

Received: 17/09/2023

Accepted: 17/10/2024

Published: 30/10/2024

Non-native English Speakers Learning to Program at Tertiary Level: Needs Analysis of Computer Science Students at Tlemcen University

تعلم البرمجة من طرف غير الناطقين باللغة الإنجليزية: نظرة عن
قرب إلى وضع تدريس/تعلم الإنجليزية لأغراض
خاصة في قسم الإعلام الآلي بجامعة تلمسان

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Langues, Littérature, Cultures/ LLC

Abstract:

Learning to program certainly involves many aspects. At the linguistic level, for instance, novice programmers with native languages other than English have to cope with the English-like introductory programming languages. However, the lack of English mastery can be problematic at this level. As such, the focal aim of this work is to bring a comprehensive account of the English-language-related challenges faced by novice Algerian computer scientists. In order to meet the study's end, a needs analysis was conducted at the level of the Computer Science department at Tlemcen University, Algeria. This study built on a mixed methods approach to data collection, including the questionnaire and the interview. The results revealed that English mastery affects computer science students' programming ability as it is required in almost every aspect of programming.

Keywords:

English for Specific Purposes; computer science; programming ability; introductory programming languages; novice programmers.

المخلص

يتضمن تعلم البرمجة العديد من الجوانب. على المستوى اللغوي على سبيل المثال يتعين على المبرمجين المبتدئين الناطقين بلغات أصلية غير الإنجليزية تعلم لغات البرمجة التمهيدية التي تتقاسم عدة نقاط مشتركة مع اللغة الإنجليزية مما قد يجعل عدم إتقان اللغة الانجليزية عائقا بالنسبة للمبرمجين المبتدئين. و بالتالي الهدف المحوري لهذا المقال هو تقديم وصف شامل للتحديات المتعلقة باللغة الإنجليزية التي يواجهها طلبة الإعلام الآلي المبتدئين. من أجل الوصول الى هدف الدراسة تم إجراء تحليل إحتياجات الطلبة على مستوى قسم الإعلام الآلي بجامعة تلمسان حيث تم جمع البيانات اللازمة عن طريق الاستبانات التي وزعت على طلبة الإعلام الآلي و المقابلات التي اجريت مع الأساتذة. كشفت النتائج على أنه إتقان اللغة الإنجليزية يؤثر على أداء البرمجة لطلبة الإعلام الآلي كما هو مطلوب في كل جانب من جوانب البرمجة.

الكلمات المفتاحية:

الإنجليزية من اجل أغراض خاصة ; الإعلام الآلي ; القدرة على البرمجة; لغات البرمجة التمهيدية ; المبرمجين المبتدئين.

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1.INTRODUCTION

Computer science education in higher institutions has been increasing in many nations. While this expansion intends to make computer science more accessible to students, there are issues with English-based introductory programming languages

in many countries, like Algeria, where Arabic is the first language and English was not introduced until middle school as a foreign language. On top of that, French is the instructional language in almost all tertiary educational institutions in Algeria, and the Computer Science Department at Tlemcen University is no exception.

This state of affairs is the driving force for this paper that aims to identify not only the encountered challenges but also the required English knowledge for novice programmers to fit within the constantly evolving industry that views a well-rounded knowledge in computer programming and English language as a survival kit. Although problems faced when learning English are regularly investigated, few research works dealt with learning English-based programming languages by non-native speakers of English and, more particularly, native speakers of Arabic, a language with a completely different origin.

In order to meet the study's end, a needs analysis was conducted at the level of the Computer Science department at Tlemcen University, Algeria. This study built on a mixed methods approach to data collection, including the questionnaire and the interview, which allowed cross-verification of the findings.

2. Review of Related Literature

English has become the most accepted language all over the world in nearly all the fields of studies. ESP has developed as one of the most important areas of EFL (English as a Foreign Language) teaching nowadays.

2.1 English for Specific Purposes and Needs Analysis

There have previously been several definitions and explanations of ESP as a construct. However, it can be best defined with a focus on students' needs that should be taken into

consideration to design an ESP course with a well-defined purpose. This is reflected in Harmer (2001: 1), who provided a comprehensible definition of ESP, considering it as "Situations where the student has some specific reasons for wanting to learn a language", which introduces the idea of students' needs.

In fact, since the early 1960s, the NAI-Needs Analysis and Identification process has been recognised in language education and was regarded as an important subject of interest within the field of ESP. The driving forces behind conducting a needs analysis, according to Richards (2001), are mainly related to identifying the skills that are mostly needed for the learners, which will help design an ESP course that genuinely meets their needs by bridging the gap between their lacks and wants.

2.2 English for Science and Technology

English for Science and Technology or EST is considered an important aspect of ESP programmes, given that the demand for a specialised language has mainly arrived from scientists and technologists who needed the English language for specific reasons. Scientific English is said to be distinct from general English in the sense that it has a narrower set of objectives. However, the EST approach can be simply perceived as a sub-branch of the ESP approach, which builds on the idea that English is learned to fulfil a precise set of goals.

2.3 Computer Programming and Programming Languages

Being the crux of computer science, computer programming is usually the main content in computer science educational institutions (Guzdial, 2015). It can be simply defined as the activity of giving some instructions to the computer in order to perform specific tasks.

Programming languages are the sole medium between programmers and the computer, given the fact that they are a set

of words, abbreviations and symbols that are used to create commands making human-machine communication possible (Shelly & Vermaat, 2011). English is nowadays considered the lingua franca of computer programming because the vast majority of programming languages are English-based which is discussed in the ensuing part of this paper.

2.3.1 The importance of English for Computer Programmers

Non-native speakers are required to develop English language skills relevant to their learning material (Janzen, 2008). In the case of Computer Science students whose native language is not English, they need to enhance their English language skills on top of learning, say, English-based programming languages.

While it is true that students' math and science abilities are essential factors that may influence the process of learning programming (Bergin & Reilly, 2005), most of the studies done in this respect were about native speakers of English. It is therefore expected that for non-native speakers of English, English language proficiency is more needed in developing the programming ability.

By raising the direct research question, "Is there a relationship between the student's English proficiency and their computer programming mastery?", Pudyastuti et al. (2014) found out that there is a significant correlation between the students' English language proficiency and their computer programming mastery. Some errors found in novice programmers' code are partly related to the lack of English language mastery, as mentioned by Bringula et al. (2012).

3. Methodological Considerations

The teaching-learning situation in the Computer Science Department of Tlemcen University was investigated with a

particular focus on programming and its relation to the English language. In order to obtain an in-depth analysis of Computer Science students' needs, Hutchinson and Waters (1987) model of needs analysis was used.

3.1 Sampling

Sampling is a crucial element of research. It is the fact of selecting a manageable group of people that is similar or, at least, more likely to represent the whole population. Regarding the present work, the sample differed from one research instrument to the other.

3.1.1 Questionnaire sampling

For the current study's situation and needs analyses, both current and previous computer scientists from the faculty of sciences of Tlemcen University, Algeria, were taken as a sample because of the possibility that previous students are more likely to be aware of the needs of novice programmers. Of all the sample, seventy students at Tlemcen University completed the questionnaires.

3.1.2 Interview Sampling

The face-to-face interviews were conducted with a convenience sample of six Algerian computer science teachers working at Tlemcen University. Some of them taught programming-related-modules for more than 20 years.

3.2 Research methodology instruments

Needs analysis procedures were employed in which both questionnaires and interviews were exploited to obtain the necessary data. The mixed-methods research design used for this study was not only intended to have a sort of complementarity

between the different instruments, but it also allowed to cross-check results.

3.2.1 Questionnaire

The questionnaire has become one of the most used means of collecting information. Questionnaires composed of 20 questions were delivered to students and employers with a computer science major to disclose their necessities, lacks and wants.

3.2.2 Interview

The interview is a common research instrument used to collect relevant data through a verbal exchange between the researcher and the informants. Semi-structured interviews were conducted with six computer science teachers.

4.1 Results of the Questionnaire

Programming languages and the English language: what kind of relationship?

The first attitudinal question was supposed to gather computer science students' opinions about the hegemony of English in the computer science field. Almost 80% of the respondents showed dissatisfaction with the fact that programming languages are English-based. No more than 1/5 of the participants were satisfied with this fact.

In order to see if computer science students are aware of the importance of English in their field, they were asked if they make extra efforts to develop their English skills. It was found that almost 93% of the participants make efforts to improve their English mastery.

On the other hand, only 7% of the participants do not make an effort to improve their English skills. In fact, an important number of the participants demonstrated that they know that a workable knowledge of English is fundamental to survive in the computer science field. Some participants mentioned that they need to master English to keep abreast with the developments in the computer science field and also to benefit from the available programming materials.

What stands out in figure (1) below is that an emergent number of the participants think that learning to program is challenging for beginner programmers.

In order to dig deeper into the studied correlation, respondents were asked if they think any relationship exists between progress in learning programming languages and English language proficiency. The results revealed that a clear majority of the participants (around 73%) claim that students who master English progress faster in programming than those who don't.

When asked about the parts of programming in which English mastery is mainly required, the respondents' answers varried between programming materials that are primarily found

in English to easily naming identifiers¹ and not only understanding code written by international programmers but also code comments and programming keywords. More particularly, according to some respondents, workable knowledge of English is required to benefit from some important online forums like StackOverflow, a famous website where solutions for different problems and bugs can be found easily by typing the problem in English.

In order to see how deep is the relationship between the English language and programming, participants were asked about the language they use to write identifiers names and code comments. It turned out that almost all the respondents (around 97%) use French in order to both name identifiers and to comment on their programmes. Only two participants mentioned that s/he uses English to do these programming activities.

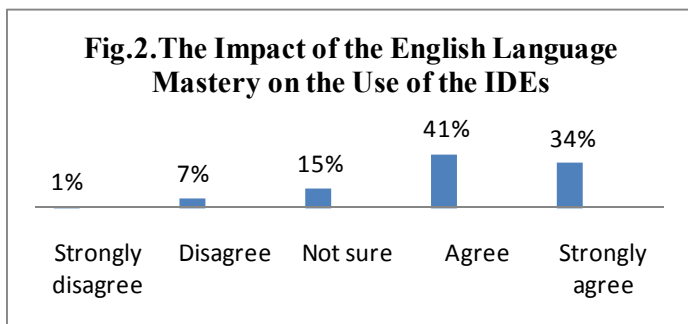
Informants were then asked if it is essential for programmers to write identifiers and comment in English. Again, almost all the participants, around 86 %, agreed on the fact that programmers need to use English in these programming activities. When asked about their opinion, there was a consensus that doing these programming activities in English makes the written code understood by programmers worldwide.

Participants who look for solutions on the search engines in a language other than English were further asked if they find it challenging to find the appropriate answers. The majority of the participants pointed out that it is both hard and time-consuming to translate everything to and from English. Notably, some participants mentioned that the translation they obtain from Google Translate, for instance, is not necessarily accurate,

¹ identifiers (IDs) are lexical tokens that name entities. Identifying entities enables programmers to refer to them which is essential for the programming activity.

indicating that it is sometimes misleading. The awareness of such an issue is an unexpected yet intriguing result.

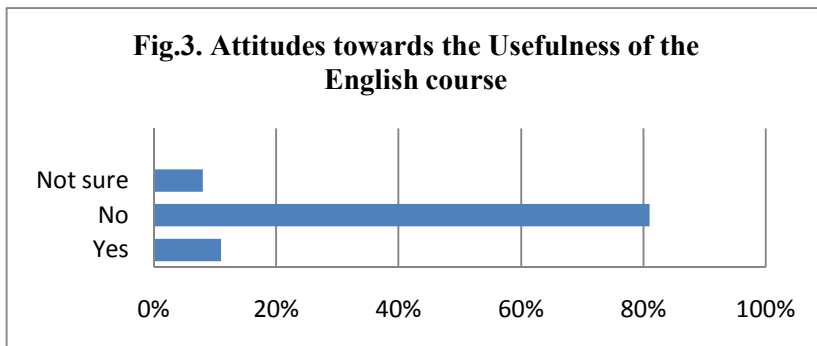
Computer scientists were then asked if they think that programmers who do not master English face difficulties using the Integrated Development Environments or IDEs². As it can be seen from figure (2) below, an emergent number of the participants, around 75%, agree that lack of English ability creates challenges with using IDE's.



Programmers' needs and technical English course

The respondents were asked if they find the Technical English course helpful in the sense that it targets their actual needs in terms of the English language. The answers showed a remarkable dissatisfaction with the provided English course. As shown in figure (3) below, around 81% of the informants do not think the technical English course introduced to Computer Science students matches their needs.

²IDE is a software that is meant to facilitate the activity of computer programming as it provides many features in a single program, i.e., all development can be done using one program only. This program comprises a source code editor, build automation tools and a debugger.



Some students argued that the course was too general, not considering their field's requirements which kept decreasing not only their motivation but also their attendance rate. It was also found that the course content did not match the student's level in English. While some participants mentioned that it was too difficult to cope with the English module, others mentioned that the level was low for them, which introduces the issue of inadequacy.

Participants were then asked about the language skills most required for improving their programming ability. The obtained answers indicated that reading and writing are considered as the most critical skills to be mastered because several parts of programming heavily draw on them. Some participants insisted on the idea that novice programmers should have at least basic English knowledge before enrolling in programming classes.

Finally, the participants were asked to provide some helpful suggestions or remarks about the issue under study. The most recurrent suggestion was to help novice programmers improve their writing and reading skills in English. An emergent number of the participants indicated that the whole computer science education, including programming teaching, should be done in English. Interestingly, one participant suggested an

experimental period in which instruction in the computer science department should be in English.

4.2 Results of the Interview

The relationship between English and programming

This topic was, in fact, the prelude of all interviews. When asked about the language used to accomplish some programming activities, the interviewees' answers were consistent in the view that all of them mentioned that their students rely on French to not only write the names of variables and functions but also to comment on their code.

Up against, the majority of the participants confirmed that all the IDEs used for instruction are English-based, which might seem quite contradictory with the language of instruction. Teachers stressed that students with a limited English background might find using IDEs challenging. As such, some field specialists suggested that students must master the terminology of the English-based programming softwares, development tools and libraries to learn to program efficiently. Some teachers explained that although mastery of the English language is not mandatory to learn to program, it remains an asset that would certainly help programming learners to progress faster.

Field specialists were asked to list the type of programming errors, difficulties and misconceptions likely to occur because of the lack of English mastery. They claimed that lack of English mastery does not cause compilation errors or the like. Instead, it was assumed that limited English mastery is more likely to inhibit the learners from spotting and fixing the errors found in their code because compilation error messages

are in English. Others mentioned that students who do not master English are likely to have syntactic errors.³

Non-natively English speaking Programmers' needs in terms of the English language

The interviewees were asked about the language skills that computer science students mostly need. A prevalent theme emerged from the scrutiny of the results when most teachers think that reading skill is highly important for programmers.

There was a sense of agreement amongst interviewees that writing skill is also important to be mastered to learn to program. For instance, some interviewees highlighted the importance of writing code and code comments that programmers can understand worldwide. On the other hand, some teachers advocated that computer science students who speak English have the chance to communicate with international programmers. Similarly, some interviewees claim that listening skill is necessary for novice programmers in the sense that it enables them to understand English-speaking tutors in online courses.

At last, teachers were asked to state their opinion about the prevalence of English in computer programming and the linguistic situation in the department of Computer Science. Although some teachers showed negative attitudes toward this situation, the most prevailing and recurrent suggestion was to teach programming in English. As such, teachers called for a gradual change in the instructional language, i.e., from French to English. Some teachers pointed out that an abrupt change in the instructional language is by no means possible.

4.3 Discussion of Questionnaires' Results

³ Syntactic errors are one of the types of errors that can occur while programming. In this case, an error can be defined as a fault or problem in a program that leads to abnormal behavior of the program. Syntactic errors may occur when the rules of writing C syntax are violated

It is evidently due to the intertwined nature of the existing relationship between English and programming that it was found that it is difficult for novice programmers with a limited English proficiency to learn computer programming. What reinforces this finding is that the respondents could easily identify the different reasons that make programming a challenging activity for learners who lack English language mastery. It is no surprise that a deficient English proficiency proved to slow the programming learning process down. Making efforts to improve English mastery is certainly a glaring flag that shows the awareness of computer science students of the importance of English.

The questionnaires' results also highlighted the problematic linguistic situation at the Computer Science department at Tlemcen University, where French is still persistent. It is worth mentioning that the unsatisfaction of some participants with the prevalence of the English language in computer programming and, more particularly in programming languages, can only be explained by the lack of English mastery. Blame is never to be put on the language of science and its omnipresence. Instead, it is the language planning and policy that should be carefully revised and improved.

Different instances about how mastery over English serves computer science students to get along the programming activities were given, starting from basic ones like naming identifiers to more complex ones such as understanding compilation error messages. It turned out that even the basic elements rely on English, which makes its proficiency a prerequisite rather than an option.

The questionnaires' results also confirmed that reading and writing are the most required language skills in learning to program. Although some skills seem more important than others, a certain complementarity should occur, especially in a

language class where deficiency in one skill can negatively affect the whole learning process.

4.4 Discussion of Interviews' Results

Results obtained from interviews firmly confirm the questionnaires' results about importance of English in computer programming. Field specialists also confirmed that reading and writing are considered the most essential skills to be mastered by novice programmers.

Although it is widely acknowledged that English is the language of Science and Technology, French is still used in the department of Computer Science to fulfil various goals. Not only is it used as the medium of instruction but also as the language on which both students and teachers rely to do the programming routines. Teachers think that the best way to solve the encountered linguistic problems in Computer Science Department is to gradually switch the language of instruction into English, a suggestion that seems promising yet farfetched due to the passive nature of the education system in Algeria in general.

5. Discussion of the Main Findings

This paper is a contribution to the ongoing discussion about the role played by English in Science and Technology and, more particularly in Computer Science where English is omnipresent. It is no surprise that some scholars are calling for the use of English as the language of instruction in programming classes; as stated by Solomon (2003:35), "The programming language should be the second language of programmers after the English language that should be the first".

This is reflected in the obtained results from both the questionnaires and the interviews, which disclosed the verity that English language mastery plays a crucial role in learning to program for novices. In the same line of reasoning, Lesser and

Winsor (2009) advocated that the limited English proficiency of students may be the reason behind their inability to understand some concepts. The same applies to computer scientists who lack English proficiency and find it difficult to deal with the natural language aspect of programming languages. The study's results are therefore in accordance with previous studies such as Guo (2018), and Pudyastudi et al. (2014).

The impact of the English ability on the students' programming ability could be better explained with reference to the constructivist theory, which posits that the new knowledge students receive is built upon the basis of previous knowledge (Ben-Ari, 2001). Translated into the process of learning computer programming by non-native speakers of English, the knowledge students already possess in English is said to affect their progress which, in turn, depends on the degree of their English language mastery.

It was demonstrated that English mastery is required to not only be able to benefit from the existing materials in the field but also to be able to appropriately give commands to the computer. It was also disclosed that programmers should be skilful in writing because it is necessary to describe the aim of (a) line(s) of code under the form of a comment. Computer science students should learn to comment on their code as early as they start to program for it keeps their work organized as well as it enables other programmers to understand it which is essential for pair programming (Noshin & Ahmed, 2018).

Given the fact that programming errors are an inevitable part of the programming activity, it is also required to have mastery over reading in order to avoid judgement errors, a type of programming errors which, according to Bringula et al. (2012), occurs when students are unable to understand the compilation error messages. Understanding compilation error messages is only one step closer to solve the problem that caused the bug. The next step is looking for solutions which are

not always easy to find. This is why programmers generally refer to specific websites wherein solutions to different problems are shared mainly in English language, which again makes its mastery indispensable for computer programmers.

Another thing to consider is that ESP teachers are often said to find themselves in a situation for which they are ill-prepared. It goes without saying that for effective instruction to take place, ESP teachers should not only possess pedagogical knowledge but content knowledge as well. Due to the lack of importance given to ESP, teachers of general English (GE) are often hired to teach 'specialised' or, say, Technical English to field specialists, a phenomenon that should be taken more seriously.

Together, the findings of the two research tools discern that a certain change in the instructional language should take place in Algerian universities in general and the department of Computer Science in particular. Putting the linguistic situation into question is a step forward to improve not only the ESP situation but the teaching/learning situation in the Computer Science department, in general. This is also said to allow computer scientists to become abreast of the technological advancement and scientific development that take place in today's unprecedented world.

6.CONCLUSION

The current paper aims to investigate the correlation between computer programming ability and English mastery for novice programmers with native languages other than English. In order to reach the study's objectives, a needs analysis procedure was exploited at the level of the Computer Science department at Tlemcen University. The study's results were quite revealing, and the interconnectedness between the English language and computer programming was notably highlighted.

It is high time that the Algerian educational institutions, mainly those related to Science and Technology, adopted English as the instructional language. A gradual shift in the language of instruction, i.e., from French to English, seems to be the best solution that would certainly open the door for Algerian students to meet today's world demands. It is also highly recommended to take advantage of the placement tests, a simple yet efficient step that should be done at the very beginning of the academic year and that would allow for accuracy and appropriateness to take place within ESP teaching practices.

7. Bibliography List :

- 1 Ben-Ari, M. (2001). Constructivism in computer science education. *Journal of Computers in Mathematics and Science Teaching*, 20(1), 45-73.
- 2 Bergin, S., & Reilly, R. (2005, February). Programming: factors that influence success. In *Proceedings of the 36th SIGCSE technical symposium on Computer science education* (pp. 411-415)
- 3 Bringula, R. P., Manabat, G. M. A., Tolentino, M. A. A., & Torres, E. L. (2012). Predictors of Errors of Novice Java Programmers. *World Journal of Education*, 2(1), 3-15.
- 4 Guo, P. J. (2018, April). Non-native English speakers learning computer programming: Barriers, desires, and design opportunities. In *Proceedings of the 2018 CHI conference on human factors in computing systems* (pp. 1-14).
- 5 Guzdial, M. (2015). Learner-centered design of computing education: Research on computing for everyone. *Synthesis Lectures on Human-Centered Informatics*, 8(6), 1-165.
- 6 Harmer, J. (2001). The practice of language teaching. *The Practice of English Language Teaching*. 3rd ed. Oxford: Longman, 164-188.
- 7 Hutchinson, Tom, and Alan Waters. *English for specific purposes*. Cambridge university press, 1987.
- 8 Janzen, J. (2008). Teaching English language learners in the content areas. *Review of Educational Research*, 78(4), 1010-1038.
- 9 Lesser, L. M., & Winsor, M. S. (2009). English language learners in introductory statistics: Lessons learned from an exploratory case study

of two pre-service teachers. *Statistics Education Research Journal*, 8(2).

10 Noshin, J. A., & Ahmed, S. I. (2018). Teaching programming to non-Programmers at undergraduate level. *International Journal of Engineering and Management Research (IJEMR)*, 8(3), 191-194.

11 Pudyastuti, Z. E., Palandi, J. F., & Kom, M. (2014). A correlation between students' English proficiency and their computer programming mastery. In *The 3rd UAD TEFL International Conference* (Vol. 3, pp. 1219-1228).

12 Richards, J. C. (2001). *Curriculum development in language teaching*. Cambridge university press.

13 Shelly, G.B., Vermaat, M.E. 2011. *Discovering Computers 2011: Living in A Digital World, Complete*. Boston: Cengage Learning

14 Solomon, J. C. (2003). *Healdeð Trywa Wel: The English Christ*.