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The Use of Language Learning Strategies by Mathematics and Computer Science Students

Ljiljana Knežević
Faculty of Sciences, University of Novi Sad

Abstract

The research into language learning strategies has mainly focused on strategy identification and factors contributing to their use, such as L2 proficiency, gender and age. One of the under-researched factors are the academic fields of learners and their effect on the strategy use. The present paper addresses the question of the interdisciplinary use of language learning strategies in the context of English for Academic Purposes. Applying Oxford's (1990) Strategy Inventory for Language Learning, the paper reports on the use of strategies by mathematics and computer science students at the University of Novi Sad, Serbia. The study reveals that both groups of students are medium strategy users and that compensatory strategies are the most preferred strategies among the participants. The results also show that computer science students are weaker strategy users than their mathematics peers. The findings offer pedagogical implications to teachers of languages for academic and specific purposes, material developers and syllabus designers.

Key words: Language learning strategies, academic field, Strategy Inventory for Language Learning, English for academic purposes.

1 Introduction

Language learning strategies (LLS) and researchers such as Rubin (1975) and Stern (1975) have played an important role in foreign language pedagogy since the 1970s. Focusing on the activities that successful language learners employ during the process of second and foreign language learning, language learning strategies are defined as "specific actions taken by the learner to make learning easier, faster, more enjoyable, more self-directed, more effective, and more transferable to new situations" (Oxford, 1990, p. 8). Relying on a more recent definition, language learning strategies are "activities consciously chosen by learners for the purpose of regulating their own language learning" (Griffiths, 2013, p. 36). The original idea was to identify and enlist these actions and activities in order to teach less successful learners how to apply them. With this aim in mind, numerous researchers have focused on identification and classification of language learning strategies (Cohen et al., 2003; O'Malley & Chamot, 1990; Oxford, 1990; Purpura, 1999) offering a number of more or less similar categorizations. One of the most detailed and widely accepted classification systems has been provided by Oxford (1990) who classifies strategies into two broad categories – direct and indirect, based on the criterion whether strategies directly involve the target language or not. Within this system the author identifies six major groups of language learning strategies: memory strategies (those that help learners store and retrieve L2 content), cognitive strategies (help learners manipulate language material), compensatory strategies (help learners use L2 in spite of the knowledge gaps), metacognitive strategies (help learners manage the learning process), affective strategies (help learners regulate their emotional state) and social strategies (help learners work with others while learning). The strategy identification procedures have mostly relied on questionnaires or self-report and qualitative research methods, such as interviews or written diaries. The literature review suggests that the greatest number of studies have applied a questionnaire developed by Oxford (1990), the so-called Strategy Inventory for Language Learning (SILL) (Nyikos & Oxford, 1993; Green & Oxford, 1995; Wharton, 2000; Bruen, 2001). The instrument aims at assessing the frequency of use of particular types of strategies and represents a standardized measure that can be applied with learners of a variety of languages. In spite of the advantages that this instrument offers, it does not provide any space for learners' creative responses (Oxford, 1993), which is often seen as one of the major shortcomings of the tool. Applying different strategy categorization, Cohen, Oxford and Chi (2003) subsequently developed the Language Strategy Use Inventory according to skills. However, the analysis of the literature sources suggests that the SILL has preserved the dominant role among researchers. A possible reason for this may lie in the fact that the choice of strategy identification instrument is closely related to the issue of strategy classification, and as Griffiths and Oxford (2014) state, in spite of numerous attempts to provide adequate categorization, no consensus has been reached among researchers, leaving thus the Oxford (1990) system of classification superior.

Apart from the research into identification and classification of strategies, there have been numerous studies focusing on factors contributing to L2 learners' use of strategies, such as the level of L2 proficiency, age, gender, learning style etc. (Green & Oxford, 1995; Wharton, 2000; Carson & Longhini, 2002; Oxford, 2003; Anderson, 2005). One of the factors that have been under-researched is the academic field of L2 learners, and its effect on the strategy use. The present paper addresses the question of interdisciplinary use of language learning strategies in English for academic purposes (EAP) context.

2 Academic field and language learning strategy use

As Meshkat and Khanjani (2014) notice, the literature is scanty regarding the influence of academic fields on students' use of language learning strategies. Examining variables affecting the choice of language learning strategies by university students, Oxford and Nyikos (1989) pointed to the differences

in strategy use related to the students' majors. University major made a highly significant difference in this respect, as humanities, social science and education students used strategies significantly more often than technical science students. Peacock (2001) investigated the use of language learning strategies by science, mathematics and engineering students in a Hong Kong university and concluded that cognitive and compensatory strategies were the most preferred strategies among the students. He also reported on some discipline differences as physics students used significantly fewer cognitive and mathematics students significantly fewer metacognitive strategies in comparison with other students participating in the study. Investigating further the same issue on a larger number of students across eight academic disciplines, Peacock and Ho (2003) came to the conclusion that humanities students were more efficient strategy users than their science and engineering peers. The study revealed that the greatest number of strategies were employed by the students majoring in English, this particularly referring to cognitive, metacognitive and social strategies, while computing students proved to be the weakest strategy users (this especially referring to the use of metacognitive strategies). The overall results showed that compensatory strategies appeared as the most favoured and affective as the least favoured strategies among the participants. Finally, applying a qualitative research method for investigating the effect of academic majors on the strategy use, Rao and Liu (2011) concluded that the students of different disciplines showed more similarities than differences regarding the strategy use. Nevertheless, the humanities students participating in this study showed to be more active strategy users than the science students.

To summarize, although scanty, the research into the effect of academic discipline on language learning strategies has pointed to some consistent differences in strategy use and strategic preferences of students of various academic subjects, suggesting thus that academic major appears as a variable affecting students' choice of strategies. According to Peacock and Ho (2003), further research in this area is highly needed considering the fact that there is a very large number of EAP students in universities around the world. As all of the studies described above were conducted in American or Asian educational context, there seems to be a lack of data referring to other social, geographical and educational contexts. Bearing this in mind, the present paper addresses the question of interdisciplinary use of language learning strategies in Serbian EAP context. More precisely, the study is concerned with the use of language learning strategies by mathematics and computer science students, the frequency of strategy use, the students' preferred types of strategies, as well as possible differences between the two groups of students.

3 Research design

The study was conducted with 59 undergraduates of the University of Novi Sad (N=59), 30 of them studying mathematics and 29 computer science. Initially, there were 67 participants as this was the final number of the undergraduates, but eight of them provided incomplete answers and were excluded from the data analysis. As shown in Table 1, the participants were first- and second-year students, and their age spanned from 19 to 21 years. Regarding their English language proficiency, all of the students were tested prior to taking their EAP course at university (Quick Placement Test, OUP, 2001) and proved to be B1-B2 level English language users. Their educational background was similar as they all completed their secondary education in Serbia.

Table 1: *Distribution of participants (N=59) in relation to the year of study*

Participants	Mathematics students	Computer Science students
First-year	12	14
Second-year	18	15
Total	30	29

As stated above, the aim of the research was to examine the interdisciplinary use of language learning strategies in Serbian EAP context. Regarding this aim, the following research questions were set:

1. Are mathematics and computer science undergraduates high, medium or low strategy users?
2. What types of strategies do these students use?
3. Does the students' strategy use differ by discipline?

Relying on Oxford's taxonomy of language learning strategies (Oxford, 1990) as a most comprehensive system of strategies proposed so far, the instrument chosen for this study was Oxford's SILL Version 7.0 for non-English speakers, as it follows the given categorization. The choice of the instrument was also supported by the fact that its reliability and validity have been proven in numerous studies conducted in various contexts (Nyikos & Oxford, 1993; Green & Oxford, 1995; Bruen, 2001; Wharton, 2000; Hong-Nam & Leavell, 2006). The SILL has consistently scored above .90 using Cronbach alpha (Peacock & Ho, 2003, p. 184), which points to the high level of internal reliability. This self-report questionnaire is comprised of 50 items, each item representing a language learning strategy. The items are grouped into six categories according to the six strategy types: memory strategies (items 1-9), cognitive strategies (items 10-23), compensatory strategies (items 24-29), metacognitive strategies (items 30-38), affective strategies (items 39-44) and social strategies (items 45-50). The respondents indicate how often they employ each of the strategies by selecting one response on the five-point Likert scale, with value 1 denoting "Never or almost never true of me" and 5 implying "Always or almost always true of me". According to the scale ranges set by Oxford (1990), small total score values (1.0-2.4) indicate low level strategy use, values 2.5 to 3.4 medium strategy use and values 3.5 to 5.00 high level strategy use.

The SILL was administered to the students at the beginning of the EAP course, more precisely, in the second week of the course. Considering that the participants' level of English was assessed as B1-B2, the survey items were all in English. However, the purpose of the survey and detailed instructions regarding the administration procedure were provided and discussed in students' L1. The participants anonymously filled in the questionnaire and the data analysis included descriptive statistics and student's t-test for comparing the means and establishing possible statistical differences between them.

4 Results

The results of the study are presented in the following order: the overall results of the students' strategy use, the results referring to the use of particular types of strategies, and finally, the results indicating the preferred individual strategies.

The analysis of the overall results suggests that all participants in the study fall within the category of medium strategy users, as the mean values representing the frequency of their strategy use range between 2.74 and 3.06. The means also indicate that mathematics students use language learning strategies more often than their computer science peers, but the difference between the two results has not proved statistically significant ($p>0.05$), as it can be seen in the following table:

Table 2: *The overall use of strategies by mathematics and computer science students*

	Mathematics students	Computer Science students
M	3.06	2.74
SD	1.27	1.34
Min-Max	2.4-3.74	2.12-3.44
p	0.5272	
Strategy Use	Medium	Medium

The results on the use of particular strategy types are given in Table 3 for mathematics students and Table 4 for computer science students. The given results are presented in descending order, with most frequently used strategies given at the top and least frequent strategies at the bottom of the table:

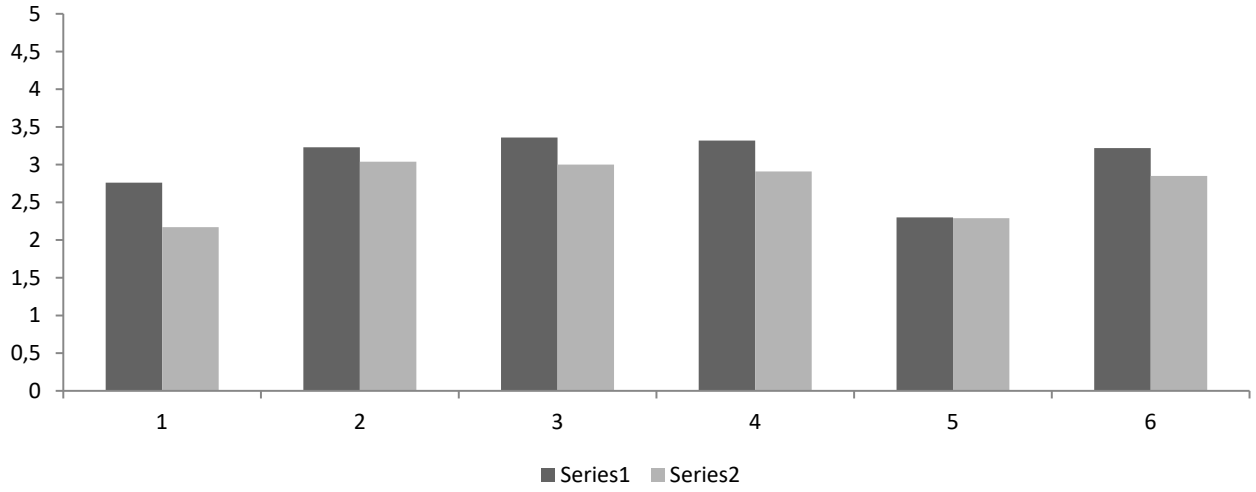
Table 3: *The use of particular strategy types by mathematics students*

Strategy type	M	SD	Strategy Use
1. Compensatory	3.36	1.13	Medium
2. Metacognitive	3.32	1.20	Medium
3. Cognitive	3.23	1.24	Medium
4. Social	3.22	1.30	Medium
5. Memory	2.76	1.26	Medium
6. Affective	2.30	1.23	Low

Table 4: *The use of particular strategy types by computer science students*

Strategy type	M	SD	Strategy Use
1. Cognitive	3.04	1.25	Medium
2. Compensatory	3.00	1.41	Medium
3. Metacognitive	2.91	1.30	Medium
4. Social	2.85	1.43	Medium
5. Affective	2.29	1.36	Low
6. Memory	2.17	1.18	Low

According to the above results, it appears that the participants mostly apply compensatory, cognitive and metacognitive strategies, while the least frequently used strategies are affective and, in case of computer science students, memory strategies. The highest recorded value refers to compensatory strategy use by mathematics students (3.36) while the lowest value describes the use of memory strategies by computer science students. Mathematics students tend to use all of the strategy types, except for affective strategies, more frequently than their computer science peers, as it is clearly observed in the graph below.



Graph 1: *The use of particular strategy types: mathematics and computer science students compared*

Finally, referring to the use of individual strategies, the survey shows that the most popular strategies among the students are the following two compensatory strategies: *If I can't think of an English word, I use a word or phrase that means the same thing* and *To understand unfamiliar English words, I make guesses.*

As for metacognitive strategies, the two most preferred strategies among the participants are: *I pay attention when someone is speaking English* and *I notice my English mistakes and use that information to help me do better*, while the most preferred cognitive strategy is *I watch English language TV shows or go to movies spoken in English.* On the other hand, the least used strategies among the students are the affective strategies *I write down my feelings in a language learning diary* and *I talk to someone else about how I feel when I am learning English* as well as the memory strategy *I physically act out new English words.*

5 Discussion

As it has already been stated in the previous section, the students majoring in mathematics and computer science at the University of Novi Sad all show to be medium strategy users regarding their English language learning and usage. Considering their level of proficiency, which ranges from B1 to B2, and taking into account the fact that strategy use generally improves learners' language competencies, somewhat higher strategy use could have been expected by the participants. The findings corroborate previously recorded results in other higher educational and cultural contexts such as India (Meshkat & Khanjani, 2014) and China (Peacock & Ho, 2003) where it was also found that all non-humanities students fall within the category of medium strategy users. Similarities are also observed when it comes to specific types of strategies, as compensatory strategies, followed by cognitive and metacognitive ones, proved to be the most favoured strategies by the participants in Peacock and Ho's study (2003). It appears that the general context of higher education initiates and supports the use of operations and techniques useful for overcoming a lack of specific information, mental manipulation and tackling various data as well as managing the learning process. The above authors also reported that computing students used the fewest language learning strategies when compared with their peers majoring in other seven disciplines. The present results, although based on the comparison between the students of two academic disciplines, also suggest that computer science students are not so fond of using strategies. This particularly seems to be the case with their use of memory strategies, as this was the lowest result recorded in the study. Apart from memory strategies, the findings of this study also point to extremely low use of affective strategies among all participants. Although they are adults and therefore supposedly mature in every segment of their life, it appears that the participants generally pay less attention to the affective dimension of their foreign language learning. A possible explanation may be found in general educational context in Serbia which still relies on traditional approaches and values, focusing mostly on learners' achievement and the assessment of gained knowledge, thus marginalizing the affective and social aspects of learning. It can therefore be concluded that since the beginning of their general education the participants have rarely been guided how to regulate their emotional state while learning, and what benefits this can bring in terms of learning efficiency. These results do not refer only to Serbian undergraduates as similar findings have been reported by Wharton (2000) who also found that affective strategies were the least favoured type of language learning strategies among undergraduates of a Singapore university. Finally, considering the students' most preferred strategies, the two compensatory strategies, it can be assumed that the choice of these strategies is related to the main principles of dealing with mathematical problems, i.e. applying various individual solutions and approaches in solving a single problem. The most favoured cognitive strategy, on the other hand, is directly related to the global dominance of English in mass media.

6 Conclusion

The interpretation of the study results offers certain pedagogical implications to EAP/ESP teachers, material developers and syllabus designers. As the results of this and previously conducted studies

show (Oxford & Nyikos, 1989; Peacock & Ho, 2003), students of non-humanities orientation do not tend to use strategies often. Therefore, in the process of syllabus design and material development for these groups of students EAP/ESP teachers and practitioners should pay particular attention to creating activities that stimulate the use of language learning strategies. In their classes, teachers themselves should try to make these students maximally aware of the importance and benefits of strategy use in language learning. This particularly needs to be the case with the courses for computing students, as they show the weakest performance regarding the strategy use. Collaborative tasks and activities should also be given more space in EAP/ESP syllabi and classroom activities as they are crucial for developing students' social strategies.

Last but not least, EAP/ESP teachers and practitioners should pay more attention to the affective domain of language teaching by creating a pleasant atmosphere in which students would not feel stressed when expected to communicate in a foreign language and where they would learn how to relax and make their language learning not only more successful, but also less stressful and more enjoyable. In addition, EAP/ESP teachers and instructors should be aware that students' language learning also reflects specific characteristics of their academic field. In case of mathematics and computing students that would mean accuracy, attention to detail, and preference for individual work in problem solving. Teachers and instructors, therefore, should be aware of these differences and show high flexibility in selecting and applying an approach and activities that would stimulate students to accept different approaches to learning the foreign language content.

This report presents preliminary results that stress the need for conducting a larger-scale study on the use of language learning strategies among LSP students of various professional orientations. The study reported in this paper has a certain number of limitations. In the first place, it represents a small-scale research with only two groups of students of a relatively small size. Additional limitation lies in the fact that the research results rely only on the quantitative data. Qualitative research design would certainly offer a better insight into students' choice of strategies and reasons for using them. A larger sample that would include students of various academic subjects would also contribute to better explanation of the influence of academic field on students' strategy use in the context of LAP/LSP teaching and learning. For the time being, the value of this report is in its pedagogical implications as it stresses the need for analyzing students' learning habits and characteristics of the field of study prior to the beginning of the course with a view to enlarging the scope of students' strategies and ensuring better learning outcomes.

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