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The Use of Code-Switching in Science Teaching in Moroccan Secondary Schools: A Mixed Analysis of Teachers' Motivations and Experiences

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Abstract

This article examines the question of using code switching between Arabic and French among secondary school science teachers in Morocco. It explores the reasons why they opt for this approach in a context where teaching is mainly conducted in French in Morocco. Based on a quantitative survey of 230 secondary school science and technology teachers, 116 of them responded to the questionnaire. Furthermore, our qualitative approach was based on semi-structured interviews with 20 science teachers in the Inezgane - ait Melloul provincial direction.

Although both studies are aimed at the same target group - science teachers - they are used in a complementary way. Indeed, the questionnaire gives us a broad perception of the subject, thanks to the collection of quantitative data concerning code-switching, general representations and variables influencing the use of code-switching. At the same time, the interviews provided an opportunity to explore the specifics and details of teaching practices, motivations, challenges encountered in the field and particular practices and strategies implemented by teachers.

This research addresses the frequency and motivations for the practice of code-switching in the transmission of scientific knowledge. The results reveal that code-switching is a widespread strategy and is considered an effective means of facilitating student understanding, particularly of complex concepts. These results provide a better explanation of the role of language in science learning, and highlight the importance of integrating code-switching into science teaching.

Keywords: Science teaching, Code switching, linguistic alternation, languages.

1. Introduction

In Morocco, multilingualism is a reality in education, and the sociolinguistic framework is extremely rich. This country has opted for a linguistic policy that articulates various languages of instruction, notably Arabic, French and, in a few cases, English. In fact, according to Bensfia et al. (2013), Morocco proposes a landscape in which national languages as well as foreign languages coexist on a territory through which political, historical and cultural tensions are evident.

However, the creation or management of contacts is a key element in the learning and use of a new language in many contexts, including contacts between first and second languages, between learners and native speakers of the first language, and contacts between various cultural groups. This is undoubtedly an interesting field for the study of language contact in global way (Py, 2007).

Nevertheless, bilingual education in Morocco is characterized by an exceptional specificity: linguistic alternation, which is revealed mainly by the use of French in a few subjects, particularly in the sciences. In this context, linguistic alternation involves the integration of French as a vehicular language for the content taught. This enables students to orient themselves in a learning environment where French is the language of instruction for science and technology. At secondary level, these subjects are mainly taught in French, a language that students often have imperfect grasp of.

Still, this language represents a barrier for a large proportion of students, whose mastery of French frequently proves insufficient to enable them to follow courses entirely. According to Haidar (2024), a survey has been carried out into the effects of using French as the language of instruction of dDNL in middle and high schools. The findings reveal that Moroccan learners find difficulty in assimilating content taught in French due to their lack of mastery of the language and a technolect that proves relatively complicated.

This situation pushes teachers to resort to specific linguistic strategies, including code-switching. Faced with such challenges, science teachers often resort to this practice, which appears indispensable to their pedagogical approach. This strategy is based on alternating between Arabic and French, the vehicular language of science teaching, in order to overcome comprehension barriers.

According to Ali-Bencherif (2009), code-switching is the use of two codes in alternation during a conversation. Such a definition implies, in a global way and with many restrictions, that it concerns bilingual conversations. It is clear from this definition that code-switching is the alternative use of two language systems in the same conversation, which could generally and prudently be associated with bilingual exchanges. Thus, due to the linguistic forms and rhetorical practices of the speakers it presents, code alternation requires exceptional regard when analyzing interactions. The use of bilingual forms in discourse truly demonstrates the ability of participants to compose in context the language resources at their disposal (Boubaya, 2020).

In fact, code-switching is currently recognized as a language practice naturally associated with the linguistic profile of bilingual speakers (ER-RADI & BOUALI, 2020). This code- switching goes beyond simple translation; its purpose is to clarify notions and complicated concepts, and to ensure a fluid pedagogical evolution in a context where linguistic immersion entirely in French could disturb learning. By calling on Arabic to clarify certain fundamental points or to respond to learners' misunderstandings, teachers adjust their methods to the real needs of their audience.

For example, teachers usually switch from English to Bahasa Indonesia to guarantee that learners can absorb their explanations much better, overcoming the knowledge deficit in the most effective and efficient way possible (Cahyani et al., 2018).

By using a more usual language, such as the mother tongue, to present or explain complex concepts, teachers give students the opportunity to establish links between new concepts and their own experiences and cultural references. This phenomenon is highly relevant in multilingual contexts such as Morocco, where alternation between French and Arabic occupies a similar place in science teaching.

This problematic then raises the following questions:

- How does this use of code-switching appear?

- For what reasons do science teachers resort to code-switching through the use of Arabic?
- This study therefore aims to:
- Determine the frequency of code-switching among secondary-school science teachers.
- Examine the main reasons for this practice, as perceived by the teachers themselves, and the effects it has on student comprehension.

2. Methodology of research

This research was carried out in secondary schools in Morocco, more specifically in schools belonging to the provincial direction of Inezgane - Ait Melloul. To carry out our study, we used mixed research techniques based on quantitative and qualitative approaches. In our approach adopted in the field, data collection took place in two forms: the questionnaire and the interview, which are addressed to science teachers.

a. Participants:

Questionnaire: 230 questionnaires were distributed to science and technology teachers at public secondary schools in the Inezgane Ait Melloul provincial direction, with 116 copies completed.

Random sampling was employed. This methodological choice contributes to ensuring that the questionnaire data correspond perfectly to the variety of profiles of the science teachers involved in the study, whether in terms of seniority, training, geographical background or teaching practices.

Interview: In order to test our results, semi-structured interviews were chosen. These were conducted with a group of 20 teachers from the Inezgane Ait Melloul provincial direction. These interviews enabled the gathering of data relating to the use of code switching, and the challenges associated with this use. We then transcribed the most significant elements of the teachers' discussions.

b. Procedure:

To collect the questionnaire data, the school directors gave their consent for the questionnaire to be distributed to the teachers. The results were analyzed using SPSS software.

Qualitative data collection was carried out by means of individual and telephone interviews. Interviews were recorded with the permission of the participants. The majority of interviews were conducted face-to-face.

c. Ethical considerations:

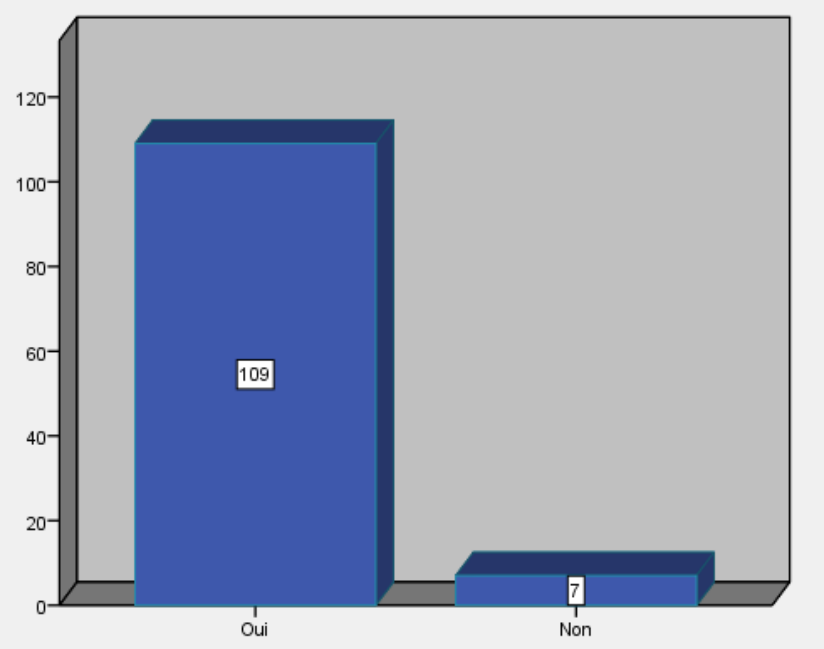
Participants in the quantitative study who completed the questionnaire were informed in advance that their data would be exploited for research objectives only and that their personal identity would not be disclosed.

Interview participants were fully informed of the interview procedure. They provided their oral consent to take part in the study and to be recorded for the purposes of research. Respondents were designated by pseudonyms.

3. Results

A. Quantitative results

Figure 1: The use of code-switching



As we can see in Figure 1 above, the majority of teachers, with a total of 109 respondents, use code-switching to explain their lessons. However, 7 teachers do not employ this practice; they use linguistic alternation exclusively in an immersive way, opting instead to explain their lessons in French only.

Table 1: Reasons for using code-switching

Option		Count	Table N %
To facilitate the transmission of disciplinary knowledge	Yes	97	85,8%
	No	16	14,2%
For better learning of disciplines	Yes	34	30,1%
	No	79	69,9%
To interact with students	Yes	79	69,9%
	No	34	30,1%
To attract learners' attention	Yes	45	39,8%
	No	68	60,2%

The table above represents a multiple-choice question, and each teacher can indicate several reasons for using code switching. So according to the table, 97 of the respondents use code-switching in their teaching practices to facilitate the transmission of subject knowledge, 79 of them use this linguistic practice to interact with learners, 34 teachers use it to ensure better subject learning and finally 45 of the participants use code-switching to attract learners' attention.

B. Qualitative results:

Three themes were identified: (a) - the use of code-switching, (b)- the obstacles associated with code-switching and (c)- the effects of code-switching on student assimilation.

- **The use of code switching:**

Code switching is a useful strategy for teachers. The combination of Arabic and French enables them to adapt to students' immediate expectations, particularly when comprehension problems arise. When they find that content is poorly acquired, particularly for complicated concepts, teachers frequently opt to switch from one language to the other.

"Code switching is the use of two languages at the same time, its relevance resides in the simplification of scientific notions, to teach complex situations as phenomena. For me, I explain in French, using easy words to clarify things, but if the students don't manage to assimilate 100%, I use a few words in Arabic and not a total translation" (Mostafa, Life and Earth Science teacher).

Despite the fact that scientific and technical subjects have to be taught in French, teachers frequently have to resort to code-switching to ensure optimum transmission of knowledge. They sometimes give a new explanation in Arabic of what has already been covered in French, to ensure that the students understand.

"For the application of code switching, I often apply it in the lesson, for the exercises, the instructions are already in French, I explain in French but if they haven't understood, I re-explain in Arabic." (Riham, physics and chemistry teacher).

- **Obstacles related to code-switching:**

While code-switching offers multiple advantages, including facilitating students' understanding and the accessibility of concepts, it also presents challenges. One of the main obstacles is the loss of time, since switching from one language to another is susceptible to interrupting the flow of instruction and prolonging the duration of clarification.

"I haven't encountered any obstacles; incorporating a few words in dialectal Arabic (Darija) helps to reinforce the assimilation of concepts. The only difficulty I've encountered is wasting time, but that's normal as I have to switch to Darija to pass on knowledge." (Riham, physics and chemistry teacher).

Moreover, this alternation requires a considerable investment of energy on the part of the teacher, who must constantly adjust his or her intervention and ensure that learners keep up the rhythm. So, while this method is advantageous for the clarity of complex notions and student participation, it requires an additional effort that can prove exhausting in the long term.

"The use of code switching requires a lot of energy and generates tiredness, since I have to explain in French after explaining in Arabic. The students are used to the fact that the teacher repeats in Arabic everything that has been said in French" (Samira, Life and Earth Science teacher).

One of the challenges of code switching is that many students don't make enough effort to follow the course taught in French. They are used to speaking Arabic frequently, and systematically ask the teacher for explanations in Arabic when they have difficulty understanding. This constant demand to revert to their mother tongue, rather than trying to understand the content in French, can hinder their acquisition of the vehicular language and reduce their motivation to evolve in this language.

"This alternation helps students to understand me, to grasp what I'm explaining, to assimilate the course... But I think that sometimes this alternation makes students lazy, because they're used to the teacher intervening in Arabic to explain things, so when I speak in French they don't show any interest, but when I speak in Arabic, they listen" (Rawan, Life and Earth Science teacher).

- **The effects of code switching on student assimilation:**

The presence of code-switching in the classroom, particularly through the use of Arabic and French, appears to be a factor that favors learners' understanding of science teaching in Morocco. Most of the

teachers interviewed said that code-switching favors the assimilation of scientific concepts, making it easier for students to grasp the pedagogical content.

"Its relevance resides in the students' understanding of terminology," (Siham, physics-chemistry teacher).

When asked about the effects of this practice, the majority of contributors admit that using both languages in class helps students overcome the language barriers associated with intensive use of French, particularly in science subjects.

"This alternation simplifies the course, making it easier for students to understand, whatever their level." (Mostafa, SVT teacher).

This bilingual approach reflects teachers' wish to get closer to the linguistic needs of their learners, who progress in a multilingual context. In fact, teachers state that code-switching is a factor in the mastery and appropriation of scientific content, offering the possibility of making explanations more approachable and increasing students' confidence in their learning.

"This code switching will enable integration of students with a low level of French with others who do not have language difficulties, so that everyone understands the course well. In addition to diagrams, gestures and demonstrations should be used to facilitate the full implementation of linguistic alternation without resorting to code switching." (Samira, SVT teacher).

Thus, when the teacher provides instruction in French and notices a certain blockage on the part of the students, he switches to Arabic to clarify the content, which not only facilitates the transfer of knowledge, but also catches his students' attention at the right moment.

"Very good practice, keeps the knowledge thread going, offers an opportunity to convey knowledge in a clear and understandable way." (Riham, physics-chemistry teacher).

4. Discussion

The present study looks at the use of code switching in Moroccan secondary schools, in order to facilitate the teaching of science subjects in French. Using a mixed-methods approach, the study explores the reasons of the use of this practice by Moroccan science teachers, as well as its effects on learner comprehension.

Several findings were highlighted by the results of this study. Firstly, the study shows that almost all teachers use code switching in their classroom sessions. There are a number of reasons for this, notably the fact that learners do not have complete mastery of the language of instruction, which prompts teachers to resort to this pedagogical practice in order to facilitate the transmission of subject knowledge.

Moreover, as a language of instruction, French takes on a new role as a vector of knowledge, and must therefore be understood not just as a language in the purely linguistic sense but rather as an instrument of communication with considerations of its own (ER-RADI & BOUALI, 2020).

According to research findings by Ben Hammou et Kesbi (2021a), Teachers claim that students grasp scientific content more effectively when they use their native tongue. On the other hand, the use of Moroccan Arabic in explanations is a natural situation in the majority of French classes, according to the teachers interviewed.

Pupils have difficulty assimilating content because of their poor mastery of the language of instruction, which means that teachers must prioritize pupils' understanding by giving explanations in their mother tongue (Ben Hammou & Kesbi, 2023). This highlights a major teaching challenge, particularly when students have a poor command of the language of instruction. In this context, pupils have difficulty

understanding the content of lessons, leading teachers to resort to pedagogical strategies to ensure their comprehension.

Code switching, which involves switching from a subject language (such as French) to Arabic in the case of Morocco, becomes a powerful tool for overcoming this language gap. By partially explaining scientific concepts in the students' mother tongue, teachers make it easier for them to access knowledge, thereby reducing the risk of misunderstanding and increasing their ability to absorb new knowledge.

Moreover, this linguistic practice is an indispensable reality in the Moroccan linguistic context, and can be seen in all areas: in citizens' daily lives, in economic life... (Choukri, 2014). Indeed, teachers know that using the L1 must be completely escaped in FMI (French medium of instruction) classes, as it reduces contact with the vehicular language, which could be detrimental to its learning. However, as students' scientific knowledge is of primary importance, they are obliged to use it when students are unable to understand... (Ben Hammou & Kesbi, 2021b).

However, this code switching helps to overcome language barriers, especially for learners with a poorer grasp of French, while maintaining a link with scientific terms in the language of instruction. In addition, it encourages greater participation by offering students the chance to formulate their questions and thoughts in the language in which they feel most comfortable, thus fostering an inclusive and accessible learning environment.

When a teacher switches from French to Arabic to clarify a scientific concept, it's not simply a matter of translation; on the contrary, it's a privileged tool for making learning easier, while minimizing the risk of confusion and loss of meaning. Code switching thus contributes to better understanding and captures students' attention,

According to Adelino Braz, switching languages is a powerful way of attracting students' attention. However, if the teacher cuts across this alternation in a non-programmed way, i.e. without strict or methodical principles, there will be communication problems between him and the learner. In this case, the learner would give pedagogical importance to this moment of alternation, which in fact, for the teacher, corresponds to nothing at the pedagogical level (Braz, 2007).

As for the benefits of code-switching, over and above the elements already outlined, it's worth pointing out that, according to researchers, code-switching has gained in legitimacy and effectiveness in recent years. They have finally come to the conclusion that this phenomenon is a crucial source of demonstrations of the psycholinguistic aptitude of bilinguals, which has ramifications for linguistics in general (Peron, 2022)

Nevertheless, when teachers switch from one language to another with the aim of perfecting their teaching, code-switching is likely to help improve learners' understanding and offer them the opportunity to contribute to the conversation (Cahyani et al., 2018). Not only that, code-switching is a linguistic practice likely to foster classroom communication overall and exploratory discourse as an indispensable part of learning (Setati et al., 2002).

One of the key features of this research is employing original data to reflect the reality of code-switching in the Moroccan education system. To this end, by combining interviews with other research instruments such as the survey of science and technology teachers, it was possible to collect more significant data on the application of code-switching and the reasons for its use in Moroccan secondary schools. However, the present study, like previous ones, has its limitations. The group of teachers involved in the survey and interview is small, and cannot be said to be fully representative of all science teachers in Morocco.

5. Conclusion

The aim of this study is to show the way in which code switching is used in Moroccan secondary schools as a pedagogical practice designed to facilitate the transmission of disciplinary knowledge by science and technology teachers. By examining the motivations and reasons behind science teachers' occasional use of the mother tongue to teach science subjects. The results of the study revealed that the majority of science and technology teachers involved in this study use this practice to convey scientific knowledge in a clear way, while at the same time attracting learners' attention and interacting with them.

This strategy enables teachers to overcome language barriers, clarify difficult ideas and ensure better assimilation of content. This is in contrast to language immersion, which requires early mastery of the language in question. The findings of this research show that alternating between Arabic and French, while having its limitations, is a resolutely pragmatic solution to the difficulties associated with language proficiency. It not only helps to reduce comprehension gaps, but also consolidates students' learning by encouraging their active participation.

However, teachers should be provided with training in bilingual methodologies such as CLIL. This approach, which integrates language and content learning, could help overcome the current limitations of code-switching, while encouraging a gradual transition to more effective language immersion.

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