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Moroccan high school science teachers' self-efficacy beliefs in the context of French medium instruction

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ABSTRACT
The relationship between science teachers' self-efficacy and the language of instruction is a critically under-researched issue in education. This study aimed to explore public school science teachers' self-efficacy with regard to the use of the language of instruction in teaching scientific subjects. Specifically, the present paper attempts to uncover the impact of the recent French medium instruction (FMI) policy on Moroccan teachers' sense of self-efficacy for teaching science and to examine how demographic variables (age, gender, education and teaching experience) modify or change self-efficacy beliefs. To that end, 151 in-service high school science teachers completed a short self-efficacy Likert scale designed especially for the purposes of the study. The results showed that science teachers have low self-efficacy beliefs with regard to the use of French as a medium of instruction (MoI). Also, while age and teaching experience were found to have a statistically significant correlation with self-efficacy, teachers' language proficiency did not. The study concludes that MoI can negatively impact teachers' self-efficacy and that the latter becomes stronger with age and accumulated experience. Moreover, having teachers with good language proficiency does not guarantee high self-efficacy beliefs. The study discusses some implications of these results for educators and educational policymakers.

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Introduction

Self-efficacy is one of the key constructs of psychology. It basically refers to a person's beliefs in her or his own perceived capabilities to manage and perform a particular task. It was first used by Albert Bandura (1977) in his seminal work '*Self-efficacy: toward a unifying theory of behavioural change*'. According to Bandura's theory, self-efficacy has a far-reaching impact on individuals' thought and behaviour. People with a high sense of self-efficacy are believed to be resilient in the face of obstacles while those with a low level of self-efficacy usually do not show perseverance in pursuing their goals. Given its importance, the construct is widely researched in the field of education. Educational effectiveness has been consistently associated with students' and educators' self-efficacy beliefs. This

way, an increased sense of self-efficacy in teachers and students has been seen as facilitating the improvement of educational outcomes.

Teachers' self-efficacy, in particular, has been the focus of a large body of research. According to Tschannen-Moran & Hoy (2006), teacher self-efficacy is 'a little idea with big impact' (p.954). With this presumed impact' in mind, empirical educational research has applied Bandura's theory to uncover the practical effects and major predictors of teacher self-efficacy. Thus, teachers' self-efficacy beliefs have been studied in relation to science (e.g., Azar, 2010) the use of technology (e.g., Abbitt, 2011; Holden & Rada, 2011) language proficiency (e.g., Chacón, 2005) inclusive education (e.g., Malinen et al., 2012) and many other aspects of teaching. Although various studies have focused on science teachers' self-efficacy, they have failed to throw light on the intricate relationship between science teachers' self-efficacy and the medium of instruction used to teach science subjects, especially in multilingual contexts. Very few studies have dealt with this neglected issue (see related works section below) and in the Moroccan context, research on self-efficacy in the domain of education is rare (we could identify only two studies: (Hassan & Ibourk, 2021; Laouni, 2023). The present study seeks to narrow this gap in research about science teachers' self-efficacy in the context of the language of instruction.

In 2019, the Moroccan Ministry of Education introduced a new language policy known as the Language Alternation Policy (LAP). The use of French as a medium of instruction (FMI) in teaching science subjects was one of the main ordinances of this policy. The policy was part of a larger reform of the education system in the country. One major justification for the new policy was the claim that the Arabisation policy, especially the teaching of scientific disciplines in Arabic, had failed. However, the introduction of the policy was not preceded by any evaluation of teachers' and pupils' readiness to adopt the French language as a medium for teaching science. Given the fact that these teachers have been teaching in Arabic for years, the new policy was expected to create challenges for teachers and impact their sense of self-efficacy.

Taking a quantitative approach to this problem, this study, thus, aims to reveal Moroccan secondary school science teachers' self-efficacy beliefs for the use of French medium instruction to teach science subjects. It attempts to show the impact of the new policy on science teachers' perceived self-efficacy and examine how the latter interacts with a number of other factors.

Theoretical Framework

Bandura's Social Cognitive Theory

The concept of *self-efficacy* was developed by Albert Bandura as part of his Social Cognitive Theory. In his 1997 book, *'Self-efficacy: The exercise of control'*, Bandura defines perceived self-efficacy as ''beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments'' (p. 3). Defined this way, self-efficacy is seen to exert a significant influence on human agency. Supposedly, it shapes individuals' thought, motivation and behaviour. How a person perceives their self-efficacy determines the amount of effort they invest in pursuing courses of action and their resilience in the face of obstacles (Bandura & Adams, 1977).

According to Bandura (e.g., 1977, 1997, 1995) people process and integrate self-efficacy information from four main sources. First, there are enactive mastery experiences. These are successful experiences that confirm one's capability. The second source is vicarious experiences which involve information gained from observing and comparing one's competencies with other individuals. The third source is verbal persuasion which involves the influence of others who convince one of possessing particular abilities. The last source is physiological and affective states which comprise a range of psycho-somatic experiences. These can 'partly' influence one's judgment of their capabilities.

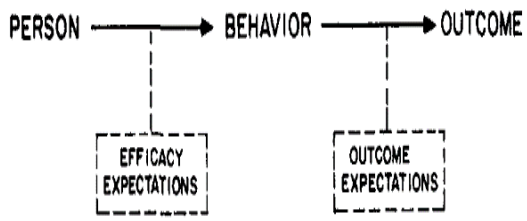
In Bandura's model, the distinction is drawn between two types of efficacies, namely *perceived self-efficacy* and *outcome expectancy*. While perceived self-efficacy is the sum of efficacy expectations, that is, someone's belief in their competence to perform a given task, outcome expectancy is a

'person's estimate that a given behaviour will lead to certain outcomes' (Bandura, 1977, p. 193). In other words, when interested in perceived -self-efficacy one asks, 'Do I have the ability to organise and execute the actions necessary to accomplish a specific task at a desired level?' and to evaluate the outcome expectancy one would ask, 'If I accomplish the task at that level, what are the likely consequences?'(Tschannen-Moran, Hoy, et al., 1998). Figure **(**1**)** below shows the difference between the two types of self-efficacy. Figure (2) shows a reworked model that depicts self-efficacy in a MoI situation where the language of instruction *mediates* perceived self-efficacy and outcome expectancy.

Although it demystified the ambiguous nature of the psychological construct of self-efficacy and showed its strong impact on peoples' agency, Bandura's theory of self-efficacy has been subject to some criticisms. Researchers pointed out its theoretical and methodological limitations (Eastman & Marzillier, 1984) such as its emphasis on the linear correlation between efficacy and performance (Yeo & Neal, 2013), overlooking idiosyncratic differences between individuals, and downplaying the role of contextual and cultural factors (Pajares, 1997). The theory, however, remains robust and widely influential as it offers a powerful explanatory framework and its principle theoretical tenets have been tested and retested in empirical research.

Figure 1

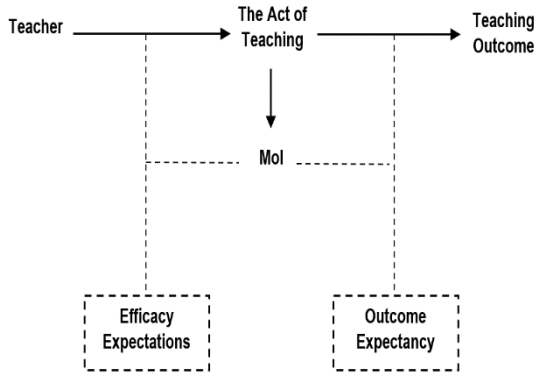
Diagrammatic representation of the difference between efficacy expectations and outcome expectations.



*Note***.** Adopted from Bandura's (1977), 'Self-efficacy: Toward a Unifying Theory of Behavioural Change', p.193.

Figure 2

A reworked model where medium of instruction mediates efficacy expectations and outcome expectations.



Teacher Self-Efficacy Beliefs

According to Tschannen-Moran & Hoy (2001), teacher efficacy is a 'simple idea with significant implications' (p. 783). Indeed, these 'implications' are very important and relevant to education. They mainly relate to teachers themselves and to a greater degree to their pupils. As for teachers, it frames their experiences in the classroom and interferes with their professional development. Concerning pupils, teacher self-efficacy is claimed to directly affect learning outcomes (Blonder et al., 2014). Old and recent studies show that a teacher with a high level of self-efficacy beliefs is alleged to positively affect learners' sense of accomplishment and boost their motivation and their own sense of self-efficacy (e.g., Ross, 1992; Mojavezi & Tamiz, 2012; Taştan et al., 2018). Teachers with a strong sense of self-efficacy tend to set ambitious yet measurable goals and invest their effort accordingly (Pajares, 1992, p. 310). Concerning teaching efficacy, teacher self-efficacy has been defined as a teacher's 'judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated' (Tschannen-Moran & Hoy, 2001, p. 783). It is, thus, viewed as being a personal belief in one's teaching abilities to effectively conquer teaching tasks and bring about desired change in learners.

Teacher self-efficacy is a slippery concept that is embedded in a complex belief system and its measurement poses problems for researchers. However, given its presumed effect on the

improvement of educational outcomes, researchers developed several scales to 'measure' teacher self-efficacy. In this respect, Tschannen-Moran & Hoy (2001) delineated two major strands in the measurement of teacher self-efficacy. The first strand incorporated Rotter's social learning theory, while the second was inspired by Bandura's social cognitive theory. Researchers from both schools have developed several teacher self-efficacy scales with different purposes and foci. Pajares (1997) notes that teacher efficacy is a key construct in teacher education and calls for more research on how it develops and the factors that influence it. In the present paper, we attempt to throw some light on instructional language, a hitherto ignored factor which mediates science teachers' self-efficacy and the outcomes of the teaching-learning process.

Related Works

Medium of Instruction and Science Teaching

Language is of extreme importance in the science classroom. Vygotsky (2012) noted that "children solve practical tasks with the help of their speech as well as their eyes and hands" (p.26). Indeed, this is usually the case in the science classroom where not only pupils but also their teachers get tasks done through and with the help of language. As such, language assumes a decisive role in the learning process, in that, it functions as the medium through which the teaching and learning of science occurs (Wellington & Ireson, 2012). It can considerably determine what learners comprehend and, ultimately, what they can do with their acquired scientific knowledge. Also, language can be used as a tool for knowledge generation in science classrooms (Si et al., 2024). However, despite the asserted role of instructional language in the teaching of science, teachers are reported to overlook its importance. For instance, Tan (2011) found that content-oriented teachers believed that that language was just a 'vehicle' for content transmission, overlooking its essential role in constructing meaning and subject-specific discourse.

In fact, being the main channel through which scientific knowledge is transmitted, any language used as a MoI can become a major barrier to the teaching-learning process, especially when this is not the teachers' and the students' native language. Research shows that science teachers believe that the language of instruction (e.g., English) can be a major barrier to acquiring scientific knowledge (Seah, 2016) as it can prevent the full comprehension of science concepts and, consequently, negatively affects learners' sense of competence and self-esteem (Mthiyane, 2016). According to Motloung et al. (2021), both experienced and novice teachers share the view that the use of L2 (English) as a medium is a real 'barrier' to the teaching and learning of life sciences. Additionally, the use of L2 as MoI usually brings to the fore several challenges mainly teachers' and learners' low proficiency, the unclarity of top-down MoI policy and the absence of support and incentives (Lourenço & Pinto, 2019). In response to these challenges faced by science teachers in L2-mediated science classrooms, teachers more often than not engage in several cross-linguistic practices as coping strategies. Code-switching, for instance, is a preferred teaching strategy that science teachers adopt to ensure science concepts are understood by their pupils (Motloung et al. 2021). Also, translanguaging is widely practised in science teaching, especially in multilingual classrooms (e.g., Charamba, 2020; Karlsson et al., 2019; Lemmi & Pérez, 2024). According to García & Wei (2014), translanguaging is "an approach to the use of language, bilingualism and the education of bilinguals that considers the language practices of bilinguals not as *two autonomous* language systems as has been traditionally the case, but as *one linguistic repertoire*" [emphasis added] (p. 2). Unlike code-switching in which bilingual speakers switch between languages or grammars, translanguaging refers to language practices which draw on the full linguistic repertoire of bilinguals.

While, to the best of our knowledge, there are no studies that explicitly explore the direct relationship between the use of a particular language for instruction and science teachers' self-efficacy, we presume that the challenges accompanying the use of L2 as a MoI do impact science teachers' sense of self-efficacy, especially when these teachers face problems of proficiency in a multilingual

context as that of Morocco. Elsewhere, it has been found that science teachers face enormous challenges primarily due to a lack of proficiency in the MoI (Al Zumor, 2019; Pun et al., 2024), which influences their classroom leadership (Wang, 2023). These studies imply that the ignored variable of language of instruction in science classrooms, particularly the use of L2, does influence teachers' sense of self-efficacy. The next section reviews research that touched on this issue.

Science Teachers' Self-Efficacy Beliefs and MoI

We venture to claim that the nexus between science teachers' self-efficacy and the medium of instruction is a huge gap in the literature. Our search for the terms 'teacher AND self-efficacy AND language/medium of instruction' and their different combinations on Google Scholar, Scopus and Web of Science databases yielded very limited results (4 moderately relevant studies). Unlike language teachers' self-efficacy which received a good deal of attention, science teachers' self-efficacy beliefs regarding the use of instructional language in the science classroom remain under-researched. A lot of research studied science teachers' self-efficacy beliefs but failed to connect it to an extremely important variable which is the medium of instruction, especially in multilingual classrooms. In this section, we discuss exclusively the studies that looked at the issue of the language of instruction in relation to teacher self-efficacy in MoI contexts in general and in science classrooms in particular.

Research exploring the interconnection between teachers' self-efficacy and MoI has been mostly conducted in English medium instruction (EMI) contexts. The studies by Shanahan & Shea (2012), Chen & Peng (2019) and Tsui (2018) explored the impact of professional programmes on EMI teachers' sense of self-efficacy. Shanahan & Shea (2012) investigated the results of a PD model which integrated the science inquiry approach with language learning. The study found that there was an improvement in the participating teachers' self-efficacy about language instruction and in their confidence in integrating science and language teaching. Similarly, using Bandura's theory of self-efficacy as a theoretical framework, Tsui (2018) studied the impact of an EMI teacher PD on Taiwanese university teachers. The study reported that although novice EMI teachers initially showed low self-efficacy beliefs, there was a positive shift in their self-efficacy by the end of the programme. In China, Chen & Peng (2018) also noticed that EMI teachers' sense of self-efficacy had improved as they became more aware of the nature and role of language in content teaching after attending a PD programme.

Language attitudes and language proficiency are two variables that were also found to interact with teachers' self-efficacy. For instance, Goh & Luen Loy (2021) investigated the connection between self-efficacy and Malaysian preschool educators' attitudes to the English language as a medium of instruction (EMI). They found that teachers with a strong sense of self-efficacy were more prone to use English for teaching. More importantly, the study found a strong correlation between self-efficacy and attitudes toward language. Wang (2021) explored the nexus between EMI teachers' self-efficacy beliefs and their classroom language proficiency. He found that language proficiency strongly correlated with teaching self-efficacy. Language of instruction and language of interaction, in particular, had a higher correlation with EMI teachers' self-efficacy.

In all, the above studies underscore the intricate relationship between teachers' self-efficacy and MoI. They demonstrate the favourable influence of professional development (PD) programs addressing MoI-related matters on teachers' self-efficacy beliefs while also emphasising the robust correlation between language proficiency, language attitudes, and teachers' self-efficacy.

Research Objectives and Questions

Given that the purpose of the study was to assess science teachers' personal self-efficacy beliefs (not outcome expectancy) for the use of French in as MoI, the present study has the following objectives:

- Assess Moroccan high school science teachers' self-efficacy beliefs with regard to the use of French as MoI for science subjects.
- Test the correlations between demographic variables (age, gender, educational background and speciality) and teachers' self-efficacy beliefs for FMI.
- Explore the relationship between their self-efficacy for FMI and language proficiency.

Based on these stated objectives, the present study is guided by the following questions:

- What are Moroccan high school science teachers' self-efficacy beliefs regarding the use of French as a medium of instruction?
- What is the impact of demographic variables on their self-efficacy beliefs?
- Is there a difference in self-efficacy beliefs for the use of French as MoI in Maths and Life and Earth Sciences (LES) teachers?
- Is there a correlation between language proficiency and science teachers' self-efficacy for the use of French as MoI?

Methodology

Assessing Science Teachers' Self-Efficacy Beliefs for FMI

Participants

The Moroccan in-service high school science teachers (n = 151) who participated in the present study all belonged to the public school system. The sample comprised Life and Earth Sciences (n = 93) and Mathematics (n = 58) teachers. They were randomly selected from all over the country. An online version of the questionnaire was hosted on Google Forms and a link was shared with these teachers via email and social media platforms. Participants were instructed to complete the questionnaire at their convenience, and anonymity and confidentiality were ensured throughout the data collection process. All participants were informed about the purpose of the study and participated voluntarily. Table (1) below shows the main characteristics of the sample:

Table 1

Demographic characteristics of study participants

	Category	%	Count
Gender	Female	51%	77
	Male	49%	74
Age	<= 29	38%	59
	30 - 39	20%	31
	40 - 49	26%	40
	50 - 59	10%	15
	60+	4%	6
Highest qualification	BA	53%	80
	MA	42%	65
	PhD	4%	6
Specialty	LES	71%	108
	Maths	28%	43

Experience	1-5 yrs	34%	52
	5-10 yrs	20%	31
	10-15 yrs	20	31
	15-20 yrs	2%	3
	20+ yrs	22%	34

Research Instruments

Scale Development: A self-report scale was used in the present study. The instrument was developed based on extant science teachers' self-efficacy beliefs scales and a review of the literature about teacher beliefs, teacher self-efficacy, and language-in-education policy, particularly MoI policy. Extant self-efficacy scales consulted are Bandura's (1977) Teacher Self-Efficacy Scale (TSES), Science Teaching Efficacy Belief or STEBI (Riggs & Enochs, 1990) and Teachers' Sense of Efficacy Scale or TSoES (Tschannen-Moran & Hoy, 2001). These are established scales with demonstrated reliability and validity in similar contexts (see Tschannen-Moran & Hoy, 2001).

Our scale consisted of an introductory section about demographics and three main subscales, namely *efficacy in student engagement* (items 1-3), *efficacy in instructional strategies* (items 4-9) and *efficacy in classroom management* (items 10-11). The validity of these subscales (as a general scale structure) was established by a factor analysis that consistently showed the existence of a moderate correlation between the three factors (Tschannen-Moran & Hoy, 2001). This established factor structure served as a guide for the inclusion and organisation of the adapted and self-generated items in our short scale to ensure content validity. The 11 items were measured on a 5-point Likert scale ranging from strongly agree = 5 to strongly disagree = 1 (see Table 3). Items adapted from other teacher self-efficacy scales were reformulated to suit the specific requirements and nuances of the present study, chiefly the integration of FMI as a main concern (see Table 4). Table 2 shows the source of the included items and their contribution to the overall reliability of the scale. Given the small number of items (11), the decision was not to conduct a new factor analysis as the dataset may not provide enough information to reliably extract meaningful factors. Accordingly, we opted for reliability testing to assess the internal consistency of the scale (see next section).

Table 2

The source of scale items with their contribution to the overall reliability

Item	Source	Contribution to the Overall Reliability
1	Self-generated (based on the literature about the relationship between attention and student engagement)	0.803
2	TSoES (adapted from item 4)	0.804
3	TSoES (adapted from item 12)	0.786
4	TSoES (adapted from item 10)	0.802
5	TSoES (adapted from item 11)	0.804
6	TSoES (adapted from item 17)	0.794
7	- TSoES (adapted from item 20) - STEBI (adapted from item 22)	0.811
8	Self-generated	0.789
9	Self-generated (based on empirical studies about MoI (e.g., Pun et al., 2022)	0.798
10	- TSoES (adapted from item 3) - TSES (adapted from item 14)	0.811
11	Self-generated	0.815

Scale Reliability*:* To assess the internal consistency and reliability of the self-efficacy scale used in the present study, Cronbach's alpha was calculated. The obtained Cronbach's alpha value was α = 0.81, indicating high internal consistency and, therefore, suggests that the scale is a reliable instrument for measuring self-efficacy levels in the target population. Moreover, all the items included positively correlated with each other, however, the correlation remains generally moderate and some of the items show weak correlations as shown in table 3.

Table 3

Inter-item correlation matrix

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11
Item 1	1,000										
Item 2	,415	1,000									
Item 3	,543	,511	1,000								
Item 4	,392	,447	,423	1,000							
Item 5	,287	,063	,336	,319	1,000						
Item 6	,416	,457	,380	,547	,186	1,000					
Item 7	,211	,092	,321	,014	,343	,308	1,000				
Item 8	,280	,539	,506	,164	,262	,459	,432	1,000			
Item 9	,346	,295	,348	,335	,411	,189	,426	,385	1,000		
Item 10	,107	,073	,364	,118	,242	,287	,326	,426	,085	1,000	
Item 11	,079	,058	,254	,365	,296	,151	,038	,193	,348	,231	1,000

Data Analysis Procedures

SPSS v. 25.0 (IBM Corp, 2017) was used for the statistical analysis of the obtained data. Given the controversy surrounding the analysis of Likert scales and the fact that our dataset shows breaches of normality assumptions, we opted for frequency, mode and median as preferred statistics to describe our data as this, we believe, will make more sense of the obtained results, especially since the negatively worded items are not reverse coded yet. Later on, negatively worded items were reverse-coded in such a way that a higher score corresponds to a higher sense of self-efficacy for the use of FMI. At this stage, parametric tests were used to check for correlations and to calculate the mean difference between subgroups within the sample. The justification for the use of parametric tests at a later stage in the analysis is that the distribution of average scores (used as the dependent variable in these tests) of the summated scale relatively meet the assumptions of normality (e.g., Carifio & Perla, 2008) and, thus, we believe the results obtained are statically valid. We use Pearson correlation coefficient (r) to check for correlations between science teachers' self-efficacy beliefs regarding the use of French as MoI and other variables of interest such as age, gender, educational background and speciality, while Independent Samples t -Test was used to compare mean differences between Life and Earth Sciences and Maths teachers.

Findings

As abovementioned, the scale consists of three subscales and 11 items (Table 4). The composite score is (55), that is, a high score means that teachers have a high level of self-efficacy for using French as MoI to teach science subjects, whereas a low score means their sense of self-efficacy beliefs for the FMI is low. The minimum score was 12 and the maximum was 40. The median was 23 and the mode was 25.

Table 4

Descriptive statistics for the scale items

	Items	Median	Mode
1.	I believe that when I use French a large number of pupils lose attention	5,00	5
2.	I believe that when I use French 'weak' pupils lose interest in my lessons	5,00	5
3.	I believe that French limits students' creativity in science classes	4,00	5
4.	I believe that the French language makes it difficult for me to gauge pupils' comprehension	4,00	5
5.	I believe that the French language makes it difficult for me to craft good and comprehensible questions for my pupils	3,00	3
6.	I believe that the French language makes it difficult for me to adjust my lessons to the proper level of individual learners	4,00	4
7.	I believe that the French language makes it difficult for me to provide an alternative explanation when learners are confused	4,00	5
8.	I believe that the FMI policy makes my teaching of science less effective	4,00	5
9.	I believe that the FMI policy limits classroom interaction and therefore obstructs knowledge construction	4,00	4
10.	I believe that the French language makes it difficult for me to deal with disruptive behaviour	3,00	2
11.	I believe that the FMI policy makes it difficult to manage class time effectively	4,00	4

Item-by-Item Analysis

Efficacy in Students' Engagement

Item 1: *'I believe that when I use French a large number of pupils lose attention.'* The participants' median response to this statement is 5, which is the highest possible rating on the scale. Additionally, the mode is also 5, indicating that the most common response is the highest rating. This suggests that a significant proportion of participants strongly agree that using French leads to a large number of students losing attention in the classroom.

Item 2: *'I believe that when I use French 'weak' pupils lose interest in my lessons.'* Similar to Item 1, participants' median and mode responses for this statement are 5, indicating a strong agreement with the idea that 'weak' students become disinterested when French is used in lessons. This suggests that participants perceive French as potentially hindering the engagement of struggling students.
Item 3: 'I believe that French limits pupils' creativity in science classes.' The median response of 4 indicates that, on average, participants moderately agree that French limits students' creativity in science classes. However, the mode being 5 suggests that a considerable number of participants strongly agree with this statement.

Efficacy in Instructional Strategies

Item 4: *'I believe that the French language makes it difficult for me to gauge students' comprehension.'* Participants' median and mode responses indicate that they generally agree that using French as a language in the classroom poses challenges in assessing students' comprehension.

Item 5: *'I believe that the French language makes it difficult for me to craft good and comprehensible questions for my students.'* The median and mode responses for this item are 3, suggesting that participants are somewhat neutral on this statement. It indicates a moderate level of agreement that the French language poses difficulties in crafting good and comprehensible questions for students.

Item 6: *'I believe that the French language makes it difficult for me to adjust my lessons to the proper level of individual students.'* Participants' median and mode responses suggest a moderate agreement

that using French in the classroom makes it challenging to tailor lessons to individual students' needs and learning levels.

Item 7: *'I believe that the French language makes it difficult for me to provide an alternative explanation when students are confused.'* The median response of 4 indicates moderate agreement, while the mode being 5 suggests that there is a substantial number of participants who strongly agree that the French language makes it difficult to provide alternative explanations when students are confused.

Item 8: *'I believe that FMI policy makes my teaching of science less effective.'* Participants' median response of 4 suggests a moderate level of agreement that FMI policy affects the effectiveness of their science teaching. The mode being 5 indicates that a significant number of participants strongly agree with this statement.

Item 9: *'I believe that FMI policy limits classroom interaction and therefore obstructs knowledge construction.'* Participants' median and mode responses of 4 suggest a moderate level of agreement that FMI policy limits classroom interaction. This indicates that many participants believe that the FMI policy restricts opportunities for students to actively engage with the material, participate in discussions, and interact with their peers during the learning process. The mode being 4 signifies that a significant number of participants hold this view strongly. The participants' belief that the FMI policy obstructs knowledge construction suggests that they feel the policy might hinder students' abilities to construct and develop their understanding of the subject matter through active participation and collaborative learning experiences in the classroom.

Efficacy in Classroom Management

Item 10: *'I believe that the French language makes it difficult for me to deal with disruptive behaviour.'* The median response of 3 suggests that respondents were equally split over the claim that using the French language in the classroom poses difficulties in managing disruptive behaviour. Participants' responses indicate that they do not perceive a link between the use of French and handling disruptive behaviour effectively. Put differently, they do not believe that language barriers, specifically using French, may impact their ability to manage disruptive behaviour. Hence, the mode being 2 indicates that a considerable number of them strongly disagree with this statement.

Item 11: *'I believe that FMI policy makes it difficult to manage class time effectively.'* Participants' median and mode responses of 4 indicate a moderate agreement that the FMI policy poses challenges in managing class time effectively. They perceive that the FMI policy may create constraints that affect their ability to manage and allocate class time efficiently. The policy, therefore, may have implications for the pace and content coverage in their lessons, potentially impacting the depth of instruction and student learning outcomes.

Overall, the results suggest that participants believe that pupil engagement becomes a challenge when French is used as MoI. Equally, the results indicate that French affects science teachers' efficacy in using some instructional strategies such as gauging comprehension, adjusting lessons, and providing alternative explanations. Although French is not believed to impact teachers' handling of disruptive behaviour, it is perceived to affect other aspects of classroom management abilities, especially managing time.

Correlation Analysis

Self-Efficacy and Demographic Variables

Science teachers' self-efficacy negatively correlated with gender (r = -.071, p = .626), academic qualifications (r = -.196, p = .176) and subject-matter taught (r = -.269, p = .062). However, all these correlations are statistically non-significant as the *p-value* was $p > 0.05$. Assigned classroom level positively correlated with teachers' self-efficacy but the correlation was statistically non-significant ($p > 0.05$). In contrast, age (r = .293, $p < 0.05$) and teaching experience (r = .329, $p < 0.05$) were the only two variables that showed a positive and statistically significant correlation with self-efficacy. These results indicate that when age and experience increase, science teachers' self-efficacy for the use of French to teach scientific subjects increases, too.

Table 5

Self-efficacy correlations with background variables

	Age	Gender	Experience	Subject	Education	Class Level
Pearson *r*	.293*	-.071	.329*	-.269	-.196	.179
Sig. (2-tailed)	.041	.626	.021	.062	.176	.219

Note. The asterisk (*) indicates that correlation is significant at the 0.05 level (2-tailed).

Comparison of Subgroups

LES vs Maths Teachers

An independent samples *t*-test was conducted to compare the mean scores of LES and Maths teachers on self-efficacy for using French to teach science. The *t*-test (t (149) = 1.91, p = .06) revealed that the mean difference between LES teachers (M = 22.23, SD = 6.63) and Maths teachers (M = 18.59, SD = 3. 96) is statistically non-significant since the *p*-value of the test was above the accepted level of significance 0.05. These results indicate that there is no statistically significant difference between LES and Maths teachers concerning their sense of self-efficacy for using French as a medium of instruction.

Discussion

What Are Moroccan High School Science Teachers' Self-Efficacy Beliefs Regarding the Use of French as A Medium of Instruction?

Overall, Moroccan science teachers generally show low self-efficacy beliefs for the use of French as MoI for teaching science subjects. The minimum average score was 11.09 and the maximum was 38.18. The median of the average score was 20.36 and the mode was 23.18. The analysis of the participants' performance on the items has demonstrated that the use of the French language has a negative impact on the self-efficacy beliefs of the majority of science teachers as exemplified by item 8 with which 65% (cumulative) of the respondents either agreed or strongly agreed as shown in the table below.

These teachers believe that the FMI policy raises challenges associated with student engagement and the unobstructed employment of various instructional strategies. They believe that French negatively impacts their teaching ability to, for instance, gauge students' comprehension and

adapt lesson plans to suit the needs of learners. Additionally, French is also believed to affect teachers' classroom abilities. particularly time management. These outcomes contribute to a deeper understanding of the complexities that arise in educational settings where a foreign language (usually L2) is employed as the MoI and underscore the importance of attending to language-related issues in science classrooms to increase pedagogical effectiveness.

What Is the Impact of Demographic Variables on Their Self-Efficacy Beliefs?

Results of the correlation analysis found that of all the other background variables only science teachers' age and teaching experience ($r = .293$, $p < 0.05$; $r = .329$, $p < 0.05$, respectively) showed a positive and statistically significant correlation with self-efficacy beliefs for the use of French as MoI. As far as these two variables are concerned, the results of the present study are congruent with other studies of teacher self-efficacy (e.g., Shaukat et al., 2019; Penrose et al., 2007). However, given the contradictory nature of the results obtained by research on teacher self-efficacy, our results are incongruent with several other studies (e.g., Tzovla et al., 2022; Azar, 2010; You et al., 2019; Mesa et al., 2020).

The positive correlation found between teachers' self-efficacy and the length of their teaching experience is not in line with Bandura's theory. Bandura (1997) claims that self-efficacy beliefs tend to become fixed once established. On the contrary, this study found that teachers' self-efficacy for FMI seems to grow with more experience, which indicates that self-efficacy beliefs are dynamic and not fixed. Research in the field of science education, namely the use of inquiry-based teaching found similar results concerning self-efficacy beliefs and teaching experience (e.g., Shahat et al., 2022). All things considered, we should bear in mind that demographic variables are not strong predictors of teachers' self-efficacy beliefs (Tschannen-Moran & Hoy, 2006, p. 952).

Is There a Difference in Self-Efficacy Beliefs for The Use of French as MoI in Maths and LES Teachers?

The results of this study showed that there is no statistically significant difference between LES and Maths teachers (M = 22.23, SD = 6.63; M = 18.59, SD = 3. 96, respectively) in their sense of self-efficacy beliefs for the use of French as a language of instruction ($t (149) = 1.91$, $p = .06$). Both groups showed low self-efficacy for FMI in science classrooms. The mean of the average score of self-efficacy for LES was (M = 22.24) and for Maths teachers it was (M = 18.60). It seems that both groups view French as a hurdle that obstructs the effective teaching of science subjects regardless of what these subjects are. This also may point to an underlying negative attitude towards the French language when used as a medium in teaching science. These results do not seem to support the claim that teacher efficacy is 'subject matter specific' (Tschannen-Moran et al., 1998, p. 790).

Is There a Correlation Between Language Proficiency and Science Teachers' Self-Efficacy?

As stated earlier, the results showed that there was no statistically significant correlation between science teachers' language proficiency and their self-efficacy beliefs for the use of French as a medium to teach science (Table 6). Most studies that explored this relationship between teacher language proficiency and self-efficacy focused on language teachers and we could not identify any study that looked at the interaction between these two variables in science teachers. Research on language teachers found that language proficiency does have an impact on self-efficacy beliefs (e.g., Sabokrouh, 2013; Faez & Karas, 2017; Choi & Lee, 2016; Yilmaz, 2011; Eslami & Fatahi, 2008). However, the study by Choi & Lee (2016) claims that although language proficiency and self-efficacy might be interdependent, they are in fact two independent constructs. The results of the present study seem to support Choi & Lee's (2016) claim since no systematic relationship could be found between

science teachers' level of language proficiency and their self-efficacy beliefs for the use of French as a language of instruction.

Table 6

Correlation between teachers' self-efficacy and language proficiency

Variables	Pearson *r*	Sig.
Teachers' Self-efficacy & language proficiency	.014	.926

Thus, although science teachers' self-efficacy for the use of French was low. it was not because of their language proficiency. The overwhelming majority have a positive perception of their proficiency as 77.6% of the participants described their proficiency in French as 'good', 18.4% as 'average' and 4.1% as 'very good'. One possible explanation for these results is that science teachers hold a negative attitude toward the French language (Sabokrouh, 2013) or it is because probably they have a negative perception of their students' language proficiency which tends to be low in Moroccan students (Bouziane & Rguibi. 2018; Kaddouri, 2018). Teachers' performance on item 5 ('*I believe that the French language makes it difficult for me to craft good and comprehensible questions for my students'*) showed that the mode was (3), which means that the majority (34.7%) were neutral towards this item. This indicates that they believe that the difficulty of asking good questions (related to language ability) is not because of their language proficiency. Hence, this interpretation of the results suggests that science teachers' low self-efficacy cannot be attributed to their proficiency which they perceive as good. This, therefore, corroborates the correlation results obtained where proficiency was not found to relate to self-efficacy unlike results obtained from other studies in EMI contexts (e.g., Wang, 2021).

Conclusion and Implications

Using a quantitative research design, this study investigated Moroccan science teachers' self-efficacy beliefs for the use of French as a medium of instruction in the science classroom. It tried to uncover the impact of adopting the FMI policy on teachers' perceived sense of self-efficacy for teaching scientific subjects and to show how their self-efficacy correlates with several other variables. The results of the study indicated that the use of the French language has a negative impact on science teachers' perceived self-efficacy. Age and teaching experience were found to systematically correlate with self-efficacy beliefs which seemed to move in the same direction of these two background variables. In contrast, language proficiency did not show any positive correlation with teachers' self-efficacy.

The results of this study imply that the MoI used in science classrooms is of paramount importance to the teaching-learning process as it might negatively affect teachers' sense of self-efficacy for teaching science and, therefore, influence the learning outcome of their students. Given the results concerning age and experience variables, they indicate that more support should be provided to novice teachers in particular as they are reported to have fluctuating self-efficacy beliefs at the beginning of their career (Tschannen-Moran & Hoy, 2006). As self-efficacy in this study did not correlate with teachers' language proficiency, this implies that teachers need more training on the use of language for instructional purposes. In this regard, the distinction between classroom language and general language proficiencies would be helpful (Wang, 2021) and any professional development programs should enable science teachers to draw this distinction since these programs do usually improve science teachers' self-efficacy (Özdilek & Bulunuz, 2009) and even spur them towards adopting innovative science teaching approaches such as inquiry-based teaching (Ladachart et al., 2022).

The study, however, has many limitations. The sample chosen for this study is relatively small and may have affected the variability of the data and it will be, therefore, difficult to generalize the

results to the whole science teachers' population. Moreover, data in this study was not triangulated and any future papers would benefit from combining psychometric scales with interviews, vignettes or Q-methods. Another potential problem in this study is the use of self-reported proficiency which may not exactly reflect teachers' actual linguistic competence. That said, future research can explore the combined effect of MoI and other contextual factors on science teachers' self-efficacy. Also, research can explore the impact of the use of a given medium of instruction on students' self-efficacy.

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