Developing Language Learning Strategies in Technology-Enhanced Learning Environment at Tertiary Level

Larysa Kupchyk
National University of Water and Environmental Engineering, Ukraine, *l.y.kupchyk@nuwm.edu.ua*

Alona Litvinchuk
National University of Water and Environmental Engineering, Ukraine, *a.t.litvinchuk@nuwm.edu.ua*

The article explores the potential of technology-enhanced learning environments in developing language learning strategies (LLSs) that are pivotal in encompassing, shaping, and enhancing learning behaviors, activities, or experiences. To evaluate the LLS development level in non-linguistic students, we conducted two surveys (initial and final) based on Oxford's Strategy Inventory for Language Learning (SILL) into students' strategic competence profiles for the A2/B1 (45 students) and B2/B2+ (21 students) English proficiency levels. The initial survey drew the students' attention to the strategic approach to language learning, and the response data allowed the teachers to gain insights into students' learning preferences and challenges. The longitudinal survey was administered on an ongoing basis throughout the two-year core course in English as a Second Language (ESL) via the end-of-class 'I can'-statements and open-ended end-of-topic questions. It supported the teachers in selecting the appropriate teaching methods and the students in getting acquainted with and adopting the best-working LLSs. The final SILL survey confirmed an increase in the strategic competence of students. It yielded valuable feedback on the effectiveness of the instructional methods employed. The study emphasizes the need for integrating LLS instruction into ESL curricula by aligning teaching practices with the demands of tech-enhanced learning environments.

Keywords: instruction, language learning strategies, non-language students, SILL survey, technology-enhanced

INTRODUCTION

Students are more tech-savvy today than ever, and their ease of navigating digital tools, as well as their comfort with them, means that their learning experiences are formed in technology-rich environments. This creates a significant challenge for educators to engage digital natives effectively by adapting learning environments to suit their evolving needs and unlocking the full academic potential of digital learners (Derilo,

2024, p. 503). Arciaga and Lucas (2024) describe language acquisition as an "adaptive" process, asserting that "adaptive systems are those which stand ready to react and change when the circumstances require," and stress the need for extensive research on language learning "across various learning contexts to comprehend the holistic impact and variations" (pp. 674-675).

The European Commission's proposals on a comprehensive approach to language education emphasize that "the potential of digital tools is fully embraced to enhance language learning, teaching and assessment" and can provide diverse opportunities for language exposure (Council of the European Union, 2019). These tools enable learners to actively shape their learning process and construct their language learning environments. Radhakrishnan (2017) further supports it by stating that "in a perfectly patterned technology-enhanced learning environment, learners will incorporate in the process of manipulating information and critical thinking" (p. 162). The rapidly expanding use of Augmented Reality (AR) applications and Artificial Intelligence (AI) technologies, such as language apps, platforms, bots, and, more recently generative technologies, is transforming language education for both students and teachers, offering a variety of benefits. In their review on the use of AR in language learning, Parmaxi and Demetriou (2020) highlight the benefits of AR, including increased motivation, engagement, and enjoyment driven by students' heightened interest in interacting with new technology; improved learning performance facilitated by AR datasets, and unlimited opportunities for authentic, real-life learning scenarios. Among the opportunities of AI-driven language learning, Creely (2024) distinguishes customizing learning, delivering instant feedback, providing immersive, interactive experiences, and creating new and innovative content.

Growing up in a world "packed with a myriad of interconnected technologies and information sources", modern learners are believed "to desire a measure of autonomy and authority over their experiences" (Derilo, 2024, p. 504). In the language acquisition context, this inclination towards autonomy and control manifests in LLS selection and application. As described by Przybył and Pawlak (2023), LLSs control various aspects of learning, demonstrating the ability to regulate states, behaviors, and learning conditions and choose between a number of strategies, all accompanied by an overall sense of agency and autonomy. Danko and Dečman (2019) claim that the whole language learning process is regulated by LLSs that aim to accomplish language tasks, improve language performance, and/or enhance long-term proficiency. Therefore, for tertiary students who follow the typical distribution of university ESL credit hours with twice as many out-of-class activities as in-class ones, strategic awareness becomes an obligatory tool that can be taught and practiced in class and persistently used out of class. Given that current language learning experiences are gained and broadened in tech-enhanced environments, the LLSs are to be adapted and optimized to benefit from the capabilities of technology and its current potential. According to Trinder (2017), it is still in question whether the learners realize their full potential and deliberately exploit the student-initiated online activities taking place in English, and are fully aware of the learning process and its product. This aligns with Amerstorfer's (2018) view describing LLSs as "teachable actions" employed for second language (L2) learning and appealing not to confuse deliberate actions or techniques applied by the students

with automatic, unconscious skills. Since LLSs "involve conscious, selected behaviors performed to achieve a particular task", their development helps increase students' learning autonomy (Sukying, 2021, p. 60). Hence, it is one of the ultimate tasks of ESL teachers to train students to use the appropriate strategies consciously throughout the learning process to enable further self-directed, self-regulated, or autonomous learning through delivering autonomy-supportive strategic instruction (Alrabai, 2021) and to "always grasp new resources and usually be pioneers in their use" (Lopes, et al., 2023, p. 533).

Literature Review

Digital transformations in higher education have been the focus of researchers thanks to their potential to enhance the learning environment for students, raise program operational effectiveness, and promote educational innovation (Benavides et al., 2020). Kumar et al. (2022) claim that when digital natives "choose to learn digitally in the technological environment, technology must be employed in education contexts" (p. 52). This highlights that digital learning is part of the "ecosystem of modern higher education" (Alenezi, 2023, p. 1). Recent technological advancements have sparked a wave of research into tech-enhanced language learning focusing on various related concepts or terms under the general approach of using computers and digital devices, as well as software and telecommunications in the context of educational technologies. They all represent the diverse and ever-evolving landscape of technology unanimously recognized for its effectiveness in language learning due to learners' exposure to authentic learning materials, supporting social interaction, facilitating "their creative expression and construction of meaning actively using the target language" (Shadiev & Wang, 2022, p. 2). Radhakrishnan (2017) attempts to categorize the ways, in which technology can be conducive to learning, i.e. technologies as media for accessing and studying learning material; technologies as media for learning through inquiry; technologies as media for learning through communication and collaboration; technologies as media for learning through construction; technologies for learners' assessment; technologies for digital and multimedia literacy. Zhang and Zou (2022) identify five major types of digital technologies in language learning: mobile learning, multimedia learning and socialization, speech-to-text and text-to-speech recognition, and digital-game-based learning. The most recent studies on AR applications, as discussed by Parmaxi & Demetriou (2020), and generative AI technologies, explored by Creely (2024) have aroused significant interest in language learning due to their ability to perform a wide range of functions. Zawacki-Richter et al. (2019) distinguish the following AI applications in higher education: profiling and prediction, focusing on student model and academic achievement; intelligent tutoring systems; diagnosing strengths and automating feedback; facilitating collaboration; automated grading; feedback; evaluation of student understanding, engagement, and academic integrity; recommending personalized content, guiding, and monitoring students.

As claimed by Reinders et al. (2022), "the value of technology exists only in the good pedagogical use that teachers make of it" since this is not the technology itself but rather "the ways educators draw on it meaningfully to enhance pedagogical practice" (p. 6). The authors also agree that technology-enabled activities "are only likely to

support language learning if they promote learning behaviors which are relevant to learners' interests and appropriate to their development level, and thus increase their competence" (Reinders et al., 2022, p. 27). Thus, language teaching is expected to be equipped with knowledge and skills, first to identify technical attributes specific to the new technologies and then design technology-enhanced pedagogy with LLS orientation for the students (Zhou & Wei, 2018). Another argument for prioritizing strategic instruction is that students should be "empowered and released from the teacher control, granted a larger space of freedom of choice, more control over learning, and more involvement in decision-making process" (Alrabai, 2021, p.13). LLSs are claimed to be critical for students to take charge of their learning, especially autonomous, intentional, and conscious actions taken by a student to overcome obstacles and difficulties in the learning process (Husin et al., 2023).

The fundamentals of research on LLSs are grounded in Oxford's (1990; 2017) content-analytic study of LLSs. Oxford (2017) concludes that the strategy forms include thoughts or cognitions; actions; techniques, devices, tools, and methods; and general tendencies, by which the author implies how learners broadly approach learning. Litvinchuk and Kupchyk (2024) define LLSs as

> a part of the content that has to be learned, an essential constituent of the process of acquiring English language skills aimed at forwarding and facilitating the learning process, making it more motivational, and allowing students to manage and self-regulate their learning; and finally, LLSs are a product of English language acquisition becoming crucial for lifelong learning (p. 94).

Sukying (2021) underscores the importance of LLSs, describing them as "a critical factor in facilitating the successful acquisition of a foreign language" (p. 60) as they might help "look inside the brain and provide us with some explanations of this input-output difference while L2 learning" (Ranjan et al., 2021, p. 74). According to Arulselvi (2016), strategy training should include explanations, handouts, activities, brainstorming, materials for reference, and home study designed to "develop learner's accountability and independence in learning the English language" (Soliman & Gorospe, 2024, p. 353). It should be individualized and provide students with a mechanism to evaluate their success in training and the value of strategy (Arulselvi, 2016). Having analyzed a range of models for teaching learning strategies, Rubin (2013) identifies a sequence of four steps common for all of them: preparation, presentation, practice, and evaluation. When in the classroom, students are exposed to how they perform language tasks or process new information under the teacher's instruction and with the use of the strategies necessary for each particular activity. It was found that "strategy instruction helped students learn cognitive strategies", which facilitates higher-level learning and, under high motivation and positive self-efficacy beliefs, can lead to transferring these strategies to other tasks (Oxford, 2017, p. 71). Given the necessity to be involved in continuous exposure to using English in the university setting – through taking EMI courses, participating in academic exchange programs, and using English in field-specific activities – non-language students are expected to improve and effectively apply LLSs independently.

For over thirty years, LLS competence or awareness has been evaluated using the SILL developed by Oxford (1990) as the primary data-collection instrument in LLS research (Danko & Dečman, 2019). Although Oxford's SILL has often been claimed to be partly outdated since it lacks strategy statements that refer to state-of-the-art L2 learning and teaching, it is still recognized as one of the most consistent reflections on L2 learners' actual strategy application (Amerstorfer, 2018). Alrabai (2021) focuses on the importance of identifying and developing "the most impactful strategies to promote the autonomy" in foreign language acquisition (p. 8). Hapsari (2019), using SILL, makes a profile of students' strategic competence at the Universitas Islam Indonesia and emphasizes the necessity of strategic-based instruction. Danko and Dečman (2019) study the use of second LLSs among Slovenian higher education students when proving the validity of SILL and examining the relationships between the strategies. Nordin et al. (2019) examine preferred LLSs employed by engineering technology students in Malaysia to guide lecturers in selecting suitable teaching and learning activities. Habók et al. (2021) explore cross-cultural differences in strategy use in Hungarian, Chinese, and Mongolian students. Zou and Lertlit (2022) investigate the differences in English LLSs among Chinese students demonstrating different levels of English proficiency, using SILL "as the most influential instrument in language learning strategy research" (p. 707).

These studies highlight the importance of integrating language education with technology-enhanced learning environments and the SILL framework's role in profiling students' strategic competence across different proficiency levels. Therefore, it is essential to align strategy employability with these technology-driven contexts, which frames the research scope and questions:

 RQ1: Do all SILL statements reflect language learning experiences in contemporary tech-supported language instruction?
 RQ2: Are employable LLSs different between proficiency levels within the Common European Framework of Reference for Languages?
 RQ3: Are LLSs teachable actions and can be developed with digital tools?

METHOD

Participants

The study was conducted at the National University of Water and Environmental Engineering (NUWEE) in Rivne, Ukraine. According to existing NUWEE's academic policies, first-year students demonstrating varying language proficiency levels are enrolled into different-level groups ranging from A2 to B2 based on the University-designed Placement test assessment. In their second year of study, they consistently progress to the next language level (B1 and B2+ respectively). Such an approach to learning English at the non-language university allowed all students to improve their English language proficiency and reach the B-level according to the Common European Framework for Languages required to effectively participate in field-specific subjects where English is a medium of instruction.

Sixty-six students aged 17-18 representing six NUWEE Institutes (out of eight) voluntarily participated in the multi-stage survey process employing the convenience

sampling technique. It involved 45 students enrolled into the groups of A2 level transiting to B1 and 21 students of B2 language level transiting to B2+ (i.e. groups of students with the lowest and highest English language proficiency levels) within the two-year ESL University course.

Instruments

The multi-stage survey included two types: cross-sectional and longitudinal.

A cross-sectional survey was conducted twice: 1) at the beginning of their University studies in the academic year 2022/2023, and 2) at the end of the core ESL course in the academic year 2023/2024. The research questionnaire consisted of three parts. The first one embraced the participants' background information, such as their major field of study and the level of English language proficiency (according to the group they were placed in). The questionnaire's second part included all 50 questions of the Strategy Inventory for Language Learning version 7.0 – SILL (Oxford, 1990) without any modifications, which has "a coherent structural design" (Amerstorfer, p. 499). It was made up of 50 items which covered six groups of strategies: 1) memory (questions No.1-9), 2) cognitive (questions No. 10-23), 3) compensation (questions No. 24-29), 4) metacognitive (questions No.30-38), 5) affective (questions No. 39-44), and 6) social (questions No. 45-50). The survey response data was measured on a five-point Likert scale (ranging from 1 (never or almost never true for me) to 5 (always or almost always true for me)) covering each English language learning strategy. Thus, students could evaluate their degree of liking vs disliking of the statement within the SILL framework. The obtained means show high, medium, and low frequencies of LLS use demonstrated in Table 1.

Table 1
High, medium, and low frequencies of using LLS (adapted from Oxford, 1990)

		Range of means per strategy group
High	High or almost always used	4.5 to 5.0
	Usually used	3.5 to 4.4
Medium	Sometimes used	2.5 to 3.4
Low	Generally not used	1.5 to 2.4
	Never or almost never used	1.0 to 1.4

The questionnaire for first-semester students was offered in two languages (English and Ukrainian) to help students better understand the questions and let them provide more accurate answers. The third part included questions on the use of technological means while learning English, such as laptops, tablets, cell phones, smart boards, and digital interactive whiteboards, the use of which the participants had to evaluate on the same five-point Likert scale.

A longitudinal survey was administered on an ongoing basis throughout the two-year course. Students were repeatedly asked to reflect on the effectiveness of the applied strategies and tech-enhanced methods. It encouraged students to consider how these tools contributed to their strategic awareness and development of language skills. These reflective practices were based on oral interviews, written responses, self-assessments, and guided reflections via end-of-class or end-of-topic questionnaires. End-of-class

questionnaires mostly consisted of one to three 'Now I can'-statements evaluated by students using Yes/Partially/No-answers to reflect on their immediate progress and assess the LLSs, including the application of tech-enhanced tools, used when completing the assigned tasks or activities. Some examples of the statements are as follows:

- Now I can use digital dictionaries to deepen my understanding of word definitions and its synonyms.
- Now I can use speech recognition tools to practice pronunciation.
- Now I can participate in online listening activities, such as podcasts, to practice recognizing key information and improve note-taking skills in English.
- Now I can use writing prompts from digital resources to practice essay writing.
- Now I can use voice-to-text technology to draft my ideas in English, then revise and edit my writing for structure and clarity.
- Now I can use online grammar and spell-check tools to identify and correct errors.

End-of-topic questionnaires were more generalized and focused on overall reflections of the learning experience, including the effectiveness of the incorporated tech-enhanced strategies. They contained open-ended questions, e.g.:

- Which specific skills (e.g. listening, speaking, reading, or writing) did you improve on the most during the topic?
- What language strategies did you use to help you understand and complete the tasks on this topic?
- How often did you use digital tools to support your language learning in this topic?

Design and Procedure

The applied research method was of a convergence design, combining the elements and characteristics of cross-sectional and longitudinal studies. The cross-sectional study enabled the collection of data from different participants at a single point in time, specifically from NUWEE students during their first semester (initial survey) and at the end of their fourth semester when they finished the core ESL course (final survey) to assess the prevalence of LLS use in the student population. At the time of the final survey, they were preparing to start core and elective field-related courses with English as a medium of instruction. As with most cross-sectional studies, this research was also quantitative and conducted via online survey methodology. The SILL research questionnaire was organized via Google Forms NUWEE students had been familiar with since their first semester at the university and which they received via the corporate emailing system. The data was collected confidentially and anonymously.

The longitudinal study involved repeated observations and students' reflections on the best-working strategies and the efficiency of the technologies they use. It allowed tracking changes and developments of using LLSs over a four-semester period.

At the end of an ESL class or a topic, a brief survey was administered to gather students' feedback on the use of LLSs discussed or practiced throughout the class or topic. This short 1-3-item questionnaire was conducted digitally via social networking sites and Mentimeter or on paper just before the class ended. The questions were

designed to evaluate students' confidence in applying the strategies learned, identify which strategies they found most helpful, and assess whether they plan to use them outside the class. Students were given 2-3 minutes to complete the survey, ensuring their responses were quick yet thoughtful. Once completed, the surveys were collected or submitted online. This feedback helped refine and adapt teaching methods focusing on the most effective language learning strategies for students' needs.

FINDINGS

Initially, we explored the responses to all 50 items from the SILL questionnaire encompassing six LLS categories. We calculated the students' results separately for two English language proficiency levels (A2-B1 and B2-B2+). By summarizing the data within each category and proficiency level, we identified that metacognitive strategies were predominantly used by the students with low English language proficiency levels, while cognitive strategies were more frequently employed by students with higher English language proficiency, as shown in Table 2 and Table 3. Affective strategies received the lowest scores for both groups. Our analysis shows that more proficient students use cognitive, compensation, and metacognitive LLSs more frequently, as evidenced by the results in Table 3.

Table 2
The survey response data obtained from the students of A2/B1-level group

	initial				final			
	M	RR	SD	F	M	RR	SD	F
Memory	3.10	2.26 – 3.64	0.51	medium	3.18	2.36 – 3.71	0.51	medium
Cognitive	3.05	2.65 – 3.46	0.21	medium	3.31	2.93 – 3.71	0.22	medium
Compensation	2.86	2.17 – 3.41	0.39	medium	3.21	2.52 – 3.78	0.42	medium
Metacognitive	3.38	2.64 – 3.90	0.47	medium	3.53	2.78 – 4.04	0.46	high
Affective	2.61	1.82 – 3.45	0.65	medium	2.78	2.00 – 3.60	0.63	medium
Social	2.85	2.29 – 3.39	0.36	medium	3.23	2.71 – 3.43	0.36	medium
Overall SILL	2.96				3.21			

Note. M – mean value; RR – response range; SD – standard deviation; F – LLS use frequency

Table 3
The survey response data obtained from the students of B2/B2+-level group

	initial				final			
	M	RR	SD	F	M	RR	SD	F
Memory	2.92	2.03 – 3.70	0.66	medium	2.95	2.05 – 3.75	0.66	medium
Cognitive	3.51	2.91 – 4.00	0.41	high	3.66	3.05 – 4.15	0.39	high
Compensation	3.22	2.16 – 3.99	0.66	medium	3.52	2.45 – 4.26	0.65	high
Metacognitive	3.45	2.54 – 4.20	0.48	medium	3.51	2.60 – 4.25	0.48	high
Affective	2.73	1.81 – 3.65	0.64	medium	2.81	1.95 – 3.70	0.63	medium
Social	3.28	2.58 – 4.03	0.63	medium	3.37	2.68 – 4.10	0.61	medium
Overall SILL	3.19				3.30			

Note. M – mean value; RR – response range; SD – standard deviation; F – LLS use frequency

The results of the two surveys (Table 2, 3) enabled the identification of an increase in the use of LLSs within each category and across both groups of students, as the mean scores either remained within the same range or shifted to a higher one.

To identify similarities and differences across diverse educational contexts and understand how different student populations engage with LLSs, we reviewed research findings on LLS use by university students from various countries (Table 4). A comparative analysis between the NUWEE (Rivne, Ukraine) students and their counterparts from four different universities (data obtained from publicly accessible studies on LLS use frequency) revealed that the NUWEE students' responses most closely resembled the findings of surveying students from the University of Ljubljana (UoL) in their LLS use patterns. However, students from Eastern cultures reported higher overall scores compared to their European counterparts from Hungary, Slovenia, and Ukraine. Another notable finding was that NUWEE students predominantly favored cognitive, compensation, and metacognitive strategies, a preference that aligned with students from Hungary, UniKL MITEC in Malaysia, and the University of Ljubljana. In contrast, Thai University and Universitas Islam students use metacognitive, compensation, and social strategies more frequently.

Table 4
Comparative analysis of LLS use frequency by students of different countries

Strategy category	NUWEE, Rivne, Ukraine	UoL, Slovenia (Danko & Dečman, 2019)	Hungarian universities (Habók et al., 2021)	UniKL MITEC Malaysia (Nordin et al, 2019)	Thai University, Thailand (Zou & Lertlit, 2022)	Universitas Islam, Indonesia (Hapsari, 2019)
Memory	3.07	2.88	2.95	3.16	3.430	3.20
Cognitive	3.49	3.26	3.14	3.47	3.564	3.45
Compensation	3.37	3.48	3.11	3.41	3.705	3.46
Metacognitive	3.52	3.41	3.28	3.49	3.656	3.63
Affective	2.80	2.73	2.49	3.09	3.534	3.38
Social	3.30	3.09	3.08	3.29	3.675	3.46
Overall SILL	3.26	3.14	3.01	3.32	3.580	3.43

The overall SILL score for NUWEE students was lower compared to students from the other aforementioned universities, except for Hungary and UoL from Slovenia. However, upon analyzing the results provided by the students from the universities in Malaysia, Thailand, and Indonesia, it was found that higher-level NUWEE students (as indicated by the final survey) were similar to or even more proficient in applying LLSs.

When analyzing NUWEE students' responses in groups with different language proficiency levels, we observed only slight differences in LLS use, as shown in Table 5. The strategies most frequently used by students are the same across both proficiency groups, except within the cognitive group. The least-used strategies fully coincide within the metacognitive and affective groups, partially overlap within the memory, cognitive, and compensation categories, and differ within the social category.

Table 5
Strategies most and least often used within each LLS group

Strategy category	B2/B2+	A2/B1
Memory	• I use new English words in a sentence so I can remember them. • I think of relationships between what I already know and new things I learn in English. • I remember new English words or phrases by remembering their location on the page, on the board, or on a street sign.	
	• I use rhymes to remember new English words. • I use flashcards to remember new English words.	
	• I review English lessons often.	• I physically act out new English words.
Cognitive	• I try not to translate word by word.	
	• I use the English words I know in different ways. • I watch English language TV shows spoken in English or go to movies spoken in English.	• I look for words in my own language that are similar to new words in English. • I first skim an English passage (read over the passage quickly) then go back and read carefully.
	• I try to find patterns in English.	
	• I first skim an English passage (read over the passage quickly) then go back and read carefully. • I say or write new English words several times.	• I make summaries of information that I hear or read in English. • I write notes, messages, letters, or reports in English.
Compensation	• If I can't think of an English word, I use a word or phrase that means the same thing. • To understand unfamiliar English words, I make guesses.	
	• I make up new words if I don't know the right ones in English.	
	• When I can't think of a word during a conversation in English, I use gestures.	• I try to guess what the other person will say next in English.
Metacognitive	• I pay attention when someone is speaking English. • I notice my English mistakes and use that information to help me do better.	
	• I plan my schedule so I will have enough time to study English.	
Affective	• I encourage myself to speak English even when I am afraid of making a mistake.	
	• I write down my feelings in a language learning diary. • I talk to someone else about how I feel when I am learning English.	
Social	• If I do not understand something in English, I ask the other person to slow down or say it again. • I ask questions in English.	
	• I ask for help from English speakers.	• I try to learn about the culture of English speakers.

Conventional symbols:

	- students of higher English language level proficiency		- students of lower English language level proficiency

Note: Compiled by authors based on the final survey results of Oxford's LLS Inventory use by NUWEE students.

In response to the third part of the questionnaire concerning students' use of technological tools in learning English, we discovered that the most favored devices were smartphones, followed by laptops. Conversely, the least utilized technologies were smart boards and digital interactive whiteboards. This trend may be attributed to students' preference for portable devices, likely due to the current unstable and frequently interrupted learning environment.

Students' answers to the end-of-topic questions revealed diverse experiences with language learning. Many reported significant improvements in listening and speaking skills, especially when the topic involved interactive activities such as group discussions or multimedia content, e.g. podcasts. However, the A2/B1 students often faced difficulties understanding them without subtitles. Frequently mentioned strategies throughout the course included active note-taking, contextual guessing, and summarizing main ideas for better understanding, alongside strategies like peer practice and repetition drills to enhance retention. Regarding digital tools, students noted using apps like Duolingo or Quizlet for vocabulary, YouTube videos and BBC podcasts for listening practice, and online translators or grammar checkers to assist with writing tasks. Usage frequency varied, with some students relying on these tools daily and others using them occasionally to supplement traditional methods.

DISCUSSION

Being challenged with diverse language backgrounds and proficiency of tertiary non-language students, the university ESL course and ESL teachers assume the responsibility to design and implement the instruction that supports language development and fosters students' autonomy in language learning. Strategic instruction becomes one of the primary goals in this context since it equips students with practical tools and techniques to navigate academic challenges effectively and enhance their critical thinking and, ultimately, language proficiency.

The research into two-step profiling of students' strategic competence – at the beginning and the end of the ESL course – helped evaluate the use and development of LLSs to succeed in language learning. As noted by Amerstorfer (2018), the initial SILL survey focuses the students' minds on LLSs, thereby increasing their awareness of LLSs (p. 507). When engaged in the SILL survey, students are encouraged to reflect on and self-assess their learning strategies, which fosters their critical thinking about how they approach language learning. It also helps identify the strengths and weaknesses in the developmental process of language learning and raises students' self-awareness, making them more efficient learners, focused on realistic learning goals. Observing and interviewing the students also revealed their increased engagement in the learning process and willingness to experiment with new strategies, particularly those involving digital aids.

The same SILL survey conducted at the end of the course helped to measure the students' progress in terms of their strategy use and language learning awareness. This follow-up survey provided valuable insights into the effectiveness of strategies they had employed, and which of them can be carried forward as the most useful for their continued, often self-regulated, language studies. By comparing the final results with

those from the initial survey, students could reflect on how their understanding and application of LLSs evolved during the course. At the same time, the ESL teachers received a clearer picture of the overall impact of the course on students' strategic learning and can use these findings to refine the future course content.

According to the initial survey, it was observed that both lower-level students and higher-level students exhibited similar preferences within the metacognitive category. It suggests that regardless of their proficiency, students recognize the importance of planning, monitoring, and evaluating their learning process. The participants' responses showed readiness to notice their English mistakes, use that information for self-improvement, and be attentive to someone's speaking English. Such consistency in metacognitive strategy preferences across different groups of students might indicate that these strategies are perceived as universally applicable and beneficial, regardless of the student's current language proficiency. According to Przybył & Pawlak (2023), they enable language learners to avoid information overload through planning and organizing the learning process and developing tactics for maintaining focus. Once students are aware of the LLSs they use, ESL instruction aims to introduce new ones and refine the existing ones to help students become more effective learners. Many language learning apps or digital tools, such as Test-English, Duolingo or Memrise, Babbel, and Quizzlet, which provide interactive exercises, quizzes, and lessons that adapt to the learners' current proficiency level and encourage regular practice, can be offered to students to strategize more effectively in terms of their metacognition. For advanced students, tools like Grammarly or ProWritingAid are particularly beneficial, since they go beyond basic error correction, offering in-depth analysis of writing style, tone, and structure, expand their vocabulary, and refine their understanding of nuanced language use. In addition, apps (e.g. YouGlish), platforms (e.g. YouTube), and podcasts offer a wide range of authentic resources to practice attentive listening and focus on pronunciation, vocabulary usage, and sentence structure used by native or proficient speakers.

As a result of strategic instruction, the final survey findings showed a gain score of 0,15 for B1-level students and 0,06 for B2+ students within the metacognitive category. This can be attributed to the fact that students with a higher proficiency level already demonstrate a more established use of metacognitive strategies in their language learning practices. This improvement is particularly noticeable among their lower-level counterparts, who have developed and integrated metacognitive LLSs more effectively. In researching the influence of metacognition on the development of listening skills, Chero (2023) argues that students are "better prepared to cope with the learning process, improve their comprehension, and gain confidence when dealing with diverse activities" (p. 300). Another goal of developing metacognitive strategies in university settings is to teach students how to effectively use academic platforms, such as MOODLE, to organize their studies. By fostering these skills, students learn not only to manage their coursework and assignments but also develop their "curriculum-based strategies", which together with in-class and out-of-class strategies contribute to learners' autonomy (Alrabai, 2021, p. 2).

As for other preferred categories identified at the initial stage, they differ between the two groups of students: A2/B1-level students prioritized memory strategies whereas B2/B2+-level students favored cognitive ones. This distinction highlights that lower-level students rely more on techniques that aid in retaining and recalling information, such as memorizing and repetition. In contrast, higher-level students tend to employ strategies that enhance their understanding and application of language.

Our findings regarding the use of some memory strategies like using rhymes and flashcards are consistent with those exhibited by Slovenian students in the research of Danko and Dečman (2019), since rhyming or using flashcards are also rarely used. At the same time, higher mean values are observed for the memory strategies such as "I think of relationships between …" and "I use new English words in a sentence …", by using which students rely on particular techniques to enhance their ability to remember and apply a new vocabulary item or grammar category. When instructing students on developing memory strategies, the main task is to integrate the techniques (e.g. interval repetition, mind mapping, using phrase and sentence level, working with different contexts) and digital tools (e.g. Quizlet, Duolingo, Lingvist, Babbel, MindMeister, Coggle) to enrich students' vocabulary systematically and more comprehensively. It allowed students to replace memory strategies mostly based on memorizing with cognitive ones aimed at deeper learning with more practicing, applying patterns, and analyzing nuances. Although the gain score within this category for A2/B1-level students amounts to 0.08, which is insignificant, such a shift indicates an important developmental state. This transition reflects a move toward a more sophisticated learning process supported by the gain score within the category of cognitive strategies.

The initial preference of higher-level students for cognitive strategies is grounded on their established ability to apply the techniques of rehearsal and elaboration, i.e. making links between new information and what they already know, working with dictionary entries, analyzing and deducing, etc. that demands involving the combination of four basic language skills (listening, reading, speaking, and writing). The highest mean values were obtained regarding such strategies as "I try to talk like native speakers", "I watch and read in English …", "I use the English words I know in different ways", and "I try not to translate word-for-word". Thus, the instruction process is designed to develop high-order cognitive skills that require deep learning and a greater degree of cognitive processing, i.e. analyzing, evaluating, and creating (Lai et al., 2022). Incorporating digital tools can significantly enhance this development by offering authentic tools and resources that provide interactive and immersive language experiences, and develop critical thinking, e.g. content creation and storytelling tools like Canva, TED-Ed, or TED Talks platforms to improve listening comprehension, critical thinking, and discussion by exploring a wide range of subjects.

Along with highly developed cognitive skills, higher-level students also demonstrate significantly higher initial mean value for social strategies, while lower-level students exhibit quite the opposite tendency since they often experience anxiety and hesitation when engaging in English conversations. This lack of confidence can be attributed to their limited vocabulary and less exposure to authentic communicative situations.

Within the SILL inventory, the category of affective strategies shows the lowest initial and final mean values, which can be attributed to Ukrainian students' reluctance to discuss their feelings with others. This tendency aligns with the findings by Habók et al. (2021), who associate low-affective strategy use in Hungarian university students with the lack of "indulgence dimension" (p. 6). To address this, it is essential to integrate affective strategies with social strategies, as their combination offers a more holistic approach to fostering a supportive learning environment, facilitating communication, and enabling anxiety-free social interaction.

To develop social strategies, in-class activities should focus on cooperation when students collaborate to resolve a problem, share resources, and produce a joint response. With digital tools, all these activities can be initiated in class and encouraged for use beyond. Group cooperation can start with a joint social network group where students can post or share interesting information or even assignments (recorded videos of oral assignments or created digital stories), ask for advice or clarification, etc. ESL teachers use other digital tools to encourage students to collaborate visually, e.g. Padlet and Miro, with which they brainstorm ideas, create mind maps, and work on shared projects in real time. In addition, Kahoot! and Quizlet Live can be used as gamified collaboration tools in a fun and interactive way; eTwinning platform collaboration engages students in joint cross-cultural projects, participating in forums, blogs, and chats with students from all over the world. Language exchange and practice platforms like HelloTalk and Tandem also enable students to practice conversational skills with native speakers and enhance their language learning experiences. A great discovery for students who feel anxious to use English in real situations and preliminarily need 'self-talk' is the AI-powered simulator SmallTalk2Me that uses advanced speech analytics, which can be used to assess and improve both spoken English and prepare for international speaking tests like IELTS. As a result of this instruction, the gain score in final surveys amounted to 0,09 for higher-level students, which is not so significant due to the above reasons; and 0,38 for lower-level students, which suggests such instruction had a more pronounced impact on their learning.

Finally, compensation strategies show the same tendency for having higher mean values for higher-level students compared to lower-level ones. These strategies imply the students' abilities and techniques to compensate for knowledge and information gaps and resolve language learning problems. Such strategies as guessing or inferencing, paraphrasing, using synonyms or approximation, and code-switching provide a way to navigate communication challenges and contribute to building confidence and fluency. It becomes an indispensable tool for lower-level students' participation and learning in the target language, is aimed at encouraging them to take more risks in language use and gradually improve their proficiency. For higher-level students, it is about advancing their knowledge of vocabulary, complex paraphrasing, and compensating in challenging situations, e.g. more specific professional communication.

Besides previously mentioned apps such as Duolingo, Memrise, Lingvist, etc. offering exercises that encourage guessing and inferencing through context, and expanding students' vocabulary, there can also be used other apps like WordHippo that help students find synonyms and learn to paraphrase effectively. Other powerful instruments

in developing strategies are provided by emerging generative technology, e.g. AI-powered language assistants Replika and ChatGPT can simulate dialogues where learners must use compensation strategies to maintain the conversation. These interactions provide immediate feedback, can adapt to learners' proficiency, and allow students to experiment with different strategies in a low-pressure environment. Providing ESL instruction with extensive involvement of digital tools helped improve the mean value regarding compensation strategies by 0,35 (which is the second highest gain score) with lower-level students, and by 0,22 (the highest gain score) with higher-level students.

Ongoing reflective practices of the longitudinal study as part of the research appear to be crucial in raising students' awareness of the strategies and tools they apply in either developing their skills or overcoming challenges, encouraging them to think critically about the content and the methods they use to learn, as well as identify their strengths and weaknesses in L2 learning. In this research, students' responses to "Now I can"-statements are critical for teachers to get immediate feedback, tailor their instructional approaches, address individual needs, and enhance the overall effectiveness of the language learning process. Students' answers to the end-of-topic questionnaires summarize their experience in applying LLS and various digital tools to support their language learning routine.

Such strategic instruction within the ESL university course is ultimately aimed at enabling further students' self-directed language learning either within the academic environment, e.g. when English is used as a medium of instruction in field-related courses, or for continuous self-development in language learning or learners' autonomy. Students are expected to be ready to apply the three self-regulatory phases, i.e. forethought phase, when learners strategically prepare for upcoming tasks; performance phase, when students make adjustments to their learning promptly according to the feedback from monitoring and evaluating; and self-reflection that influences the forethought processes of learners' subsequent learning actions (Zimmerman, 2000, as cited in Lai, 2022). As stated by Amerstorfer (2018), "time and effort invested in strategic learning are linked to autonomy […] and to an individually experienced demand" (p. 516).

CONCLUSION

University students with their heightened, compared to young learners, consciousness and awareness of language learning practices and well-established digital habits, can enhance their performance and language proficiency through strategic instruction. The new era of language education taking place to a great extent in tech-enhanced environments greatly influences the development or optimization of particular strategies when benefiting from the capabilities of technology. Surveying students at different levels of English language proficiency enabled a deeper understanding of how LLSs vary across proficiency levels, how responsive students are to developing LLSs in tech-enhanced learning environments, which strategies are extensively used and can be developed through the use of digital tools, and which of them need adjustment. Using SILL "with its clear and understandable design" (Amerstofer, 2019) to answer *RQ1*, we

noticed that most statements can generally reflect students' language learning preferences and practices. However, all-round technological support in extending learning experiences necessitates modifications and adjustments to SILL to better capture the evolving use of digital tools and their impact on LLS development.

Based on the survey response data to address *RQ2*, metacognitive strategies emerged as the most frequently used by students of both levels. Integrating technology into ESL instruction further enhanced students' ability to establish goals, control their actions and behaviors, analyze their level of achievement in learning, and arrange revision. Developing cognitive strategies deserved more attention from the ESL teacher at a lower level with the idea of shifting their focus from applying memory strategies to enhancing students' understanding, retention, employment, and reflection on new information. Tech-enhanced environments proved to be highly beneficial for developing socio-affective strategies due to their unlimited potential for fostering communication, collaboration, and engagement among learners. The most significant increase in LLS development for both levels was observed in compensation strategies when the support of technology in resolving language learning problems and compensating for missing knowledge and information was the most pronounced.

The research showed that strategies can be explicitly taught through instruction by applying specific stages, methods, and techniques, which provides a clear response to *RQ3*. This instruction is implemented in four steps: raising students' awareness of different strategies and their potential benefits; providing strategy-oriented instruction when demonstrating how a particular strategy can contribute to increasing language proficiency, e.g. explaining how to work with texts applying cognitive strategies like summarizing or inferring; practicing these strategies and applying them to different contexts: providing feedback to help students refine their use of strategies.

Based on the results of our study, we can conclude that this research emphasizes the need for integrating LLS instruction into ESL curricula, with a focus on aligning teaching practices with the demands of tech-enhanced learning environments.

The perspectives for future research lie in exploring the application of LLSs in both formal and informal tech-enhanced learning environments. Consequently, it stipulates the need to adjust and refine SILL, as a primary LLS assessment tool, to better reflect the evolving landscape of language learning and the specific needs of modern learners.

Despite the positive insights into the formation of students' strategic competence in technology-enhanced environments, the study was limited to a sample of only 66 students from the same university, the same age, and the same nationality, which constrains the generalizability of the findings across diverse learner populations and contexts.

COMPETING INTERESTS

The authors declare that there are no competing interests.

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