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Teaching science language grammar to would be translators in vocationally oriented language learning via m-learning

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Today, as pandemic has shown, m-learning has turned into the only possible form of education in numerous cases. To take full advantage of m-learning, one should create a suitable environment and choose appropriate techniques to provide the desired results. This study aims to prove the efficiency and effectiveness of teaching science language grammar to would-be translators in vocationally oriented language learning (VOLL) via m-learning within a student-centered approach. The research covered the spring semesters of 2019–2020, 2020–2021, sampling 120 second-year students from Peoples' Friendship University of Russia (RUDN University), Academy of Engineering (seven departments). The researchers used theoretical, empirical, and experimental methods and prepared questionnaires and tests as data collection tools. The outcomes revealed all tricky issues for the students among the selected science language grammar points. The students of the experimental group used both MOODLE and the technology developed by the researchers. The experimental groups scored better than the control groups (90.1% vs. 65.4% and 89.5% vs. 67.2% correct answers in the final test, which meets the research criteria) and proved the efficiency and effectiveness of the proposed teaching technology.

KEYWORDS

MOODLE, m-learning, VOLL, science language grammar, learning management systems

Introduction

The year 2020 and the pandemic that swept over the world and changed all spheres of our lives, including education, have demonstrated that educators and methodologists must be prepared to meet the real challenges of the present-day changing world, be flexible, adaptable, and pro-active. In the time of lockdown, when students and professors communicate online, the lectures have to deliver high education standards, keep students motivated, and interested in achieving excellent results and becoming professionals in their field.

The challenge can be tackled by choosing the right tool(s), selecting the relevant material, and applying the appropriate technology to teach the students and make the process controllable (Georgiev et al., 2004; Liu et al., 2008; Halvonik and Kapusta, 2020; Nagi and Bojiah, 2020).

Currently, more and more students prefer to study any time anywhere at their own pace. In this sense, they are mobile, which is one of the reasons why the concept of *m-learning* has gained popularity. By *m-learning*, we mean "*the e-learning activity carried out through the features offered by the computer and communication technologies of devices such as PDA and mobile phones, which we can carry with us in daily life*" (Niazi, 2007, p. 4). Its purpose is to facilitate knowledge creation and provide students with problem-solving abilities, social skills, and other competencies not associated with traditional classroom teaching. *m-learning* enables educators to adopt different teaching styles and types of content, maximizing student engagement. For students, advantages also include better communication, encouraged interaction and collaborative learning, a more comprehensive range of tools and platforms, personalized educational process (Herrador-Alcaide et al., 2020).

According to Keegan (2005), more than 90% of people use mobile phones. There are three times as many mobile phones in use today as PCs. Besides, many mobile devices are much cheaper, smaller, and lightweight than computers, which makes it possible to take them anywhere. In some digitally-advanced countries, the mobile phone penetration rate is close to 100%, making access to high-level education available to a more significant number of people.

To take advantage of the educational potential of m-learning, educational establishments should create suitable environments and the strategic use of a range of tools and approaches that can provide positive results in continuous and self-directed learning (Kolb, 2006; Wang, 2008; Cavus et al., 2020).

For students getting an additional diploma of "Translators in the field of professional communication" [vocational language learning (VOLL)] in the mobile age, m-learning can become a potential scenario and a valid option to other forms of education.

The novelty of the work performed lies in the fact that the authors investigate the issues of teaching grammar to translators in the field of professional communication using m-learning, which reveals huge opportunities in personality-oriented learning. This area occupies an intermediate position in the linguistic and non-linguistic profiles of education. At the same time, all previous studies conducted in this area were aimed at studying the grammar of common English, English as a second language, or devoted to teaching grammar to students of linguistic or non-linguistic universities.

Literature review

The term *e-learning* was first coined in 1999 at a CBT (Cognitive Behavioral Therapy) seminar. Although as early as in the 1920s, there were some attempts to automate language learning and testing: the first testing machine (1924) and the teaching machine (1954) by B. F. Skinner. The first computer-based training program was devised at the University of Illinois (1960). With the introduction of personal computers and the Internet, learning new subjects and developing sets of skills became much more straightforward. In the 21st century, e-learning has become extremely popular since individuals realized its benefits.

At the same time, other terms, such as *online learning, virtual learning, Web-based learning, distributed learning, computer-assisted instruction, or Internet-based learning,* started to appear in an attempt to give a more accurate description of the new phenomenon.

The European Commission (2001) describes *e-learning* as the use of new multimedia technologies and the Internet to increase learning quality by easing access to facilities and services as well as remote exchanges and collaboration. According to Guri-Rosenblit (2005, p. 469), "*e-learning* is electronic media used for various learning purposes ranging from conventional classroom add-on functions to online substitution for face-to-face meetings with online encounters." In Maltz's opinion, the term *e-learning* is applied in different perspectives, including distributed, online-distance, as well as hybrid learning (Maltz et al., 2005). According to OECD (2005), *e-learning* is the use of information and communication technologies (ICT) in diverse processes of education to support and enhance learning in institutions of higher learning (IHL). It includes the usage of ITC as a complement to traditional classrooms, online learning, or mixing the two modes. Ruiz et al. (2006, p. 207) consider that *e-learning* is the use of Internet technologies for enhancing performance and knowledge. Arkorful and Abaidoo (2015, p. 30) define *e-learning* as "using information and communication technologies for enabling access to online teaching and learning resources." For Clark and Mayer (2016, p. 8), *e-learning* is "instructions

delivered through digital devices with the intent of supporting learning."

E-learning has a number of advantages and disadvantages when used in IHLs. The advantages include an ability to focus on individual needs and a student-centered approach (Sanderson, 2002; Price, 2021); flexibility in terms of time and place (Smedley, 2010); time and commuting expenses savings (Shim and Lee, 2020); ease of communication between the learners and the teachers (Wagner et al., 2008); cost-effectiveness, self-pacing, increased learning satisfaction and decreased level of stress (Klein and Ware, 2003; Amer, 2007; Algahtani, 2011); online communication allows more time for students to speculate over their answers (Bailey and Lee, 2020). Rabah (2005) considers that learning objectives can be accomplished in the shortest time with the least amount of effort. Alsalem (2004) believes that *e-learning* helps students become more independent and autonomous. According to Kuimova et al. (2018, p. 837), it allows students to develop digital literacy, creativity, and thinking skills. Since the teacher is not physically present to guide and scaffold students, online instructions are presumably often carefully and successfully planned and tested beforehand, resulting in improved teaching pedagogy (Bailey and Lee, 2020). For teachers, learning management systems (LMSs) can help distribute the content easily and quickly and provide effective feedback (Price, 2021).

Despite all the promises and prospects of *e-learning*, it also has some disadvantages. Bailey and Lee (2020) noted that teachers face a number of challenges, including lack of familiarity with a constantly rising arsenal of ICT and fears of having to troubleshoot and fix technical problems. Researchers emphasize that *e-learning* means a complete absence of face-to-face interaction between teachers and students as well as students themselves (Young, 1997); it leads to the decline in the ability to concentrate (Shim and Lee, 2020); requires strong motivation and time management skills (Collins et al., 1997); can have an adverse effect on students' social and communicative skills (Klein and Ware, 2003); network instability can disrupt learning efficiency (Shim and Lee, 2020). When it comes to the assessment tools, it is not always possible to avoid unethical activities such as i-cheating (Hameed et al., 2008); *e-learning* can lead to plagiarism when private materials are copied and distributed through modern technologies (Akkoyuklu and Soylu, 2006); the role of the teacher can be treated by some learners as less significant (Lewis, 2000). Moreover, *e-learning* is not suitable for all fields: medicine, pharmacy, and some others requiring more practical skills cannot fully employ it (Scott et al., 1999).

However, according to Almosa (2002), the advantages of e-learning outweigh its disadvantages and encourage researchers to search the ways to decrease the latter.

As to learning foreign languages, the first attempts to employ ICT in computer-assisted language learning (CALL) were made as early as in the 1960s when leading universities used mainframes for this purpose (Singh, 2015). The term CALL was introduced in the 1980s. Since then, researchers have defined CALL in several ways. A generally accepted broad definition of CALL is "the search for and study of computer applications in language teaching and learning" (Levy, 1997, p. 1).

Early researchers have found that incorporating technology into teaching foreign languages offers a considerable number of advantages; among them is exposure to authentic materials in the target language (TL) that significantly improves the results (Fithriani and Alharbi, 2021); opportunities to vary the methods of presenting material, free and independent access to multimedia resources under teachers' guidance (Kuimova et al., 2018). However, it was not until the 1980s when the development of PCs made CALL a widespread practice in the USA and Europe.

In the 21st century, CALL has evolved into several subdivisions: Blended learning, Computer-Mediated Communication, Gamification, and the like. Besides, there is CALL for ESP, EAP, young students, among others. CALL is no longer a unified subject but is still a practice-oriented field where "digital technologies are making an increasingly significant contribution to language learning" (Motteram, 2013, p. 177).

The term *m-learning* became recognized in 2005. According to O'Malley et al. (2005), *m-learning* is any sort of learning that happens when the learner is not at a fixed location or when the learner takes advantage of learning opportunities offered by mobile technologies. Traxler (2005) defines it as any educational provision where technologies are handled on palmtop devices. Sharples et al. (2007, p. 64) considers *m-learning* as "the process of coming to know through conversations across multiple contexts amongst people and personal interactive technologies."

When the term *m-learning* came on the scene, *e-learning* methods and techniques were implemented in *m-learning* since early mobile technologies lacked functionality, screen size, processor speed, and battery life. Only when cell phones became available for almost everyone, mobile technology began to be used to almost its total capacity.

M-learning includes the following components: education, organization, technical content, and satisfies the basic teaching principles (Cheung, 2015; Crompton and Burke, 2018).

M-learning and *e-learning* share some similarities and differences. According to Basak et al. (2018), the similarities include the need for infrastructure with/without WiFi; they are digitized; learners and instructors can learn independently; the learning materials are presented in different forms and can be updated. Whereas the differences include: communicating with e-mail, lectures in classroom or internet lab, synchronous; fixed location, plugged in, tethered; more formal, paced, structured delivery; private location for e-learning vs. instant messaging; lecture capture technology, synchronous or asynchronous

learning; collecting and analyzing data in the field, untethered; less formal, self-paced, on-demand delivery; no geographic boundaries in m-learning.

As *m-learning* continues to develop, state-of-the-art mobile devices offer new opportunities. According to Traxler (2011), *m-learning* is contingent, situated, authentic, context-aware, personalized. *M-learning* is more flexible, informal, and interactive (René and Aubin, 2017); it motivates students through challenge, curiosity, control, recognition, competition, and cooperation (Ciampa, 2014); improves literacy, encourages communication, enhances creativity, develops thinking, and increases students' activity and interaction (Sung et al., 2016).

However, there are some challenges in *m-learning*: not all teachers have enough knowledge of ICT; some teachers consider mobile devices as cheating instruments and can be somewhat skeptical about their use in the learning process; lack of well-established theoretical and methodological implementation of mobile devices (Pedro et al., 2018; Zain and Bowles, 2021); students can be distracted by other sites or become addicted to their gadgets (Sung et al., 2016). Besides, there are technical limitations to overcome: limited working time of the mobile device due to battery life; poor resolution because of small screens. Nevertheless, with advances in technologies and mobile devices in the near future, these barriers will become memories of the past.

In the past decade, along with the growing popularity of mobile devices, a new approach, called MALL (mobile-assisted language learning), has come into use to fully harness the advances of technologies in language learning. In the opinion of Kukulska-Hulme (2013), MALL is the use of mobile technologies such as smartphones, tablets, or laptops for language learning. MALL includes several components significant for efficient language learning, with the essential ones being practicality and engagement. The former means that the learners are becoming more familiar with mobile devices; the latter implies that teachers can create some space for supplementary students' activities outside the classroom. Besides, more software specifically designed for language learning appears on the market every year (Huang et al., 2016). It is constantly updated and upgraded according to the demands of students and teachers, changing it from a tedious, repetitive process into a more exciting and interactive one.

Researchers say that MALL allows students to increase their language proficiency and become active members of the process of socialization (DeLambo et al., 2011); it also helps students put the material they have learned into real-world settings (Taradi and Taradi, 2016). Other findings indicate the following benefits of MALL: language performance development, positive attitudes towards the learning process, increased motivation and metacognitive skills, improved students' retention, extensive learning opportunities (Zain and Bowles, 2021, p. 293).

Since its emergence, MALL has been proliferating; meanwhile, it has been the topic of heated debates among scholars, teachers, and others involved in the field (Wu, 2019). As a result, a lot of MALL-related studies have been conducted recently, focusing on investigating better and more innovative ways to implement it inside and outside the classroom (Namaziandost et al., 2021).

The main difference between MALL and CALL is that students use PCs, laptops, and notebooks in the latter, whereas in the former, they use handheld devices (Hazaea and Alzubi, 2018). Besides, MALL provides an opportunity to study any time in and outside the classroom, and it is more tailored to personal needs (Zain and Bowles, 2021).

In Russia, the pandemic has triggered the use of both *e-learning* and *m-learning* that is proved by a number of studies (Gafurov et al., 2020; Bolgova et al., 2021). According to Gafurov et al. (2020), IHL students were totally satisfied (41.2%), somewhat satisfied (43.4%), rather or totally unsatisfied (15.4%) with e-learning/m-learning.

As technologies advance and provide other forms of mobile technology, such as tablets and laptops, more sophisticated i-phones, i-pads, and the like, *m-learning* is progressing and making a giant leap further into the realm of learner-centered pedagogy, perfecting the learning process, making it unique, tailored to individual needs of each and every member of the society.

The present study is the first attempt to select and teach science-language grammar to would-be translators in VOLL in Russian institutes of higher learning (IHL) via M-learning. A number of studies have been conducted to use m-learning to teach grammar of General English (Wang et al., 2021) or in countries where English is spoken as a second language (Rozina et al., 2017). Also, there are studies devoted to teaching foreign language via MOODLE to students of non-linguistic (Kapsargina and Olentsova, 2020) and linguistic universities (Degil, 2015), but the topic of the present study has not been properly covered in the scientific literature.

Purpose of the study

The main aim of the research is to prove the efficiency and effectiveness of teaching science-language grammar to would-be translators via m-learning within a learner-centered approach.

To achieve this goal, the following tasks were set:

(1) To select science language grammar points to teach would-be translators in VOLL at the beginning of the course
(2) To choose LMS to post on the selected material
(3) To identify the problems students have with the selected science language grammar points
(4) To suggest and check the technology to cope with the identified difficulties.

Materials and methods

In the present research, the authors used theoretical (analysis, synthesis, generalization, putting forward hypotheses), empirical (questionnaires, tests), and experimental methods (ascertaining and educational experiments).

To determine the students' progress in mastering the selected science language grammar points, the authors used Beslpal'ko's methodology (Bespal'ko, 2009) along with Welch's Test and Mann–Whitney–Wilcoxon test.

Participants

The research was conducted in the spring semesters 2019–2020, 2020–2021 academic years with 120 second-year students from Peoples' Friendship University of Russia (RUDN University), Academy of Engineering (Departments of Mechanics and Mechatronics, Innovative Management in Industries, Civil Engineering, Architecture, Machine Building, Transport, Oil and Gas Engineering). The demographic information of the participating students was the following: 75 (62.5%) were female, and 45 (37.5%) were male.

All participants had at least an 18-months experience of working on LMS and using m-learning prior to the experiment since they have other courses on MOODLE beginning from the first year at University.

Research tools

The researchers developed questionnaires on the basis of specialized literature and the authors' own experience that consisted of open-ended and closed-ended questions, and suggested possible answers based on the Likert scale. Also the authors devised entry, mid-of-the-term, and final tests as data collection tools. Prior to the experiment, the questionnaires were analyzed, and trial questioning of non-participating in the experiment students was held. Also the questionnaires, were examined by experts (a linguist, two psychologists, two IT specialists). The authors made adjustments according to their recommendations. The questionnaires were posted on MOODLE. The students had a time limit to answer them throughout the day.

According to the previous research (Chernova, 2018), learner autonomy of would-be translator in VOLL consists of three components: personal, competence-based and motivational. For this reason the questionnaire was divided into four parts: personal information and questions to identify the levels of the above-mentioned components (**Table 1**). Besides the questionnaire, the authors used the following methodologies to enhance reliability of the research: Mil'man (1990) and Rokeach (2009) methodologies for the motivational component; Rogov (1999) and Kozlov et al. (2002) methodologies for the personal component.

The tests were devised with various MOODLE plug-ins to check preliminary knowledge of science language grammar, to trace the progress of mastering the selected grammar points in the middle and at the end of the term.

Procedure

Firstly, the researchers selected the science language grammar points, chose an LMS to host the material and drilling exercises, and proposed the technology to increase the efficiency of the learning process.

Then we randomly divided the participating students into two groups: an experimental (EG1) group ($N = 30$) and a control (CG1) group ($N = 30$) (2019–2020 academic year); an experimental (EG2) group ($N = 30$), and a control (CG2) group ($N = 30$) (2020–2021 academic year). In the course of the experiment, both EGs and CGs had online classes in Zoom or Microsoft Teams (four double periods a week) and used the same coursebooks. Besides, the EGs had unlimited access to the complex of grammar exercises on the chosen LMS. They allocated time and drilled the material autonomously. The experiment lasted 18 weeks (one term) each academic year and consisted of three stages.

In the *self-check* stage (1 week), the professor introduces the subject of Science language, challenges students, sets objectives, motivates them to study Science language in English, and describes independent learning strategies. The students of both groups got logins and passwords to work on the LMS; after the class, all participants answered Questionnaire 1 to examine their motivation to study and took the entry test to check their knowledge of science language grammar.

In the *cognitive-creative* stage (16 weeks), the students of the EG1 and EG2 had online classes and did exercises on the selected LMS; practiced self-monitoring, self-analysis, self-correction, and self-control. While the students of the CG1 and CG2 had online classes and did their home assignments set by the professor.

In the middle of the term, all participants took a mid-of-the-term test on the LMS, where 50 questions were randomly chosen from the learned material.

During the *evaluation stage* (1 week), students from both groups answered questions in the final test comprising 50 questions of different levels of complexity (from 0.05 to 1 point). In addition, they responded to Questionnaire 2, which was aimed at helping the students evaluate their achievements and make adjustments in their future work.

TABLE 1 Questionnaire at the self-check stage.

Personal information		
Full name		
Sex		
Age		
Speciality		
Component of learner autonomy	**Questions**	**Likert scale**
Motivational	(1) How important is it for you to study Science language in English?	(5) It's necessary to study (4) It's desirable to study (3) It's possible but unessential (2) It's unnecessary (1) There is no need
	(2) Why should a would-be translator in VOLL study science language? To develop: (a) Skills to discuss topics connected with his/her profession, (b) Skills to understand and translate special literature, (c) Skills to translate and understand special literature in related professions, (d) Other(*) (*) give a comprehensive answer	Evaluate each point according to a 5-grade scale: (5) It's necessary (4) It's desirable (3) It's possible but unessential (2) It's unnecessary (1) There is no need
	(3) How important is it for you to solve the set tasks independently?	(5) It's necessary (4) It's desirable (3) It's possible but unessential (2) It's unnecessary (1) There is no need
	(4) How essential are skills for autonomous work for your professional growth?	(5) They are necessary (4) They are desirable (3) They might help, but I'm not sure (2) There is no need to develop them (1) They are absolutely unnecessary
	(5) How much time are you ready to spent on autonomous work?	(5) Every day at least 30 min (4) Several times a week but enough to acquire necessary skills (3) Several times a week when possible (2) At most once a week (1) Sometimes if I have free time
Competence-based	(6) What goals do you set at the beginning of the course?*	
	(7) How well can you set goals and tasks for self-education?	(5) Perfectly well (4) Well (3) Satisfactory (2) Unsatisfactory (1) I have never done it before, I fulfilled the tasks set by the teacher
	(8) How well can you set priorities?	(5) Perfectly well (4) Well (3) Satisfactory (2) Unsatisfactory (1) I have never done it before. It the teacher who set priorities
	(9) How well can you work autonomously to develop necessary skills for a translator in VOLL (information inquiry search, use of online dictionaries, modern ICT, etc.)	(5) Perfectly well (4) Well (3) Satisfactory (2) Unsatisfactory (1) I have no idea
	(10) How well can you apportion time for self-education?	(5) Perfectly well (4) Well (3) Satisfactory (2) Unsatisfactory (1) I have never done it before

(Continued)

TABLE 1 (Continued)

Component of learner autonomy	Questions	Likert scale
	(11) How well can you analyze your mistakes and correct them?	(5) Perfectly well (4) Well (3) Satisfactory (2) Unsatisfactory (1) I have never done it before, it's the teacher who corrected them
	(12) How well can you work with LMSs?	(5) Perfectly well (4) Well (3) Satisfactory (2) Unsatisfactory (1) I have no idea what it is
Personal	(13) Do you always fulfill the set tasks?	(5) Always, in 100% cases (4) Almost always, only serious circumstances can prevent me from fulfilling the task (3) Approximately half the time (2) If there are no other things to do (1) I have never cared about it. I often have other things to do
	(14) Do you read supplementary literature to master the material?	(5) Always. I also consult the teacher or specialists in the field (4) Mainly yes (3) More likely yes than no (2) More likely no than yes (1) I don't have time for this
	(15) Do you read literature in related field to master the material better?	(5) Yes, I do. I want to know what is going on in related fields as well. (4) Mainly yes (3) Occasionally (2) Rarely (1) Never
	(16) How responsible will you be doing the task unlikely to be checked?	(5) The tasks will be done whether or not the teacher will check it (4) Probably I'll do it because it's necessary for me (3) More likely yes than no (2) More likely no than yes (1) I won't do it. I don't want to waste time if nobody checks it
	(17) You start doing the task	(5) On the same day when it was set (4) Next day to have some time (3) The day before the lesson (2) At night before the lesson (1) Just before the lesson

Selection of science language grammar points to teach would-be translators in vocationally oriented language learning at the beginning of the course

Since the primary goal of teaching would-be translators in VOLL at the initial stage is to get them familiar not only with the specifics of the language and style of scientific and technical literature but also with science language grammar and the laws of translation of texts related to science language, it is of vital importance to employ the original material from specialized journals and manuals, as well as perform a systematic analysis of the encountered lexical and grammatical difficulties.

We agree with Pumpyansky (1997) that "since a formal-logical style is inherent to the science language, it is necessary from the first lessons to instill in students a strictly logical, rigorous analysis of linguistic patterns, to focus on the phenomena specific to scientific texts which cause standard translation errors," and, "when drilling grammatical material, students must be taught to analyze different meanings of homonymous forms, including such grammatical characteristic of the English science language as Infinitive, Participles, and ing-forms, modality, and conditional sentences."

Having analyzed articles from several journals and manuals, e.g., *American Machinist*, *ACM Journal on Emerging Technologies in Computing Systems*, *Acta Geotechnica*, *Professional Builder*, we can conclude that in such papers, one can find grammatical norms characteristic of written speech, Passive, impersonal, and indefinite-personal sentences together with compound and complex ones. Nouns, adjectives, and impersonal forms of verbs predominate since scientific literature provides definitions, descriptions, and explanations of facts

and puts forward hypotheses. Even though "pseudo-simple" grammatical constructions such as modal verbs with a Perfect Infinitive are less widespread, they are crucial for the adequate translation of scientific texts and therefore cannot be ignored or underestimated. Besides, the verbs and phrases that characterize the degree of reliability of the information are equally important (it is believed, it seems, and the like). If a translator is unfamiliar with these phrases, he/she often mistranslates or ignores them, turning a relative statement into an absolute truth.

Considering the above mentioned, we have selected the following science language grammatical points: (1) emphatic construction *it is . . .that*, (2) *once* in different meanings, (3) the Complex Subject, (4) noun-noun constructions, (5) the prop words, (6) plural nouns of Latin and Greek origin, (7) used to do vs. to be used to doing, (8) *since, for* meaning *because, as*, (9) *provided, providing* meaning *if*, (10) the Passive Voice, (11) Participle I, II, the Absolute Participial Construction, (12) double degrees of comparisons, (13) the Infinitive, (14) the Subjunctive Mood, (15) to have smth done, (16) modal verbs + Perfect Infinitive.

Platforms for posting the selected material

The researchers have analyzed and compared various LMSs, such as Xerte, Blackboard, WebTutor, LWCL, Atutur, Academ Live, SAKAI, OLAT, eLML, eXe-Learning, and MOODLE. They are aimed at educators who do not have in-depth knowledge of programming and database administration. The LMSs include various kinds of individual assignments and projects for work in small groups and the whole class, based on content and communication. All of them have their pros and cons.

The authors have chosen MOODLE in this research since it has been implemented in plenty of IHLs both in Russia and abroad. It provides professors and students with a broad scope of personal and professional growth opportunities and boosts conditions for motivating and developing students' self-organization skills. It is free for IHLs and allows professors and students to be flexible; it has a variety of plug-ins and allows combining individual and group work, and there is no limit on the number of installations or users.

Results

Problems students face with the selected science language grammar points

Answering the questions in Questionnaire 1, most students in EGs and CGs responded that it is vital for would-be translators in VOLL to know science language grammar: EG1 (90%) and CG 1 (91.7%); EG 2 (92%) and CG 2 (90.3%), correspondingly. The major reasons were: they would be able to translate scientific papers, report at the conferences, write articles, take part in negotiations, and more. Also, they were asked to evaluate their ability to use LMS and various mobile devices. The majority of the students stated that they are confident users: EG 1 (70%) and CG 1 (75%); EG 2 (72%) and CG 2 (74%). The students of EG1 and EG2 were also asked how much time a week they were ready to spend drilling grammar in MOODLE. Their answers were as follows: EG 1: (a) 1–2 h – 33.3%, (2) 3–4 h – 53.3%, (3) 5–6 h – 10%, (4) more than 6 h – 3.3%; EG 2: (a) 1–2 h – 30%, (2) 3–4 h – 50%, (3) 5–6 h – 13.3%, (4) more than 6 h – 6.7%.

The results of the entry test revealed similar problems students of EGs and CGs had encountered.

As can be seen from Tables 2, 3, most students had problems with the Complex Subject, noun-noun, and modal verbs + Perfect Infinitive constructions.

As far as the Complex Subject is concerned, there were three groups of difficulties: (1) verbs used with the verb to be (to know, to report, and the like) or without it (to appear, to seem,

TABLE 2 Problems with science language grammar students encountered in the Entry test 2019–2020 academic year.

Number	Science language grammar point	Percentage of correct answers, EG1	Percentage of correct answers, CG1
1	It is. . .that	20%	21.7%
2	Once	26.7%	30%
3	The complex subject	8.33%	10%
4	Noun-noun constructions	13.3%	16.7%
5	The prop words	66.7%	65%
6	Plural nouns of Latin and Greek origin	21.7%	25%
7	Used to do vs. to be used to doing	30%	35%
8	Since, for meaning because, as	23.3%	23.3%
9	Provided, providing meaning if	35%	33.3%
10	The Passive Voice	78.3%	75%
11	Participle I, II, the absolute participial construction	63.3%	61.7%
12	Double degrees of comparisons	45%	51.7%
13	The infinitive	33.3%	38.3%
14	The subjunctive mood	60%	55%
15	To have smth done	36.7%	40%
16	modal verbs + Perfect Infinitive	11.7%	13.3%
	Total	**35.8%**	**37.2%**

TABLE 3 Problems with science language grammar students encountered in the Entry test 2020–2021 academic year.

Number	Science language grammar point	Percentage of correct answers, EG2	Percentage of correct answers, CG2
1	It is. . .that	23.3%	26.7%
2	Once	36.7%	33.3%
3	The complex subject	16.6%	16.6%
4	Noun-noun constructions	13.3%	20%
5	The prop words	60%	53.3%
6	Plural nouns of Latin and Greek origin	33.3%	36.7%
7	Used to do vs. to be used to doing	53.3%	63.3%
8	Since, for meaning because, as	50%	46.7%
9	Provided, providing meaning if	35%	33.3%
10	The passive voice	80%	86.7%
11	Participle I, II, the absolute participial construction	66.7%	70%
12	Double degrees of comparisons	56.7%	63.3%
13	The infinitive	46.7%	46.7%
14	The subjunctive mood	60%	53.3%
15	To have smth done	46.7%	50%
16	Modal verbs + Perfect Infinitive	16.6%	13.3%
	Total	**43.4%**	**44.6%**

and similar); (2) the form of the Infinitive (Simple, Continuous, Perfect, Perfect Continuous); (3) the place of the particle not.

As for the noun-noun constructions, students failed to find the keyword in the phrases. In the case of modal verbs + Perfect Infinitive, students could not choose the correct verb; moreover, they had problems with the correct form of the Infinitive.

Technology to overcome the identified problems

The authors have developed a technology to help students cope with the difficulties mentioned above. The critical component in this approach is a multilevel model of different exercises posted on MOODLE. When developing the complex of exercises, we were guided by the works by Passov (2002) and defined the following criteria: the goal; the stage of formation of skills and abilities; the native language of students; the purpose of the speech material; gradual build-up of difficulties; the ability to ensure the error-free actions of the student; the ability to ensure the acquisition of the course content; compatibility of the type of exercises with the type of speech activity.

Considering the interdisciplinary nature of this research, the complexity and novelty of the material, plug-ins available in MOODLE, the authors considered it necessary to base their findings on the works of a number of psychologists (S. L. Rubinshtein, D. V. Elkonin, I. A. Zimnyaya, et al.). Each exercise includes instructions reflecting the components of the motivational-incentive phase of the corresponding type of speech activity.

The work on the selected material was carried out in three stages: introduce a grammatical concept (the *File, Page*, or *Hyperlink* plug-ins); drill the grammatical concept (the Quiz plug-in); consolidate the grammatical concept (*Quiz* and *Hyperlink* plug-ins).

Quiz plug-in teaching exercises were arranged according to the principles from simple to complex, from part to whole, and whole to part. Their main goal is to develop grammatical skills by repeatedly performing simple, then more complex, exercises for a particular grammatical rule. For example:

(1) Choose the correct variant

If I knew her address, I. . .then.
(a) would have given (b) would give (c) gave (d) will give

(2) Paraphrase, make use of one of the modal verbs

I do not think he did it all by himself

(3) Translate from English into Russian:

That was the first push-button-controlled solid fuel central heating system.

At the end of the term, the students from both groups were given a final test. The results were the following:

To measure the students' academic progress, it is necessary to measure the quality of knowledge and productivity criteria. Productivity characterizes the degree of closeness to the required result. The authors used several criteria: the first one is Beslpal'ko's methodology (Bespal'ko, 2009). The data of an experiment are analyzed to obtain numerical values according to the formula: $K = a/n$, where a is the number of correctly performed operations of a particular task, n is the total number of proposed tasks, K – the criterion for this level. It is advisable to accept $K \geq 0.7$ (70% of the tasks).

As can be seen from **Tables 4**, **5**, the students from the EGs demonstrated mastering the material with $K = 90.1\%$ and $K = 89.5\%$, which proves the suggested technology's productivity, whereas the students from the CGs do not meet the criterion ($K = 65.4\%$ and $K = 67.2\%$).

In addition to the methodology mentioned above, we applied the Welch's Test and Mann–Whitney–Wilcoxon test.

TABLE 4 End of the term results of Science language grammar course 2019–2020 academic year.

Number	Science language grammar point	Percentage of correct answers, EG1	Percentage of correct answers, CG1
1	It is. . .that	83.3%	58.3%
2	Once	91.7%	80%
3	The complex subject	90%	71.7%
4	Noun–noun constructions	80%	55%
5	The prop words	66.7%	65%
6	Plural nouns of Latin and Greek origin	100%	91.7%
7	Used to do vs. to be used to doing	96.7%	85%
8	Since, for meaning because, as	93.3%	70%
9	Provided, providing meaning if	100%	85%
10	The passive voice	98.3%	91.7%
11	Participle I, II, the absolute participial construction	96.7%	80%
12	Double degrees of comparisons	93.3%	88.3%
13	The infinitive	91.7%	68.3%
14	The subjunctive mood	86.6%	76.6%
15	To have smth done	90%	80%
16	Modal verbs+Perfect Infinitive	83.3%	50%
	Total	**90.1%**	**65.4%**

TABLE 5 End of the term results of Science language grammar course 2020–2021 academic year.

Number	Science language grammar point	Percentage of correct answers, EG2	Percentage of correct answers, CG2
1	It is. . ..that	91.7%	50%
2	Once	86.7%	73.3%
3	The complex subject	93.3%	63.3%
4	Noun-noun constructions	80%	56.7%
5	The prop words	70%	50%
6	Plural nouns of Latin and Greek origin	100%	93.3%
7	Used to do vs. to be used to doing	93.3%	86.7%
8	Since, for meaning because, as	93.3%	56.7%
9	Provided, providing meaning if	100%	86.7%
10	The passive voice	90%	80%
11	Participle I, II, the absolute participial construction	93.3%	73.3%
12	Double degrees of comparisons	93.3%	63.3%
13	The infinitive	90%	53.3%
14	The subjunctive mood	83.3%	76.6%
15	To have smth done	90%	58.3%
16	Modal verbs + Perfect Infinitive	83.3%	53.3%
	Total	**89.5%**	**67.2%**

Since the empirical value of the Welch's Test for CG1 and EG1 (T_{empB} 0.1878) is less than the critical value $T_{0,05}$ 1.96, the hypothesis about the coincidence of the characteristics of the CGs and EGs before the start of the experiment is accepted at a significance value of 0.05. At the end of the experiment, we compared characteristics of the EGs and CGs T_{empE} 4 1.96. Consequently, the reliability of differences in the characteristics of the CGs and EGs at the end of the experiment is 95%. Based on this, we can conclude that the difference between the samples CG1 and EG1 is caused by using the suggested technology via MOODLE. The results are similar for EG2 and CG2: T_{empB} 0.0810 1.96; T_{empE} 4 1.96; that is why the hypothesis about the validity of the differences between EGs and CGs at the end of the experiment has also been proved.

The Mann–Whitney–Wilcoxon test results can be summarized in the following way: W_empB = 0 $\leq$ 1.96. Consequently, the characteristics of the EGs and CGs coincide with a significance level of 0.05, with W_empE = 4 > 1.96. That is, the initial states of the EGs and CGs coincide, but the final states differ. Therefore, we can conclude that the changes are due to the use of the proposed technology via MOODLE.

At the end of the course, the students were asked the questions from Questionnaire 2: (a) have you achieved the goals set at the beginning? Students of the EGs answered: yes (80%), no (6.67%), partly (13.33%), whereas the students of the CGs: yes (56%), no (11.25%), partly (32.75%); the students of the EGs only: (b) what do you like in the course on MOODLE? Interactivity (36%), efficient, practical tasks (41%), available technique of obtaining information (28%), the opportunity to do the tasks at any time and place (37%), the ability to work on errors an unlimited number of times (10%); (c) What is the use of m-learning for you? Does it motivate you to study? Most respondents noted that m-learning helped them master the material (57%), it is available 24/7 (44%), it helped with time-management, planning, goal-setting (86%).

Discussion

In the present study, several research questions have been considered. Firstly, the authors selected science language grammar points necessary for would-be translators in VOLL

at the initial stage. The research findings revealed 16 most widely used grammatical units that proved extremely difficult for students to translate.

These findings have been evidenced by those reported by Starzhinskaya (2017) and Ibatova (2018), who noted in the English science language the wide use of the Passive Voice as a means to avoid any indication to the author or experimenter; construction *it is . . . that* to set more emphasis to different parts of the sentence; frequent use of Participle I, II, Absolute Participial constructions, the Infinitive and noun compounds illustrating a tendency for conciseness; the Complex Subject to make statements less categorical.

The analysis of the second research question has indicated that MOODLE proved highly effective in teaching science language grammar to would-be translators in VOLL; it also helps increase students' motivation to master the subject, stirring up their interest in further knowledge. The self-rated assessment of learning outcomes of EGs mirrors the quantitative results. The findings are in line with those by Kuimova et al. (2018), which proved that MOODLE had been successfully used in the IHLs in Russia to develop different skills among undergraduate and postgraduate students of linguistic and non-linguistic universities. The results of this study confirmed those by Semushina (2017) in blended learning, which show that properly designed quizzes contribute to the correct assessment of the learners' results.

The outcomes of this study do not go along with those reported by Dozhdikov (2020), who claims that broader use of LMS during the pandemic indicates learners' interest in education but not a desire to fulfill academic courses by this means. The author supposes that after the pandemic, learners will prefer traditional forms of education.

The analysis of the third research question demonstrated that among all sixteen selected grammar points, the most difficult ones appeared to be the Complex Subject, noun-noun, and modal verbs+Perfect Infinitive constructions. Our previous research (Litvinov et al., 2017) conducted before *m-learning* and LMS were used in training proved that science language grammar was a stumbling block for students that made them frustrated and discouraged.

The findings related to the fourth research question prove that the technology developed by the authors, based on a multilevel model of different exercises posted on MOODLE, turned out to be effective. It is illustrated by Beslpal'ko's methodology and the Welch's and Mann–Whitney–Wilcoxon tests.

The present study provides the potential for future research in teaching science language vocabulary and translation skills via *m-learning* on the selected LMS. Further studies using delayed post-tests seem necessary to ensure that the proposed technology's efficiency promotes both short-term and long-term mastering of the science language grammar.

Conclusion

The conducted research and analysis of 10 Engineering journals allowed the authors to select 16 widely used science language grammar points to be mastered by would-be translators in VOLL at the beginner stage. MOODLE was chosen to host the material as the one having a range of advantages.

The researchers prepared two questionnaires: the former was meant for doing students' needs analysis, setting their goals, evaluating the expectations of the course, allocating the learning time; in the latter, the participants evaluated their progress and analyzed the results. Besides, the authors worked out three additional tests to check the students' progress: entry, mid-of-the-term, and final. The results revealed that among the selected science language grammar points, the Complex Subject, noun-noun, and modal verbs + Perfect Infinitive constructions appeared the most complicated ones.

The authors have developed a technology to help students cope with the grammar challenges mentioned above. It's essential component is a multilevel model of different types of exercises based on MOODLE.

All research participants were divided into the EGs and the CGs. Both groups enjoyed equal treatment: mastered the same course content, had the same number of ZOOM or MS Teams academic hours, used the same textbooks. The only difference was that the EGs had 24/7 access to the material posted on MOODLE. The final test demonstrated that the students of the EGs achieved better results in mastering science language grammar points (90.1% vs. 65.4% and 89.5% vs. 67.2% of correct answers) and met the criterion by Bespal'ko $K \geq 0.7$. The results of Welch's Test and the Mann–Whitney–Wilcoxon test prove the effectiveness of the proposed technology via MOODLE.

Based on the above, we can conclude that the proper use of m-learning with appropriately selected LMS and material can significantly enhance the results, improve students' motivation and responsibility, and prepare them for self-development and life-long learning.

Implications for practice

The grammatical material selected and minimized for different learning profiles will be different. At the same time, we believe that our proposed technology for overcoming grammatical difficulties in students studying under the "Translators in the field of professional communication" program can be partially used in teaching grammatical phenomena using m-learning and in other foreign language teaching profiles.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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