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THE IMPACT ON MOTIVATION OF CLIL-IZING EMI IN SCIENCE EDUCATION. A LONGITUDINAL CASE STUDY IN PRE-SERVICE TEACHER TRAINING

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Abstract

The objective of this study was to identify the impact of implementing English as a medium of instruction (EMI) drawing upon Content and Language Integrated Learning (CLIL) methodology in science for pre-service teachers. Lecturers specialized in modern languages and science education collaborated to design and implement the CLIL-izing EMI intervention. The sample was made up of 105 students, 55 of whom were given instruction in English, and 50 in their mother tongue, Spanish. Two instruments for motivation in English and science were applied before the intervention, two weeks and one year afterwards. Additionally, an open-ended questionnaire was used with the experimental group to gain a more in-depth insight into student perception of EMI. Results showed that the short intervention had a beneficial effect on motivation towards science content learning in the short and long term, although no differences were detected on motivation to English language learning. The student stance on the experimental instruction of science in English was highly positive.

Keywords – Science education, Content and Language Integrated Learning, English-Medium Instruction, Pre-service teachers, Longitudinal study.

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1. Introduction

In recent decades, English-Medium Instruction (EMI), defined as "the use of the English language to teach academic subjects (other than English itself) in countries or jurisdictions where the first language of

the majority of the population is not English" (Macaro, 2018: page 19), has become a global trend at Higher Education Institutions (HEIs).

In the current context of globalisation, HEIs seek internationalization, prestige and competitiveness, and EMI helps to achieve these goals. However, although, at 71% of the Spanish universities some degrees are partially taught in English, it is considered there is room for improvement in EMI implementation (Pérez-Guillot, Pulido, Sanmartín, Estella & Fernández, 2020).

The main shortcomings reported are the level of English of lecturers in Spain (González-Alvárez, 2020), and the lack of pedagogical guidelines to implement this type of instruction. Lecturers frequently feel insecure (Farrel, 2020), as EMI is generally seen just as a change in the language used, and the pedagogical tools and training for implementing it are not usually provided by the institutions. Similarly, lecturers are concerned about possible drawbacks this shift in language might entail for the acquisition of content, such as slowing the pace of lessons. Additional downsides have also been detected such as decrease in student motivation (Contero, 2020) and limited participation (Doiz, Lasagabaster & Pavón, 2019). Against this backdrop, this study intends to (i) provide a pedagogical framework based on CLIL to implement EMI at HE, (ii) ascertain its impact on motivation and (iii) explore HE students' perceptions on science instruction in English though CLIL

2. Literature Review

Within this context of the global demand for learning second languages, bilingual education providing instruction of academic subjects in a language other than the mother tongue is rising worldwide at different educational levels, since students simultaneously learn subject content and the foreign language used for its instruction. Within this framework, the most comprehensive approach for bilingual education is CLIL (Content and Language Integrated Learning), with a dual focus on content and language teaching and learning (Coyle, Hood & Marsh, 2010). Multiple advantages have been reported with CLIL: language learning (Nieto Moreno de Diezmas, 2016), content assimilation (San Isidro & Lasagabaster, 2018), acquisition of competences (Nieto Moreno de Diezmas, 2018), and even helped develop the mother tongue because of the transfer of competences between languages and the effect on broadening students' language awareness (Nieto Moreno de Diezmas, 2020; Pérez Cañado, 2018). Likewise, CLIL has been reported to be the most suitable approach to implement when dealing with students with weaker language competences (Sánchez-Pérez & Salaberri, 2017). Therefore, CLIL methodology was implemented in the context of this study, thereby "CLIL-izing EMI" (Pérez & Rascón, 2019).

Despite these well-documented positive effects, the stakeholders in tertiary education have disregarded CLIL, because the concept of integrated learning of content and language is considered to be appropriate at primary and secondary school, but not for university studies, where "content is king" (Airey, 2020: page 343), and therefore they prefer the EMI acronym. University lecturers are specialists in different areas of scientific knowledge who are responsible for transmitting it when teaching the contents of their subjects. Therefore, they consider addressing language issues to be beyond the scope of their duties (Doiz & Lasagabaster, 2020). This reluctance HE professors have to include language learning in their multilingual or bilingual classes might be due to their own lack of training in specific methodologies for EMI (Sánchez-Pérez & Salaberri, 2017). However, successful implementation of EMI instruction needs to deal with these issues (Airey, 2012) since, contrary to certain beliefs (Cots, 2013), teaching in English is not the same as teaching in the first language (L1), and incidentally, even when teaching in L1, teacher language awareness is also beneficial (Airey, 2020). As a result, new methodological and teaching techniques are necessary to cope with the challenge that teaching and learning through a foreign language entails (Sánchez-Pérez & Salaberri, 2017), thereby avoiding the trial-and-error method (Farrel, 2020).

Due to scarce pedagogical training for implementing EMI at HEIs (Dafouz, Haines & Pagèze, 2019), collaboration between language and content lecturers can provide the necessary expertise to address the main challenges EMI poses and improve the quality of teaching in bilingual university degrees (Doiz et al., 2019). Therefore, the pedagogical intervention of EMI at HEI described in this study was designed in

partnership with content lecturers of science, and English language lecturers with experience in CLIL and EMI research.

2.1. Motivation and Affective Factors in EMI

Affective factors in EMI have mostly been studied in primary and secondary school settings, where CLIL is the main approach followed. In comparison, this issue has drawn much less attention at higher education. At secondary education, correlations between English achievement and student motivation in CLIL have been found (Lasagabaster, 2011). Empirical evidence shows CLIL students are more intrinsically motivated, more instrumentally oriented, have greater interest in foreign languages and have more drive for English learning than non-CLIL students (Doiz, Lasagabaster & Sierra, 2014). Lasagabaster and Doiz (2015) concluded in a longitudinal study set in secondary education that CLIL helped sustain motivation on the subject matter when taught in English over the three-year period analyzed, but not specifically for learning English itself.

Concerning EMI at higher education, there is a dearth of studies on affective factors. Within this backdrop, Fernández-Costales (2017) found that student satisfaction was comparatively lower for students in their final years, and for those on science degrees, which suggests better teaching practices are needed in that branch of university studies. In turn, Rivero-Menéndez, Urquía-Grande, López-Sánchez and Camacho-Miñano (2018), compared learning strategies and motivation of 368 EMI and non-EMI undergraduate students on a Business Administration degree, and found no significant differences in motivation, except for self-confidence. However, EMI students showed better metacognitive self-regulation, study time management and effort regulation.

According to the authors, these findings might be related to voluntary access to EMI and to student awareness of the need of working harder, being better organized and allocating more time to studying in these bilingual degrees. These outcomes are in line with Doiz and Lasagabaster's (2018) study, which reveals students in EMI are aware that they have to make an extra effort, but they consider it to be worth it. This research also found students consider English proficiency to be fundamental to obtaining higher qualifications and gaining better employment, and therefore, they even devoted part of their free time reinforcing their multilingual identity. Nevertheless, these positive findings might have been due to the fact that the participants in all these studies conducted at HE voluntarily and willfully chose to enroll on courses in English, and they might have already been more motivated to learning English before accessing EMI programs.

3. Research Objectives

To bridge the gap in knowledge in literature concerning motivation in EMI at higher education, the general objective of this study was to get quantitative and qualitative insight into the impact of CLIL-izing EMI on affective factors related to both English and Science learning. The specific objectives of this investigation are as follows:

OB. 1) To assess the impact of CLIL-izing EMI intervention in a science module for a monolingual teacher training degree on motivation in English learning.

1.1) To determine if CLIL-izing EMI impacted motivation in English learning two weeks after the intervention (short-term impact),

1.2) To check if the differences, if any, were maintained after a year (long-term impact).

OB. 2) To measure the impact of CLIL-izing EMI intervention in a science module for a monolingual teacher training degree on motivation in learning Science in English.

2.1) To determine if CLIL-izing EMI impacted motivation in learning Science in English two weeks after the intervention (short-term impact).

2.2) To check if the differences, if any, were maintained after a year (long-term impact).

OB. 3) To get insight into student perception on teaching and learning Science through English in the following aspects:

3.1) The contribution of the intervention to English language learning.
3.2) The acquisition of science contents.
3.3) Difficulties and advantages of the instruction in English.
3.4) Feelings experienced.
3.5) Improvement suggestions of the experimental intervention.

4. Methodology

4.1. Design of the Research

The study had a quasi-experimental design with an experimental and control group, and longitudinal evaluation: pre-test, post-test two weeks after finishing the intervention, and one year afterwards to ascertain if the effects were sustained over time. Data was gathered by means of three questionnaires that provided two types of data: quantitative and qualitative.

4.2. Participants

Participants were early childhood pre-service teachers in their second year of the monolingual degree at the university of Castilla-La Mancha (Spain), selected by non-probabilistic and intentional sampling in the science subject "Biology, Health and Infant Nutrition" (6 European Credit Transfer System -ECTS). All students had already gained 12 ECTS in instrumental English, equivalent to B1 (intermediate level), that guaranteed the minimal competences for following the lessons.

Two cohorts were considered: the experimental one was composed of 66 subjects (all women, age: $\bar{x}$ = 21.35 years, *SD* = 3.15 years), and the control, of 68 participants (66 women, 2 men, age: $\bar{x}$ = 21.03 years, *SD* = 3.37 years). Out of this initial sample, a total of 55 subjects in the experimental group (83.33%, all women, age: $\bar{x}$ = 20.49 years, *SD* = 1.82 years) and 50 in the control group (73.53%, 48 women, age: $\bar{x}$ = 21.38 years, *SD* = 3.67 years) completed the protocols 2 weeks and 1 year after instruction.

4.3. Description of the Experience for CLIL-izing EMI

The intervention comprised 2 ECTS, corresponding to 20 hours of classroom (10 sessions of 2 hours each). During the sessions, health and nutrition concepts were addressed. The contents included in the syllabus were (i) the types of nutrients and their function, (ii) presence of these nutrients in the different groups of food, (iii) the healthy nutrition habits according to the healthy eating pyramid published by the School of Public Health of the University of Harvard, now presented as "my healthy plate" (University of Harvard, 2023), (iv) analysis of nutrition labels and (v) design of healthy breakfast or lunches for children.

In the experimental group, the module was taught in English with CLIL methodology. Students were given the necessary linguistic support and scaffolding to understand new terms and express content knowledge as they completed different written and oral tasks. This way, language learning was integrated into the process of content acquisition.

In order to ease cognitive work, the content was divided into digestible pieces, and activities were carefully planned with progressive difficulty, from the least demanding to the most complex ones, in terms of both linguistic and cognitive demands. Thus, the first activities of the teaching unit were focused on lower order think skills (identification, classification), whereas the subsequent ones entailed development of higher order thinking skills (analysis, creation). Students learnt to classify foodstuffs into different groups of food, identify the main nutrients in different types of food and drinks, and placed them in a healthy eating pyramid. They analysed food labels, and created healthy breakfast or lunches for children.

In the control group, traditional teaching in the mother tongue, Spanish, was used, with a greater presence of expositive lessons. The classification activities, together with those focused on analysis and diet proposals, were also carried out but in their mother tongue, with a similar temporal design.

4.4. Instruments of Data Collection

Three instruments were used for data collection:

a) The instrument for measuring motivation in English language learning (Tables 1 and 2) was an adaptation of Gardner's (1985) and Schmidt and Watanabe's (2001) scales. Intrinsic motivation, instrumental orientation, global integration, interest in foreign languages/cultures, anxiety, and motivational strength were the dimensions considered. Due to the ordinal nature of the variables, the ordinal Cronbach's *alpha* was calculated and the result, .70, revealed good reliability and internal consistency.

b) The instrument for measuring motivation for learning science in English (Tables 3 and 4) was adapted from the Lasagabaster and Doiz's (2015) scale, which considered intrinsic motivation and motivational strength. It was validated in content and form by a panel of two experts in science education and one in modern languages. The Cohen's *Kappa* interrater agreement (.91) showed an excellent validation result. It was applied to a pilot sample of 10 students to guarantee a correct understanding. Cronbach's ordinal *alpha* value, .810, revealed very good reliability and internal consistency. The Kaiser-Meyer-Olkin (0.842) and Bartlett Sphericity ($p < .05$) tests results indicated good sample adequacy and the pertinence of doing an exploratory factorial analysis, which grouped the items into the following factors: a) enjoyment of English in science, items 1, 2, 3, 4, and 5, b) attitude to science in English, items 7, 8, 9 and 10, and c) feelings in the science class, items 6, 11, 12, 13 and 14. These results confirmed the adequacy of the instrument.

c) A qualitative instrument was designed with the aim of gathering information to gain an insight into the quantitative results (Table 5). The instrument was validated by a panel of two experts in science education and one in modern languages in both content and form. Cohen's *Kappa* interrater agreement (.88) showed an excellent result. It was also applied to a pilot sample of 10 subjects and revealed no problems in understanding or any ambiguous answers.

Both quantitative instruments (five-point Likert scales which ranged from 1 = strongly disagree to 5 = strongly agree) were applied for both cohorts: a pre-test before the experiment, post-test 1, two weeks after, and post-test 2, one year later. The qualitative instrument was applied two weeks after the experimental instruction and one year later exclusively to the experimental group.

4.5. Data Analysis

The data analysis was carried out with R, Factor, and the SPSS v. 23 software. A global score for each subject and scale was calculated as the mean value of the scores of the items (negatively worded items were reverse coded). The Kolmogorov-Smirnov test was applied to the scores in both instruments, and the normality criteria was not satisfied ($p < .05$), so non-parametric statistics were used for contrast analysis: the Mann-Whitney *U* test for two independent samples, the Wilcoxon test for two related samples, and the Friedman test for more than two related samples (Field, 2009). The Bonferroni correction was considered when more than two comparisons were made. The *Chi*-Square test was used for dichotomic variables, and the Fisher test when *Chi*-Square requirements were not reached. Data analysis was completed with descriptive statistics: due to the ordinal nature of the variables, the median was supplied, together with mean and standard deviation to help interpret the results.

5. Results

5.1. Motivation in Learning the English Language

Globally, student perception on learning English before the experience was rather good (*Mdn* = 3.5; $\bar{x}$ = 3.5; *SD* = 0.4 for the experimental group and *Mdn* = 3.4; $\bar{x}$ = 3.4; *SD* = 0.5 for the control group) without any significant differences between the cohorts (*U* = 1215.5; *Z* = -1.024; $p > .05$). Results are detailed in Table 1. Two weeks after the experience (*Mdn* = 3.4; $\bar{x}$ = 3.5; *SD* = 0.4 for the experimental and *Mdn* = 3.4; $\bar{x}$ = 3.4; *SD* = 0.5 for the control group; *U* = 1213.0; *Z* = -.892; $p > .05$) and one year later (*Mdn* = 3.6; $\bar{x}$ = 3.5; *SD* = 0.5 for the experimental and *Mdn* = 3.4; $\bar{x}$ = 3.5; *SD* = 0.5 for the control group; *U* = 1228.0; *Z* = -1.001; $p > .05$) student views remained similar. After the intervention, there were occasional differences among items: item 5, 15 (better perception in control group, 2 weeks later) and 19 (higher score in experimental group, 1 year later).

"Motivation towards English Language Learning"		**Pre-test**				**Post-test 2 weeks after**				**Post-test one year later**			
		Md	***x̄***	***SD***	***U, Z, p***	***Md***	***x̄***	***SD***	***U, Z, p***	***Md***	***x̄***	***SD***	***U, Z, p***
1. I really enjoy learning English.	Exp.	3.0	3.39	0.98	1243.500, -0.888, .375	3.0	3.54	0.77	1280.000, -0.489, .625	4.0	3.48	0.99	1363.500, -0.077, .938
	Ctr.	3.0	3.28	1.01		3.0	3.62	1.03		3.5	3.52	1.03	
2. I enjoy my English class.	Exp.	3.0	3.09	0.85	1074.000, -2.065, .039	3.0	3.22	0.82	1096.500, -1.746, .081	3.0	3.24	0.91	1091.500, -1.924, .054
	Ctr.	3.0	2.74	0.99		3.0	2.94	1.02		3.0	2.92	0.99	
3. I enjoy using English in the class.	Exp.	3.0	3.02	0.98	1228.000, -1.001, .317	3.0	3.26	0.91	1203.500, -0.996, .319	3.0	3.06	1.04	1370.500, -0.030, .976
	Ctr.	3.0	2.94	1.00		3.0	3.06	1.10		3.0	3.10	1.02	
4. I don't like learning English.	Exp.	2.0	1.80	0.92	1148.000, -1.386, .166	3.0	1.93	1.15	1158.500, -1.506, .132	1.0	1.74	1.07	1158.500, -1.506, .132
	Ctr.	2.0	2.24	1.32		2.0	2.24	1.25		2.0	1.94	1.00	
5. I often feel bored when I study for my English class.	Exp.	2.0	2.30	0.94	1033.000, -2.308, .021	2.0	2.50	1.00	993.500, -2.049, .016	2.0	2.54	1.02	1261.500, -0.758, .449
	Ctr.	3.0	2.74	0.92		3.0	2.98	1.04		3.0	2.64	1.05	
6. Studying English is important for me because I'll need it for my future studies.	Exp.	5.0	4.69	0.61	1228.500, -1.169, .243	2.0	4.61	0.56	1307.500, -0.328, .743	5.0	4.70	0.50	1275.500, -0.796, .426
	Ctr.	5.0	4.58	0.61		5.0	4.48	0.86		5.0	4.58	0.73	
7. Studying English is important for me because it will be useful in getting a job.	Exp.	5.0	4.67	0.48	1273.000, -0.767, .443	5.0	4.59	0.60	1276.000, -0.547, .584	5.0	4.46	0.61	1248.000, -0.672, .331
	Ctr.	5.0	4.48	0.71		5.0	4.50	0.68		5.0	4.52	0.68	
8. Studying English is important for me because people will respect me more if I speak English.	Exp.	3.0	2.67	1.17	1161.000, -1.420, .156	3.0	2.63	1.15	1116.000, -0.196, .114	3.0	2.70	1.34	1096.500, -1.851, .064
	Ctr.	3.0	3.04	1.11		3.0	2.98	1.08		3.0	3.18	1.14	
9. I am learning English to understand films, videos, music, games, chat on the Internet.	Exp.	3.0	3.13	1.06	1351.500, -0.158, .875	3.0	3.30	1.16	1321.000, -0.196, .845	3.0	3.33	1.13	1316.000, -0.396, .692
	Ctr.	3.0	3.04	1.11		3.0	2.98	1.08		3.5	3.18	1.14	
10. Studying English is important for me because I can meet and talk with more people.	Exp.	4.0	3.94	0.86	1336.000, -0.263, .792	4.0	4.04	0.85	1213.000, -0.963, .336	4.0	4.07	0.99	1363.000, -0.083, .934
	Ctr.	4.0	3.90	0.97		4.0	4.18	0.80		4.0	4.14	0.78	

"Motivation towards English Language Learning"		**Pre-test**				**Post-test 2 weeks after**				**Post-test one year later**			
11. I would like to learn different foreign languages.	Exp.	4.0	3.74	1.08	1292.000, -0.557, .577	4.0	3.76	1.01	1311.500, -0.262, .793	4.0	3.87	1.01	1310.500, -0.439, .661
	Ctr.	4.0	3.66	0.94		4.0	3.70	1.04		4.0	3.78	1.04	
12. I enjoy meeting and talking with people from other countries and other cultures.	Exp.	4.0	3.72	0.98	1366.500, -0.057, .954	4.0	3.80	0.81	1347.500, -0.017, .986	4.0	3.28	1.19	1257.000, -0.791, .429
	Ctr.	4.0	3.78	0.95		4.0	3.76	0.98		4.0	3.76	1.12	
13. Studying foreign languages is an important part of my education.	Exp.	4.0	4.15	0.83	1342.500, -0.222, .824	4.0	4.24	0.73	1303.000, -0.334, .739	5.0	4.39	0.76	1189.000, -1.315, .189
	Ctr.	4.0	4.08	0.92		4.0	4.28	0.73		4.0	4.24	0.74	
14. I feel nervous when I have to speak in English in my English class.	Exp.	4.0	4.04	1.10	1160.500, -1.454, .146	4.0	3.85	1.07	1337.000, -0.089, .929	4.0	4.00	1.10	1217.000, -1.064, .287
	Ctr.	4.0	3.74	1.17		4.0	3.84	1.13		4.0	3.80	1.11	
15. I don't worry about making mistakes when speaking in front of my English class.	Exp.	2.0	2.44	1.02	1185.000, -1.275, .202	2.0	2.31	0.93	1051.000, -2.028, .043	3.0	2.56	1.19	1338.500, -0.242, .808
	Ctr.	3.0	2.72	1.09		3.0	2.76	1.10		3.0	2.62	1.09	
16. I feel more tense and nervous in my English class than in my other classes.	Exp.	4.0	3.44	1.21	1371.000, -0.026, .979	4.0	3.46	1.16	1249.000, -0.680, .496	3.0	3.24	1.30	1257.500, -0.778, .437
	Ctr.	4.0	3.44	1.18		4.0	3.26	1.26		4.0	3.46	1.13	
17. I always feel that the other students speak English better than I do.	Exp.	4.0	3.63	1.14	1163.500, -1.416, .157	3.0	3.35	1.20	1250.000, -0.675, .499	4.0	3.81	1.08	1286.500, -0.601, .548
	Ctr.	4.0	3.34	1.04		4.0	3.50	0.95		4.0	3.74	0.94	
18. I work hard in my English class even when I don't like what we are doing.	Exp.	4.0	3.59	0.86	1147.500, -1.582, .114	4.0	3.65	0.91	1160.000, -1.328, .184	4.0	3.72	0.96	1163.500, -1.443, .149
	Ctr.	3.0	3.38	0.64		3.0	3.40	0.81		3.5	3.48	0.76	
19. Even when course materials are not interesting, I always finish my work.	Exp.	4.0	3.96	0.87	1046.500, -2.227, .026	4.0	3.85	0.90	1171.500, -1.222, .222	4.0	3.91	1.07	1081.500, -1.971, .049
	Ctr.	4.0	3.58	0.91		4.0	3.62	0.95		3.0	3.58	0.88	
20. I put my best effort into learning English in my English language class.	Exp.	4.0	4.19	0.73	934.000, -3.010, .003	4.0	4.13	0.75	1046.500, -2.106, .035	4.0	4.06	0.86	1117.500, -1.772, .076
	Ctr.	4.0	3.74	0.78		4.0	3.78	0.84		4.0	3.82	0.77	

Exp: experimental group; Ctr.: control group.

Table 1. "*Motivation towards English Language Learning"* questionnaire for the experimental (CLIL) and control groups: descriptive statistics and Mann-Whitney's *U* (contrasting between groups for each test) results

Regarding the longitudinal perspective within each group, the Friedman test determined statistical differences only in the control group in questions 1 and 17 (Table 2). Globally, there were no statistically significant differences in the experimental ($\chi 2 = 5.522$; $p > .05$) and control groups ($\chi 2 = 2.166$; $p > .05$). All in all, the experimental instruction in English of the subject "Biology, Health and Infant Nutrition" did not significantly impact motivation for English learning.

"Motivation towards English Language Learning"		**Friedman test** ***Chi*-square, *p***
1. I really enjoy learning English.	Exp.	1.226, .542
	Ctr.	14.473, .001
2. I enjoy my English class.	Exp.	0.792, .673
	Ctr.	4.641, .098
3. I enjoy using English in the class.	Exp.	2.554, .279
	Ctr.	2.446, .294
4. I don't like learning English.	Exp.	2.736, .255
	Ctr.	4.568, .102
5. I often feel bored when I study for my English class.	Exp.	2.584, .275
	Ctr.	3.659, .160
6. Studying English is important for me because I'll need it for my future studies.	Exp.	2.027, .363
	Ctr.	0.024, .988
7. Studying English is important for me because it will be useful in getting a job.	Exp.	4.771, .092
	Ctr.	0.320, .860
8. Studying English is important for me because people will respect me more if I speak English.	Exp.	0.638, .727
	Ctr.	2.823, .244
9. I am learning English to understand films, videos, music, games, chat on the Internet.	Exp.	1.200, .549
	Ctr.	2.823, .244
10. Studying English is important for me because I can meet and talk with more people.	Exp.	1.437, .487
	Ctr.	3.875, .144
11. I would like to learn different foreign languages.	Exp.	2.713, .258
	Ctr.	1.421, .492
12. I enjoy meeting and talking with people from other countries and other cultures.	Exp.	2.934, .231
	Ctr.	0.322, .851
13. Studying foreign languages is an important part of my education.	Exp.	3.679, .159
	Ctr.	1.448, .485
14. I feel nervous when I have to speak in English in my English class.	Exp.	3.358, .187
	Ctr.	0.239, .888
15. I don't worry about making mistakes when speaking in front of my English class.	Exp.	1.232, .540
	Ctr.	1.928, .381
16. I feel more tense and nervous in my English class than in my other classes.	Exp.	1.291, .524
	Ctr.	1.851, .396
17. I always feel that the other students speak English better than I do.	Exp.	5.542, .063
	Ctr.	13.271, .001
18. I work hard in my English class even when I don't like what we are doing.	Exp.	1.187, .552
	Ctr.	1.298, .523
19. Even when course materials are not interesting, I always finish my work.	Exp.	0.444, .801
	Ctr.	0.157, .925
20. I put my best effort into learning English in my English language class.	Exp.	0.140, .933
	Ctr.	0.636, .727

Exp: experimental group; Ctr.: control group.

Table 2. "*Motivation towards English Language Learning"* questionnaire for the experimental (CLIL) and control groups: Friedman's test (contrasting differences within the same group throughout the time) results

5.2. Motivation in Learning Science in English

Student motivation before the experience was moderate considering the scale globally (*Mdn* = 3.0; $\bar{x}$ = 3.0; *SD* = 0.5 for the experimental group and *Mdn* = 2.8; $\bar{x}$ = 2.8; *SD* = 0.5 for the control group) without significant differences between the groups (*U* = 1111.0; *Z* = -1.695; *p* > .05). Statistical differences were

found in 5 out of 14 items (4, 8, 9, 10 and 12, see Table 3), in favour of the experimental group in four of them (items 4, 8, 9 and 10).

Two weeks after the intervention, considering the scale globally, significant differences were found between both cohorts (*Mdn* = 3.3; $\bar{x}$ = 3.3; *SD* = 0.7 for the experimental group and *Mdn* = 2.8; $\bar{x}$ = 2.8; *SD* = 0.6 for the control group; *U* = 756.5; *Z* = -3.780; $p < .05$). Looking at the items separately, there were 8 differences (items 1, 3, 6, 7, 9, 10, 11 and 12) with the experimental group scoring significantly higher (Table 3).

One year later, considering the scale globally, the experimental group still maintained significant differences (*Mdn* = 3.3; $\bar{x}$ = 3.2; *SD* = 0.5 for the experimental group and *Mdn* = 2.8; $\bar{x}$ = 2.9; *SD* = 0.5 for the control group; *U* = 800.5; *Z* = -3.691; $p < .05$) which were also present in 5 items, the same as in the first post-test except for number 7, 11 and 12, which showed constant positive perception over time. The longitudinal study shows this effect clearer (Table 4). Two overriding conclusions can be drawn from these results. Firstly, motivation in the control group did not change ($\chi 2 = 2.984$; $p > .05$). Secondly, there was a rise in motivation in the experimental group ($\chi 2 = 15.6$; $p < .05$) after the experience in 9 items, with differences between groups that were sustained over time (Table 3). Consequently, it can be concluded CLIL experimental instruction in English had a positive effect on student motivation in learning science in English.

"Motivation towards Science taught in English"		**Pre-test**				**Post test 1**				**Post-test 2**			
		Md	***$\bar{x}$***	***SD***	***U, Z, p***	***Md***	***$\bar{x}$***	***SD***	***U, Z, p***	***Md***	***$\bar{x}$***	***SD***	***U, Z, p***
1. I like learning Science in English.	Exp.	3.0	2.85	1.21	1245.500, -0.865, .387	3.0	3.45	1.03	834.500, -3.613, .000	4.0	3.31	1.03	1033.000, -2.294, .022
	Ctr.	3.0	2.64	1.06		3.0	2.66	1.17		3.0	2.82	1.10	
2. I enjoy these classes.	Exp.	3.0	3.04	1.10	1284.00, -0.607, .544	3.0	3.38	0.93	1154.000, -1.509, .131	3.0	3.40	0.89	1104.000, -1.838, .066
	Ctr.	3.0	2.92	1.12		3.0	3.12	1.12		3.0	3.04	1.05	
3. I enjoy using English in these classes.	Exp.	3.0	2.80	1.19	1212.000, -1.086, .278	3.0	3.24	1.02	960.000, -2.768, .006	3.0	3.31	0.98	995.000, -2.548, .011
	Ctr.	3.0	2.58	0.99		3.0	2.62	1.23		3.0	2.76	1.04	
4. I often feel bored when I study Science in English.	Exp.	3.0	2.55	0.96	965.000, - 2.737, .006	2.0	2.64	0.97	1295.500, -0.532, .595	3.0	2.65	1.11	1243.000, -0.882, .378
	Ctr.	3.0	3.10	1.13		3.0	2.76	1.15		3.0	2.84	0.98	
5. I enjoy learning Science in English more than in Spanish.	Exp.	2.0	2.20	1.04	1257.000, -0.794, .427	2.0	2.42	0.94	1208.500, -1.122, .262	2.0	2.60	0.99	923.500, -3.028, .002
	Ctr.	2.0	2.06	1.10		2.0	2.22	1.00		2.0	2.04	0.97	
6. I enjoy using English in these classes more than using English in the English class (Lengua extranjera y su didáctica).	Exp.	3.0	2.69	1.15	1182.000, -1.284, .199	5.0	3.35	1.13	800.500, -3.863, .000	3.0	3.25	0.99	793.000, -3.879, .000
	Ctr.	2.0	2.42	0.99		3.0	2.56	0.93		2.0	2.46	1.09	
7. I think is more interesting to learn English learning Science in English than through the subject of English.	Exp.	3.0	2.85	1.04	1231.500, -0.959, .337	3.0	3.24	0.94	891.000, -3.309, .001	3.0	3.09	0.89	1127.000, -1.716, .086
	Ctr.	3.0	2.60	0.99		3.0	2.76	0.87		3.0	2.66	1.00	

"Motivation towards Science taught in English"		**Pre-test**				**Post test 1**				**Post-test 2**			
8. I work harder in these classes than in others even when I don't like what we are doing.	Exp.	3.0	3.51	0.96	1062.500, -2.128, .033	3.0	3.33	1.02	1278.000, -0.655, .513	3.0	3.44	1.12	1141.000, -1.591, .112
	Ctr.	3.0	3.20	0.99		3.0	3.20	0.81		3.0	3.08	0.83	
9. Even when course materials are not interesting, I always finish my work.	Exp.	4.0	4.00	0.90	881.000, - 3.330, .001	4.0	3.75	1.00	1084.500, -1.969, .049	4.0	4.00	1.02	1027.500, -2.329, .020
	Ctr.	3.0	3.40	0.90		3.0	3.38	0.95		4.0	3.58	0.93	
10. I put my best effort into learning Science in English.	Exp.	4.0	3.82	0.92	787.000, - 3.981, .000	4.0	3.85	0.93	864.000, -3.449, .001	4.0	3.91	1.01	818.500, -3.736, .000
	Ctr.	3.0	3.10	0.84		3.0	3.22	0.95		3.0	3.28	0.86	
11. I feel less nervous when I have to speak in English in the Science class than when I have to do it in the English class.	Exp.	3.0	2.85	1.27	1313.000, -0.411, .681	4.0	3.62	1.16	893.000, - 3.184, .001	4.0	3.29	1.18	1163.000, -1.400, .162
	Ctr.	3.0	2.88	1.06		3.0	2.88	1.24		3.0	2.94	1.30	
12. I am less worried about making mistakes when speaking in front of my Science class (when taught in English) than in my English class.	Exp.	2.0	2.58	1.05	995.000, -2.583, .010	4.0	3,31	1,23	1047.500, -2.198, .028	3.0	3.04	1.04	1171.500, -1.377, .169
	Ctr.	3.0	2.98	0.84		3.0	2.86	0.97		3.0	2.76	0.92	
13. I feel less tense and nervous in my Science class (when taught in English) than in my English class.	Exp.	3.0	2.73	1.01	1153.000, -1.516, .129	2.0	3,40	1,13	1106.000, -1.822, .068	3.0	2.96	1.04	1370.000, -0.033, .973
	Ctr.	3.0	3.00	0.99		3.0	3.00	1.14		3.0	2.96	1.05	
14. In my Science class (when taught in English) I do not feel that the other students speak English better than I do.	Exp.	3.0	2.69	0.92	1334.000, -0.280, .780	4.0	3.00	1.19	1164.000, -1.439, .150	3.0	3.00	1.07	1209.500, -1.110, .267
	Ctr.	3.0	2.64	0.94		3.0	2.76	0.87		3.0	2.78	1.00	
Overall	Exp.	3	2.90	0.11		3	3.24	0.10		3	3.19	0.08	
	Ctr.	3	2.79	0.09		3	2.82	0.14		3	2.82	0.11	

Exp: experimental group; Ctr.: control group.

Table 3. "*Motivation for science taught in English*" questionnaire for the experimental (CLIL) and control groups: descriptive statistics and Mann-Whitney's *U* (contrasting between groups for each assessment) test. Post-test 1 was carried out two weeks after the intervention, and post-test 2, one year after

"Motivation towards Science taught in English"		**Friedman test**	**Wilcoxon (*Z, p*)***		
		Chi*-square, *p	**Pre-test – Post-test 1**	**Post-test 1 – Post test 2**	**Pre-test – Post-test 2**
1. I like learning Science in English.	Exp.	14.982, .001	-3.456, .001	-2.278, .023	-0.586, .558
	Ctr.	1.248, .536			
2. I enjoy these classes.	Exp.	10.155, .006	-2.343, .019	-1.988, .047	-0.030, .975
	Ctr.	0.313, .855			
3. I enjoy using English in these classes.	Exp.	12.163, .002	-2.348, .019	-2.859, .004	-0.439, .661
	Ctr.	1.145, .564			
4. I often feel bored when I study Science in English.	Exp.	0.506, .777			
	Ctr.	2.083, .353			
5. I enjoy learning Science in English more than in Spanish.	Exp.	7.311, .026	-1.521, .128	-2.084, .037	-1.166, .243
	Ctr.	1.730, .421			
6. I enjoy using English in these classes more than using English in the English class (Lengua extranjera y su didáctica).	Exp.	13.236, .001	-2.827, .005	-2.893, .004	-0.689, .491
	Ctr.	0.637, .727			
7. I think is more interesting to learn English learning Science in English than through the subject of English.	Exp.	6.909, .032	-2.405, .016	-1.318, .188	-0.817, .414
	Ctr.	0.496, .781			
8. I work harder in these classes than in others even when I don't like what we are doing.	Exp.	0.834, .659			
	Ctr.	0.756, .685			
9. Even when course materials are not interesting, I always finish my work.	Exp.	2.507, .286			
	Ctr.	3.345, .188			
10. I put my best effort into learning Science in English.	Exp.	0.715, .699			
	Ctr.	0.212, .899			
11. I feel less nervous when I have to speak in English in the Science class than when I have to do it in the English class.	Exp.	13.838, .001	-3.369, .001	-1.706, .088	-1.445, .149
	Ctr.	0.456, .796			
12. I am less worried about making mistakes when speaking in front of my science class (when taught in English) than in my English class.	Exp.	19.087, .000	-3.754, .000	-2.645, .008	-1.150, .250
	Ctr.	1.274, .529			
13. I feel less tense and nervous in my science class (when taught in English) than in my English class.	Exp.	17.414, .000	-3.253, .001	-1.275, .202	-2.360, .018
	Ctr.	0.101, .951			
14. In my science class (when taught in English) I do not feel that the other students speak English better than I do.	Exp.	5.560, .062			
	Ctr.	0.197, .906			

Exp: experimental group; Ctr.: control group.
**p-value* considered for Wilcoxon test is 0.016 due to the Bonferroni correction.

Table 4. "*Motivation towards science taught in English*" questionnaire for the experimental (CLIL) and control groups: Friedman's and Wilcoxon *post-hoc* results (contrasting differences within the same group throughout the time). Wilcoxon has been only carried out when Friedman test revealed statistically significant differences among temporal evaluations

5.3. Qualitative Perspective of Students about the CLIL-EMI Intervention

The answers collected by means of open-ended questions (Table 5) revealed students considered the instruction of science in English helped improve learning this language, and this positive perception was sustained over time.

Although two weeks after the intervention students stated they had no problems in following the lessons, one year afterwards, they showed more critical stances and declared they had found it difficult to use

specific vocabulary and terminology in English. Interestingly, and this perception was maintained in the second post-test one year after receiving the instruction in English.

In regard to science content acquisition, student perception of their learning decreased over time, and one year later they had a greater tendency to think that they were focusing more on language than on subject contents. Notwithstanding, the feelings students experienced were very positive in general (fine, comfortable, relaxed, excited, motivated…) which are congruent with the safe learning environment it was intended to create during the intervention. Fewer students felt nervous or frustrated, particularly when speaking in English. Oral production seems to be a controversial issue, since although it was mentioned among being one of the main benefits of the instruction in English in the first post-test, one year later, student perception of their improved oral skills decreased significantly. Besides, one improvement suggested was to devote more time to student oral practice in the CLIL sessions.

Question 1: Which difficulties have you found learning Science in English?						
	Two weeks after the intervention		**One year after the intervention**			
	n	**% (N = 55)**	**n**	**% (N = 55)**	**p-value for $\chi 2$**	**Examples**
None.	20	36.36	10	18.18	.032	"I have found no difficulties".
Specific vocabulary that difficult to understand some explanations.	20	36.36	35	63.63	.004	"I couldn't follow some explanations because I didn't know many words".
I had difficulties with oral skills.	8	14.55	6	10.91	.567	"The most difficult task was talking, more than writing".
I felt nervous.	1	1.81	1	1.81	.752*	"I felt nervous when I had to expose the final activity".
Others.	8	14.54	5	9.09	.420	"It was easier than I thought at the beginning". "I had difficulties with grammar skills". "I had difficulties with listening skills". "I was afraid at the beginning".
Question 2: Which advantages have you found learning Science in English?						
	n	**% (N = 55)**	**n**	**% (N = 55)**	**p-value for $\chi 2$**	**Examples**
Acquisition of vocabulary.	37	67.27	34	61.82	.55	"I have learnt many new words".
Acquisition of didactic training to teach Science in English.	6	10.91	2	3.64	.271*	"Now I know how to teach in this way".
To learn Science in English.	3	5.45	0	0.00	.243*	"I have studied Science in another different language".
Improvement in English language, as a whole.	3	5.45	3	5.45	1.000*	"I have improved my level of English".
It is a more enjoyable and motivating methodology.	3	5.45	7	12.72	.185	"Classes have been funnier". "I wanted to go to the classes more than before".
Improvement of oral skills and fluency.	3	5.45	5	9.09	.716*	"I am less stuck when talking in English".
To feel less embarrassed when talking in English.	2	3.64	0	0.00	.495*	"I've lost my shame when talking in English".
Practice of English.	2	3.64	1	1.82	1.000*	"I had the opportunity of practicing English".
To use English in different subjects than English.	2	3.64	3	5.45	1.000*	"I have used English beyond the English class".

It has no advantages.	0	0.00	3	5.45	.243*	"It has no advantages".
Others.	6	10.90	11	16.36	.187	"I can learn two subjects at the same time, to develop communication skills, personal enrichment".
Question 3: Have you improved in English language? Explain your answer.						
	n	**% (N = 55)**	**n**	**% (N = 55)**	**p-value for $\chi 2$**	**Examples**
Vocabulary.	21	38.18	16	29.09	.313	"I have learnt new words".
Oral skills.	10	18.18	3	5.45	.073*	"I have improved my oral expression".
Confidence talking in English.	6	10.91	1	1.82	.113*	"Now I feel less nervous when talking in English".
Practice of English.	6	10.91	4	7.27	.507	"We have practiced English beyond the English class".
Listening skills.	4	7.27	2	3.64	.679*	"I have improved my listening skills".
I have improved (without an explanation).	3	5.45	9	16.36	.124	"I have improved a little".
Learning of new concepts in English.	3	5.45	7	12.73	.320	"I have learnt many issues in English".
It isn't enough time to improve.	2	3.64	4	7.27	.679*	"More days are necessary to make a change".
No, my English level is low.	2	3.64	1	1.82	1.000*	"No, my academic background in English is very poor".
Fluency.	1	1.82	2	3.64	1.000*	."Now I speak more fluently".
I haven't improved (without an explanation).	1	1.82	2	3.64	1.000*	"I don't feel I have improved my English level".
Learn a new methodology.	0	0.00	2	3.64	.495*	"It served to know alternative methodologies".
Others.	7	12.72	7	12.72	1.000	"Yes, I have acquired didactic knowledge to teach Science in English". "I have improved my grammar skills". "No, as my level of English is medium-high".
Question 4: Do you think you have improved in Science? Explain your answer.						
	n	**% (N = 55)**	**n**	**% (N = 55)**	**p-value for $\chi 2$**	**Examples**
Yes, I have acquired contents and vocabulary on nutrition.	41	74.54	26	47.27	.003	"I had learnt new vocabulary". "I know how to analyze nutrition facts". "I have learnt to design a healthy diet".
Yes (without an explanation).	4	7.27	8	14.55	.360*	"Yes".
No, English has hindered the learning.	2	3.64	3	5.45	1.000*	"Sciences in Spanish are more understable".
Yes, but it was harder in English.	2	3.64	2	3.64	1.000*	"Yes, but I had to work hard yo study in English".
No (without an explanation).	1	1.82	5	9.09	.206*	"No".
Yes, the methodology made classes more interesting.	0	0.00	4	7.27	.118	"Contents have been taught in a more interesting way".
Others.	11	20.0	20	36.36	.056	"I have focused more in English than in Science". "I already knew many of the concepts studied".
Question 5: How did you feel during the teaching and learning process of this unit?						
	n	**% (N = 55)**	**n**	**% (N = 55)**	**p-value for $\chi 2$**	**Examples**
Fine.	27	49.09	31	56.36	.445	"I felt fine".

Comfortable.	9	16.36	9	16.36	1.000	"Very comfortable".
Relaxed.	3	5.45	2	3.64	1.000*	"When days passed, I felt more relaxed".
I liked it.	3	5.45	2	3.64	1.000*	"I have enjoyed with the experience".
Excited.	3	5.45	2	3.64	1.000*	"I waited the lessons with expectation".
Motivated.	2	3.64	4	7.27	.679	"Motivated".
Sometimes fine. sometimes bad.	2	3.64	0	0.00	.495*	"Good, except when I had to talk in English".
Nervous.	4	7.27	4	7.27	1.000*	"Nervous when I had to talk in public".
Others.	11	20.00	12	21.81	.815	"Insecure". "Fulfilled". "Blocked". "Frustrated".
Question 6: Which improvements do you propose in the development of this unit to make you feel more confident?						
	n	**% (N = 55)**	**n**	**% (N = 55)**	**p-value for $\chi 2$**	**Examples**
Nothing. everything was OK.	20	36.36	11	20.00	.056	"Nothing, it was well planned to feel secure".
To promote more the oral communication.	9	16.36	6	10.91	.405	"To include more oral activities".
To spend more time with these sessions.	8	14.55	11	20.00	.449	"More sessions are necessary to be more confident with English".
To improve the level of English previously.	2	3.64	0	0.00	.495*	"The English necessary should be leant previously".
To improve specific vocabulary of Science in English previously.	2	3.64	4	7.27	.679*	"Previous lessons with specific vocabulary would help".
To do the sessions more dynamics.	2	3.64	2	3.64	1.000*	"Activities could be more dynamic".
To combine explanations in English and Spanish.	2	3.64	0	0.00	.495*	"All the explanations in English makes it more difficult".
To address the linguistic mistakes.	2	3.64	0	0.00	.495*	"To improve in English, I need to know my mistakes".
To follow this methodology in other themes or subject.	3	5,45	1	1.82	.618	"This methodology should be used all across the degree". "More science themes could be taught this way".
To consider the different levels of English of the students.	0	0.00	5	9.09	.057*	"To include two levels of difficulty of English, as for me it was a little boring".
Others.	8	14.55	14	25.45	.153	"The advantaged students in English could help to those with less English level". "To improve didactic materials". "To consider the different levels of English in the classroom".

*Fisher test *p*-value has been considered as requirements for *Chi*-Square test were not reached.

Table 5. Descriptive analysis and *Chi*-square test results for open questions

6. Discussion

Regarding OB. 1) findings indicate that CLIL-izing a science course in pre-service teacher training did not affect student motivation in learning English, in the short and in the long term. This outcome can be ascribed to the fact that the degree of motivation to English learning among students was already high before the intervention, which limited the possibilities of significant improvements. In our globalized

society, English is considered to be the most important *Lingua franca* and a must have to be successful in a competing labor scenario (Nieto Moreno de Diezmas, 2023). These perceptions are fully rooted in society and, as the present study shows, are also part of the imaginary of future teachers. This trend has been identified in previous investigations (García Fernández, Nieto Moreno de Diezmas & Ruiz Gallardo, 2017).

As long as OB. 2) is concerned, the present study reveals that the CLIL-izing experience positively impacted motivation to learning science contents in English in the short term and the beneficial effect was sustained in the long term. The finding that instruction in English resulted in increased motivation towards content learning is consistent with previous studies (García Fernández & Ruiz-Gallardo, 2016; García Fernández et al., 2017; Lasagabaster & Doiz, 2015). García Fernández et al. (2017) assigned the positive effect on content motivation of teaching in English, among other factors, to the CLIL approach itself, since it provided more enriched scenarios characterized by a more student-centered teaching style and the promotion of active and collaborative learning. These ingredients were also present in the intervention, which was carefully planned, and designed. Linguistic and cognitive demands were considered and addressed, an adequate progression in knowledge and thinking skills was observed, and scaffolds for reception and construction of knowledge were included. Thus, CLIL could have acted as a catalyst for methodological improvements which might have positively impact on student motivation for science learning.

Additionally, it is important to mention that, in contrast to previous studies, all participants were enrolled in a monolingual degree and were involved in a mandatory experience of English-medium instruction. This circumstance implies that positive results on motivation cannot be attributed to voluntary access to a bilingual program. In fact, before the intervention no differences were observed between the control and the experimental group, which indicate the students who received content instruction in English had a similar level of motivation than their peers.

Regarding OB. 3), participants considered they have learnt both English and science, found no major difficulties, experienced mostly positive emotions during the experience, and identified a wide range of advantages. Interestingly, students were aware of the methodological enrichments the instruction through English entailed and highlighted them mainly in two interesting ways: a) Serving as examples to use them in future teaching practice. Scientific literature shows that normally little time is devoted at school to science and activities are low quality (Saçkes, Trundle, Bell & O'Connell, 2011), so good examples are highly necessary to improve science teaching. b) Making science learning more enjoyable and motivating: several studies show that teachers and pre-service teachers have a rather poor grounding in science (Garbett, 2003; Kallery, 2004) and their attitude to science is less favorable than in other disciplines (Erden & Sönmez, 2011). As a result, this CLIL-izing experience may help give future teachers an insight into higher quality science teaching techniques, which could be applied to both deepen their own knowledge and interest in science, and to be used in their future professional practice. In this vein, the actual impact of this intervention on the expansion of future science teaching practice for the participants is an open line of research and would need further investigation.

The highly positive emotions expressed by students revealed good acceptance of the experimental implementation of CLIL, even though participants had a limited English level (B1). Among the positive stances that students expressed, it was detected CLIL helped lower the affective filter and reduced anxiety, which has been extensively identified as one of the main consequences of the CLIL focus on meaning and content (Jiménez & Ruiz de Zarobe, 2009). As the intervention gave them greater confidence for learning science in English, future teachers became aware they could teach at a bilingual primary education school, increasingly frequent all over Spain (García Fernández, Ruiz-Gallardo, Nieto Moreno de Diezmas, Fernández Cézar, Mateos Jiménez, Martínez González et al., 2019).

The main limitation of the study is the short duration of the CLIL experience. This circumstance might be behind the fact that the intervention had no impact on motivation in English language learning. In addition, even if statistical differences were found on content motivation between control and

experimental groups one year after, the intragroup analysis reveals that some of these differences weakened over time. It is possible that differences could increase and be more strongly sustained over time with a longer exposure to this approach. This hypothesis should be checked in the future if the conditions to extend the experiment are met. Another limitation of the study is that academic and learning outcomes were not considered, which could have been helpful to discuss the results more in depth. The relation between motivation and academic performance remains an area to explore for further research.

The main pedagogical implications derived from this study are as follows. Firstly, team teaching by means of collaborations between English language specialists and science content lecturers has been revealed as an ideal tandem and a very productive strategy for implementing instruction in English at HE, since the fusion between the expertise in second language acquisition and in science content led to effective methodological planning and practice. The analysis of the specific context in terms of cognitive and language needs was crucial for making pedagogical decisions. Secondly, researching the impact of innovative teaching practice was fundamental to understanding its effect and improving its implementation. In this vein, students suggested spending more time in CLIL lessons and also addressed certain points such as increasing oral communication, which, incidentally, is essential for teachers and is usually disregarded even in non-bilingual science subjects (García Fernández et al., 2019). Additionally, students indicated more language support, more corrective feedback and more use of translanguaging and code-switching would be needed to cater for the different level of English of students, which was low in many cases.

7. Conclusion

This study intended to ascertain the impact that delivering in English (drawing upon CLIL methodology) a part of the subject "Biology, Health and Infant Nutrition" had on motivation for English language and science learning.

Results indicated that teaching science in English did not impact motivation for English language, but it did positively affect motivation for learning science contents in English. It is important to highlight that, even if the pedagogical intervention was brief, this positive outcome regarding motivation was sustained over time. Participants expressed they had experienced very positive emotions, stated they had improved their English proficiency (particularly, regarding vocabulary and oral skills), and understood the contents conveyed in English, even if their level of English before the CLIL intervention was not very high (around B1 of the CEFR).

The success of the experimental implementation of EMI may be ascribed to the methodology applied based on the CLIL approach. In this case, students' insufficient English language level made it advisable to focus on both language and content integration in order to guarantee students were able to understand and construct science knowledge in English. Within this backdrop, CLIL provided the pedagogical tools to analyze and respond to language and cognitive needs, scaffold language reception and production, and develop science thinking skills.

Collaboration of English language and science content lecturers provided a balanced and satisfactory contribution from both areas of expertise and might be an example of good practice for smooth implementation of English as a medium of instruction in Higher Education. This tandem was very effective in the process of lesson planning and has enormous potential for enhancing reflection on the context in terms of linguistic and methodological needs and organizing a tailored pedagogical plan.

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