasis only; its length from 5 to 32 characters; it remains unchangeable; it must end in "bot" (e.g., in our case "Worldview_Bot" or "WorldviewBot").

3. After setting a name for the new bot – it is created. You will receive a message with a link to your bot, recommendations to set up a description, profile picture, and a list of commands to manage it. Besides, you will get a token, which should save wherever, as you will need it later.

4. Go to the search tab, enter "ManyBot" and choose the named bot. Then click the "Start" button, choose the language, and click the "Create a New Bot" button. You will be invited to enter the token you have received earlier and enter a description for your bot (you can do it later, if necessary). Then you will be sent a link, which you can use to invite other users to your bot.

5. Now you can design your bot and fill it with content. Choose your bot in the left column list and then click the "Start" button. Choose the "Custom Commands" in the list proposed, and click "Create Command". Now you can enter the command name, putting the slash "/" at its beginning (e.g., "/Lecture_1"). After that, you should add the information that will appear for the user after clicking this command. It can be text, your voice message, pictures, videos, or any other file type.

6. It is available to connect each command you have created, with the graphical menu. Firstly, go back to the section "Custom Commands", click the "Config. Main Menu", and then click the "Add Menu Item" button. Now you can see the list of commands you have already created. Choose any command and enter the name of the menu item, which will be connected with it (e.g., in our example these titles are almost the same). You can use Emoji. A message appears that "Command was successfully added to the menu". The title of the menu item can be changed if necessary.

7. Now, the commands were successfully added to the menu and the functionality of the bot is formed.

To improve the pedagogical effect of using ChatBots in Telegram Messenger, we propose to observe the following recommendations:

- ChatBot should disclose the essence of the course you provide. In particular, the name, icon (image), description, etc. should correspond with the discipline, illustrate the content studied;

- The material should be given in a short and as clear as possible. It is advisable to structure the material in such a way that its main part was placed on the mobile device screen, without the need for long scrolling. It is necessary to break the material into separate modules, add links to other modules and resources;

- The availability of control and self-control should be provided. Each thematic unit is expedient to accompany by test control – both for learning results monitoring and self-control of the student. In particular, to use external apps to evaluate (introducing a relevant link to the test, pre-created by the lecturer), for example, MyTestX, Indigo, Online Test Pad, and many others;

- The ChatBot should contain tasks of different formats. Variation of tasks, their diversity allows us to diversify the educational process, maintain students' interest, to attract them to various types of work, which positively affects the mastering of the material. In particular, in our work we submitted an educational material using text blocks, illustrations, videos, and audio fragments; stimulated students' independent work (mandatory practical assignments, additional individual and group project tasks, etc.); used gaming techniques (quiz, brain ring); systematically monitored the degree of perception of material by testing (at the end of the study of each theme);

- It is necessary to fill the ChatBot with useful links and resources. Since the submission of material in Chatbot should be compact, it is advisable to complement its additional links. This allows students to expand and deepen knowledge, independently study tangent themes, etc.

2.3   Analysis of results of educational interaction via Telegram messenger

During the II semester in 2019-2020 in pandemic conditions, the authors of the article have organized the educational process with students of the National Academy of Internal Affairs via Telegram messenger. Taking into account the above-mentioned advantages, this messenger was chosen as the main tool for educational interaction, both synchronous and asynchronous (ChatBot, text and voice messages, etc.).

At the beginning and the end of the study, we surveyed students aimed at finding out their preferences in messengers and their functionality (at the beginning of the study), satisfaction with the organization of classes via Telegram messenger, identifying problems, advantages, and needs for further improvement of the educational process (at the end of the course). The total number of respondents amounted to 112 people – students of the specialty 081 "Law" (according to the list of branches of knowledge and specialties of Ukraine, 2015), the first (bachelor) level of higher education, aged 17-23, including 42.1% – males, 57.9% – females.

Respondents noted using Telegram more often than other messengers. As a students' survey showed, Telegram messenger leads among other similar services (98.9%), ahead of Viber (73,7 %), Facebook Messenger (26,3 %), WhatsApp (17,9 %) and Snapchat (12,6%). Most students (69.5%) use messengers continuously each day, and some (30.5%) – if necessary, several times a day.

Organizing the course "Police officers' worldview culture", 30 hours of practical classes via Telegram messenger was carried out with each group of students. At the end of the course, we offered students to evaluate such a form of work. Among the advantages were noted: ease of use Telegram messenger (88.4%), usability on different platforms (66.3%), free of charge (61.1%), high-quality connection (51.6%), reliable data protection (48.4%).

Among the disadvantages, students noted an unstable Internet connection (33.7%), resulting in interruptions in the messenger functioning (20%). For 6.3% of respondents turned out to be an unclear interface.

As for changes that students would like to offer to improve the educational process using Telegram messenger, 2% noted the wish to increase the number of multimedia content, add more accompanying audio and video fragments. In general, students estimated educational activities using Telegram messenger in pandemic conditions positively, choosing answers: "Very good" (43.2%) and "Good" (50.5%).

In addition to studying the general impression of students from training via Telegram messenger, it was important for us to determine the pedagogical effect of this.

First, we have examined the homogeneity of experiment and control groups. For this, we used the Pearson criterion ($\chi 2$), as, according to [2]: (1) the sample is large enough, more than 30 (in our case 112 students in the experiment group and 110 students in the control group); (2) scale of measurements is a scale of titles with 3 categories (in our case these are three levels of students' knowledge: high (90-100 scores), medium (75-89 scores), and low (60-74 scores). Since no student received lower than 60 points (that is, below the passage boundary), the range of scores 1-59 in the calculation was not taken; (3) measurement was carried out on an ordinal scale (that is, for each level of knowledge we determined in which the number of students it turns out).

For the initial data, we took the results of students' evaluation received after studying the first module of the discipline. This module in both groups (experimental and control) was taught in traditional terms, without attracting the Telegram messenger, since quarantine restrictions have not yet been introduced. We have identified whether students groups are homogeneous or significantly different (at the beginning and at the end of the study). To do this, two hypotheses have been identified:

1) H_0 – differences between $\chi^2_{exp.}$ and $\chi^2_{contr.}$ are random, and therefore, the chosen groups are homogeneous;

2) H_1 – differences between $\chi^2_{exp.}$ and $\chi^2_{contr.}$ are significant.

To calculate homogeneity of samples the formula was used:

$$\chi^2_{emp.}=N \cdot M \cdot \sum_{i=l}^{L} \frac{(\frac{n_i}{N} - \frac{m_i}{M})^2}{n_i + m_i} \qquad (1)$$

$\chi^2_{emp.}$ – homogeneity criterion;
N – number of students in experiment group;
M – number of students in control group;
n_i – number of students in experiment group that are on the i-level;
m_i – number of students in control group that are on the i-level;
L – number of levels (in our case $L = 3$).

Table 2 shows the results we received during the initial and final evaluation.

Table 2
Results of the initial and final evaluation

№	Levels of knowledge	Initial evaluation results (traditional learning in both groups)		Final evaluation results (control group – traditional learning, experiment group – learning in quarantine conditions via Telegram)	
		Experiment Group	Control Group	Experiment Group	Control Group
		Number of students (112 total)	Number of students (110 total)	Number of students (112 total)	Number of students (110 total)
1	High	63	59	63	55
2	Medium	47	47	44	48
3	Low	2	4	5	7
	Average score	4,55	4,50	4,52	4,44

Substituting the results (table 2) in the formula 1, we received the following:

1) Based on initial evaluation results (after traditional learning in both groups) the empirical value of chi-square is 0,780 ($\chi^2_{emp.} = 0,780$). Critical value of chi-square at the level of significance 0,05 is 5,991 ($\chi^2_{critic.} = 5,991$). In our case, the inequality is carried out: $\chi^2_{emp.} < \chi^2_{critic.}$ (0,780 < 5,991). That is, the empirical value of the criterion calculated above is less than the critical value. This means that the H_0 hypothesis is confirmed, the differences between the evaluation results in both groups (experimental and control) are insignificant and coincide at the level of significance 0,05. The obtained data certify the homogeneity of samples.

2) Based on final evaluation results (control group – traditional learning, experiment group – learning in quarantine conditions via Telegram) the empirical value of chi-square is 1,032 ($\chi^2_{emp.} = 1,032$). Critical value of chi-square at the level of significance 0,05 is 5,991 ($\chi^2_{critic.} = 5,991$). In our case, the inequality is carried out: $\chi^2_{emp.} < \chi^2_{critic.}$ (1,032 < 5,991). That is, the empirical value of the criterion is less than the critical value. This means that the H_0 hypothesis is confirmed again, the differences between the evaluation results in both groups (experimental and control) are insignificant and coincide at the level of significance 0,05. The data obtained show that learning outcomes in both groups are similar.

It should be emphasized that we did not set the task to introduce a method that would significantly increase the effectiveness of the educational process. Instead, our goal was to introduce a tool that would allow support for the educational process in the conditions of unexpected and forced quarantine restrictions, with no loss of qualitative indicators. Since the results of learning in the experimental and control groups are not significantly different, we believe that we have reached the goal.

In this regard, we can confirm that Telegram messenger is a tool that allows supporting the format of distance learning with preserving the quality of learning outcomes. It is advisable to adhere to the recommendations that we have outlined above.

3. Conclusions

The quarantine restrictions caused by the COVID-19 pandemic made adjustments to the current functioning of national educational systems. Online learning methods and relevant tools and apps went to the fore. The need to adjust the educational process quickly and promptly in crisis conditions has contributed to the fact that non-educational digital services popular among students, but which are safe, multifunctional, and easily configurable, began to spread rapidly.

Our observations, results of a survey, and analyzing students' learning success confirmed the following facts:

- Telegram messenger, as a tool for supporting training in a pandemic, was selected appropriately. Students, being active users of this messenger, have effectively joined the process of educational interaction, without spending extra time to install an application, studying the interface elements and functionality, etc.
- Functionality of Telegram messenger allowed to a greater extent to meet the needs of all participants in educational interaction (both lecturer and students), applying various forms and methods: conferencing, chatbots, text and voice messages, video fragments, etc.;
- Combining various synchronous (audio and videoconferencing) and asynchronous tools (chatbot, different types of format, e.g. text, voice, video fragments, surveys, tests, etc.) allowed achieving the didactic goals effectively.

Subsequently, we plan to create a typical Mind Map for Telegram ChatBot to support the educational process.

4. Acknowledgements

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