Development of Students' Metacognitive Skills by Means of Educational Technologies in ESP Instruction at University

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Abstract: *Metacognitive skills which provide regulation and management of students' intellectual activity in the process of their self-education are of great importance, especially in the context of the learner-centered education paradigm in the global information space, with its focus on the self-study and self-development of an individual. In this regard, the article aimed to analyze the development of metacognitive skills in first year students by means of educational technologies in ESP classes at technical university in Ukraine. As shown by the results of the study, educational technologies can be successfully used for the development of such metacognitive skills as self-directed learning skills, collaboration skills, self-management skills, self-reflection skills in first year students studying ESP at university level. The educational technologies used in our study – the Moodle platform, WebQuest, blogs and wikis, Google Classroom, Quizlet – confirmed their efficiency as a useful tool for the development of metacognition since they provide the learning environment which makes it possible for students to organize and control their learning, make decisions, reflect on the results of their learning experience and make necessary changes and adjustments if necessary.*

Introduction

In the context of the humanistic learner-centered paradigm of education in the global information space, particular focus is made on the self-study and self-development of learners, especially in view of the substantial freedom which they have in the choice of purpose, content, technology, resources, time, duration and place of learning, active collaboration and partnership relations with the teacher, reflective approach to learning (Lytovchenko & Saienko, 2019). Therefore, the development of metacognitive skills which provide regulation and management of the intellectual activity in the process of self-education is of high priority. Metacognitive skills also help students to transfer their knowledge and skills to new contexts, build up their professional competence and, which is necessary for specialists of all qualifications in all areas of life, since modern society and job market demand not only skilled specialists but a holistic highly educated personality (Lavrysh, 2016).

It is obvious that in educational institutions in the technological era, metacognitive skills can and should be developed with the use of information technologies which provide new opportunities and stimuli both for students and teachers. Technologies in learning are so preferable because they encourage students to use language both within and outside the classroom and allow for a high degree of self-direction and interaction (Kornieva & Vashchylo, 2019; Lytovchenko et al., 2021). In view of this, the **purpose** of our study was to analyze and share the experience of development of metacognitive skills, such as self-directed learning skills, collaboration skills, self-management skills, self-reflection skills, by means of educational technologies – Moodle platform, WebQuest, blogs and wikis, Google Classroom, Quizlet – in teaching ESP to first year students at technical university.

Literature review

The term "metacognition" was coined by Flavell (1979) who understood it as "cognition about cognitive phenomena," or in other words "thinking about thinking" (p. 906). The definitions subsequently made by other scientists were built on Flavell's understanding of this term. Thus, Metacognition, as defined by Meichenbaum (1985), is the awareness of one's own knowledge – what one does and doesn't know – and one's ability to understand, control and manipulate one's cognitive processes. The Teaching Excellence in Adult Literacy (TEAL) (Teaching Excellence, n. d.) views

metacognition as the ability to use prior knowledge and experience to create a strategy for reaching learning goals, take appropriate actions to find the solution to the problems, reflect on and evaluate findings, and modify one's approach if necessary.

The process of learning is based on both cognitive and metacognitive elements. Learners gain knowledge using cognitive strategies, and they direct, control, and assess their learning using metacognitive strategies. Real learning happens as a result of this "thinking about thinking" and application of metacognitive techniques. Students acquire confidence and become more independent as learners as they develop their metacognitive skills. (Teaching Excellence, n. d.). Since metacognition is vitally important for successful learning, it is imperative for teachers to help students develop their metacognitive skills (Nietfeld & Shraw, 2002; Railean et al., 2017; Thiede et al., 2003). In teaching English, instructors should provide students with classroom activities that enhance both language skills and metacognitive strategies (Thamraksa, 2005) as metacognitive learners are successful learners (Rahimi & Katal, 2012).

Powerful resources for the development of students' metacognitive skills are provided by educational technologies that "empower" students to engage in a cognitive process which involves new learning environment providing them with opportunities to control their learning, make choices and reflect on their consequences, which are the factors of development of metacognition (Sewell, 1990). As stated by Gordon (1996), educational technologies "can provide a context for learning and the opportunity to observe 'expert' models of particular skills" and "should be used as facilitators of thinking and knowledge construction so that students can devise their own ways of handling the information that is presented in multiple modes of representation" (p. 49). Interactive multimedia provide a support for students by inspiring metacognitive learning and developing problem solving skills. Educational technologies promote learning effectiveness due to a variety of its characteristics, including its high accessibility, flexibility, and convenience of learning, the availability of opportunities for language acquisition, the development of independent learning skills, professional competence, and advancement in the use of technologies (Lavrysh et al., 2022).

Distance learning courses and WebQuests as tools for the development of students' self-directed learning skills

Our practical experience in the use of educational technologies shows that they not only help to significantly improve the educational process, achieve successful results in the acquisition of knowledge, development of skills and creative abilities of students in higher education, but also provide opportunities for the development of metacognitive skills, particularly, self-directed learning skills, collaboration skills, self-management skills, self-reflection skills.

The use of distance learning courses for students of National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" confirms that they allow effective organizing and planning of students' work in order to improve their self-directed learning skills which imply the autonomy and ability to control and be responsible for one's own learning. Scholars (Colorado & Eberle, 2010; Moore & William, 2008) argue that in the educational system of today, online learning that combines graphics, text, audio and video in the elements and resources of distance learning courses is a contemporary form of self-directed learning.

To create distance learning courses at our university, we use the Modular Object-Oriented Dynamic Learning Environment (Moodle) platform which is highly adaptable and accessible and is able to create favorable environment for the development of the necessary skills in learning a foreign language. The main objectives of the distance courses designed for students of the Institute of Aerospace Technologies of National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" are to stimulate the desire for self-directed learning, systematization of knowledge, development of creative abilities, effective organization of students' independent work. Tasks developed for each lesson take into account the level of English language competence (determined by testing) and individual characteristics of learners that allow for differentiated learning. The Moodle platform contains interactive tools for collaborative problem solving such as wiki, glossary, blog, forum, chat, which are important in self-directed learning.

Finding the ways to develop students' motivation and self-directed learning skills is one of the major issues of online learning (Llerena-Izquierdo, 2022; Mustapha, 2023; Tlili et al., 2022). Teaching practice shows that a high level of motivation can ensure success in learning even for students with mediocre abilities (Nikolaeva & Synekop, 2020). We suggest using the elements and resources of distance learning courses to engage students and increase their motivation to study. For example, we invite students to use the

Glossary element as an encyclopedic resource with suggested topics (for example, "Interesting facts from the Wright brothers' biography", "Pioneers in Aviation", etc.). Students create the content themselves trying to find interesting information in different sources, which urges them to self-directed learning. The Forum element can be used to discuss students' slides, projects, and comment on the choice of topics, and relevance of materials. Therefore, we invite students to take an active part in the formation of content of our courses, which will contribute to the formation of self-directed learning skills, the ability to work effectively with different sources, better acquisition of knowledge.

Students' survey (Lukianenko & Vadaska, 2020) shows that they find the Moodle platform particularly useful because they can study at any convenient time and place, and have the ability to see and analyze their own mistakes. Due to its capabilities to make distance courses highly interactive, Moodle enables students to learn the language independently and thus promotes the individualization and intensification of learning, the development of students' self-directed learning skills, and their desire for self-development.

Another technology that can be effectively used to develop self-directed learning skills is WebQuest which is an inquiry-focused activity providing possibilities for learners to interact with the information that comes from the Internet resources (Dodge, 2001; 2006), to perform an authentic task that motivates them to investigate a central, open-ended question. It develops students' ability to process and organize the information they have found in the Internet, to orient their activities to the achievement of a certain purpose, and thus promote their self-direction in learning (Benz, 2001; Gaskill et al., 2006).

Our experience in teaching ESP to first-year students demonstrates the effectiveness of using WebQuest in the study of the following topics: Safety, Environmental Engineering, Robotics, Household Technology, Innovations, etc. When developing WebQuests we based on its structural design suggested by Dodge (2001) which includes the following elements: Introduction, Task, Process, Evaluation, Conclusion, Credits, Teacher Page. However, since the WebQuest structure is quite mobile, we used only its basic elements – Introduction, Task, Process and Evaluation.

Creating a WebQuest we asked students to make a detailed plan of the Introduction, helped them in defining goals and objectives and then select and evaluate resources independently. We divided students into teams of 3-5 people, discussed and agreed on a list of reliable online resources. In the

following sessions, each team reported on the results of their research in the form of a Power-Point presentation or a Web site.

We agree with María José Luzón-Marco (2010) who identifies WebQuest's core language criteria and emphasizes that "students should interact with resources (and audiences) in the same way and for similar purposes as they would do in real life; students should engage in the same cognitive and metacognitive processes as those required by the tasks that online media users carry out in the real world (e.g. synthesizing information from multiple texts, problem solving, evaluating information); the task should be functionally designed, and socially contextualized" (p. 33).

The study by Synekop (2020) aimed to find out teachers' attitudes and possibilities of using WebQuests at differentiated ESP instruction of technical students. Instructors state that this technology improves students' ability to communicate in a foreign language, encourages the acquisition of professional knowledge, and fosters the development of critical thinking, teamwork, and self-directed learning skills. The author proposed 10 criteria for categorizing WebQuests: duration, number of performers, kind of tasks, types of language learning skills to be developed, ability to differentiate tasks, location where the WebQuest is performed, level of learner autonomy, type of assessment, and type of learning content (p. 48). To sum up, using different types of WebQuests promotes diversifying ESP learning at technical university, supports self-directed learning and facilitates the development of communicative competence of future engineers.

Improvement of students' collaboration skills by means of blogs and wikis

Among other metacognitive skills which constitute 21st century competence are collaboration skills. For decades, the educational potential of collaboration of students in groups to complete a task, solve a problem or learn material has been recognized by theorists and practitioners. Collaborative group work promotes students' higher academic achievement, positive attitude to learning, communication skills (Kyndt et al., 2013; Slavin & Lake, 2008). In recent years, there is a growing interest in the role of technology in facilitating collaborative learning. Information and Communication Technologies (ICT) promote collaboration by means of providing visual presentations of learning tasks, guidance of the collaboration processes, and scaffolding for the collaborative knowledge construction (Chen et al., 2018; Goodyear et al., 2014). ICT broaden the access to information and communication and thus provide equal possibilities for

people to contribute to the learning process irrespective of their abilities and conditions (Capp, 2017).

The use of technology as a tool to promote collaboration in writing instruction has been explored for the recent decades (Ducate et al., 2011; Fitzgerald & Palincsar, 2017; Miyazoe & Anderson, 2010). We found it appropriate to promote students' collaborative learning skills while teaching ESP writing with the use of blogs and wikis. We applied a recent approach to writing instruction that has changed from product-oriented to process-oriented, which implied that the writing was carried out in stages and the students, as recommended by Storch (2005) and Teng (2021), were provided with opportunities to collaborate during planning, monitoring and evaluation activities. During the writing process, the collaboration of students was realized through group discussions that included brainstorming of ideas, which was also in focus of studies of Shen (2013) and Yeh (2014). The quality of writing was improved through feedback that students gave and received in groups. This advantage of collaborative learning over individual learning was also marked by Loretto et al. (2016) and Wang (2014).

In a commonly accepted meaning, blog is an easy-to-use web page that contains short entries of temporary significance that are regularly updated (Proydakov & Teplitskyi, 2006, p. 74). In our study, students in groups first created entries in draft blogs with open access to commentators, and then transformed the texts into clean copy blogs that were also open and commentable. The blogs were on professional topics and based on the students' master's theses. We used this tool to develop collaborative learning skills, as blogs create a social network among bloggers who have the opportunity to communicate on topics of professional interests. Students learned to interpret information, make scientific conclusions and proposals based on scientific research. Registered users had the opportunity to comment on one another's information, organizing virtual communication within the blog. The reader and the author could discuss what was written, evaluate the information presented, agree or disagree with it. Based on the results of cooperation on improving the content, the authors made corrections to the text, added and changed entries, and then published them in the World Wide Web. The work of the students in groups on blogs of professional focus contributed to their collaboration, since they were focused on researching and solving common problems. Blogging platforms are particularly appropriate for the development of collaboration skills since communication between authors and readers takes place in virtual space at a time convenient for them.

Finally, after creating a blog on a blogging platform each group also posted it on a wiki website which is a collaborative platform that allows users

to create, contribute, store, edit or modify entries. Then, members of each group performed the function of "experts" and had to improve the entry created by another group. We found wikis an expedient tool for enhancing the students' skills of working in groups and learning from one another because it gives them the opportunity not only to consume knowledge produced by others but also to create new knowledge collectively.

Google Classroom and its possibilities for enhancing students' self-management skills

Along with other metacognitive skills which we find it particularly important to develop in students are self-management skills since they allow organizing learning activities and establishing collaboration between teacher and students. Self-management skills help students to control their plans and actions, set goals independently and take the initiative to achieve them, communicate, interact effectively, make the right decisions and improve time management thus making them more organized, creative and motivated. The learning process at university should promote the development of students' self-management skills since they are important for their further successful employment. In ESP instruction self-management skills are crucial since they can help to learn a foreign language in a learner-friendly way, perform tasks individually.

Since interdisciplinary connections are viewed as factor of increase of learning efficiency (Kuzminska et al., 2019), we find it appropriate to use Google Classroom as a learning tool that has many resources for the development of self-management skills. This is a web-based application that runs on a web browser without being installed on a user's computer. This is one of the key benefits of the program because it can be accessed from any computer connected to the Internet.

While using the Google Classroom, students learn to organize the learning process by themselves, choose the time convenient for them to complete the tasks, independently determine the sequence of tasks, take responsibility for making decisions, choose the sources of information among those offered by the course (textbooks, videos, online articles etc.). The Google Classroom Course "English for Engineering" created by us to teach ESP includes texts, audios, videos, a discussion board, grammar and vocabulary exercises, a calendar, chats and other resources. The course has such functions of management as planning, organizing, leading and controlling.

Being integrated in the problem-based learning, the Google Classroom application helps to develop problem-solving skills (Stavytskyi & Urazgaliyeva, 2018) as the teacher gives students a problem task and the deadline for its completion. While working on the task independently the students learn to manage their time and plan their activities.

The Google Classroom has a function of a chat room that develops communication skills. During the chat, students discuss the problem tasks assigned by the teacher and can easily get feedback at any time. Videoconferencing tools, like Google Meet, are user-friendly, easy to install and operate. In addition, students or universities globally may be connected through these tools making possible to organize international scientific Olympiads, experts meetings, conferences, projects, sharing knowledge and experience in real-time (Mukan & Lavrysh, 2020). Among other features of Google Classroom technology are easy access to learning materials, possibility of creating tasks and distributing them individually to each student, teamwork, real-time communication, interactive check of the completed tasks which help to develop the ability of students to plan, solve problems, self-study, make decisions and manage the time as integral constituents of self-management skills.

Development of students' self-reflection while learning vocabulary with Quizlet

Important metacognitive skills which allow learners to analyze and evaluate the way of their study are self-reflection skills. Reflecting helps learners review the effectiveness of their study, question the way they learn something, and then decide if any changes and adjustments should be made, or new strategies should be used to make learning more efficient and relevant in the future. In this regard self-reflection is a powerful tool of learning from experience, since, if we do not reflect and analyzes our previous experiences, we cannot improve and grow.

One of technologies used by us in ESP classes to develop students' self-reflection skills is Quizlet (http://www.quizlet.com/), since it provides numerous opportunities for reflection over different ways and strategies of vocabulary learning. Quizlet is an online resource which can be used on computers and smartphones for learning vocabulary with digital flashcards which can be created by teachers or students. As stated by Foster (2009), quizlet is an efficient tool which can be used by students for reviewing vocabulary that they learned in class as also for making their own flashcard sets and sharing them with peers.

Practical experience shows that students have positive attitudes toward Quizlet, which is supported by other studies (Chien, 2015). Using Quizlet technology proved to be efficient in learning general and professional foreign language vocabulary (Chaikovska & Zbaravska, 2020; Fursenko et al., 2021). The technology is time-saving, since creating online flashcards on smartphones by students does not take much time (Wright, 2016). Another important feature of Quizlet is the availability of a whole range of options (learners can create their own flashcards; the target words and their translations can be created in any language; flashcards can be created for multi-word units as well as single words, etc.). This tool is also highly accessible, since it can be used for free (Nakata, 2011).

At our ESP classes the learners used the Quizlet site on their mobile phones to learn the vocabulary in and outside of classroom. Vocabulary sets were created by students themselves and shared with others in the group. The teachers also created activities which were done by all learners at the revision stage of each module of the learning program. The vocabulary sets consisted of activities for studying (which included flashcards, learning, writing, spelling, testing exercises) and playing (which included matching, "gravity" and "live" games). Quizlet was used for learning English vocabulary and intended to provide possibilities for development of students' self-reflection skills. The feedback from students showed that, reflecting on their learning experience, the students found Quizlet activities effective, since they helped them remember and review words rather quickly and without much effort and they promote group collaboration.

Conclusion

As shown by our experience, educational technologies can be successfully used for the development of metacognitive skills, in particular, self-directed learning skills, collaboration skills, self-management skills, self-reflection skills, of first year students in ESP classes at technical university. The educational technologies used in our study – the Moodle platform, WebQuest, blogs and wikis, Google Classroom, Quizlet – confirmed their efficiency as a powerful tool for the development of metacognition since they provide the learning environment which makes it possible for students to organize and control their learning, make decisions, reflect on the results of their learning experience and make necessary changes and adjustments if necessary.

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