

L2-PROFICIENCY AND MATHEMATIC COMPETENCES OF 10-12 YEAR-OLD CHILDREN IN SWISS TWO-WAY IMMERSION ELEMENTARY SCHOOL PROJECT *FIBI*

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Abstract

This article presents a study that was conducted in the (Swiss-) German and French bilingual city Biel/Bienne in Switzerland during 2016-2017. The paper investigates the effect of a two-way immersion school project (FiBi) on the L2-Proficiency of children 10-12 years old. Using mathematic tests, the study examines whether learning in another language affects school competences. Comparing FiBi students (n=41) and a control group (n=24), the analysis reveals a significant higher L2 proficiency in four tested competences and no significant difference in mathematics results. Some recommendations for the improvement of the two-way immersion project and for further research are presented in the final part of the paper.

Keywords: Bilingualism, two-way immersion, French, German, L2-Proficiency, primary school.

1. Introduction

Bilingualism is one clear goal of education nowadays especially in multilingual European countries, such as Switzerland. Language policies encourage immersion projects through recommendations, articles and teacher training (CDIP 2004; Council of Europe, 2001). However, research on bilingualism in primary school and its concrete implementation are still missing, belonging on regional and political resources rather than on initiatives from education stakeholders.

The city of Biel/Bienne, the biggest bilingual city in Switzerland, started in 2010 a two-immersion primary school project, called *Filière Bilingue* (hereafter FiBi). French and German, both national and majority languages in Switzerland, are used as the language of teaching to roughly the same extent. Pupils of both language communities as well as children from migrant backgrounds are represented in the classes in order to enhance bilingual interaction. In 2014, a first evaluation of the speaking competences of children involved in this project was achieved (Buser, 2014) and the city council and the canton of Berne have decided in 2016 to proceed to new assessments of L2-Proficiency and mathematics competences within the frame of FiBi.

This paper presents some of the results of the 2016 evaluation of FiBi. First, the theoretical frame and the research question about L2-Proficiency and mathematics competences will be presented. Thereafter, the methodological approaches chosen to pursue the research questions will be briefly introduced. Finally, the presentation of the results as well as some recommendations for this project will conclude the paper.

2. Bilingualism and immersion

Many studies on bilingual schools have been conducted around the world, often aiming to measure the impact of the program on the L1, the L2, other school subjects or even on social and emotional aspects (Gajo, 2001). Until the late 1960s-1970s, opinions about bilingualism were controversial and some people considered it as an obstacle to cognitive development and school success. However, many studies in Canada, USA, Australia and Europe showed evidence of the benefits of bilingualism. For example, Bialystok (2001) argues that bilingual individuals would show better competences in focusing on one activity and making decisions. They also tend to have an easier time remembering lists of words. Cavalli (2005) presents many studies carried out on bilingual school projects between 1970 and 1990 and highlights that: 1) competences in L1 are not slowed by the presence of a L2; 2) receptive competences of pupils of immersion projects can be comparable as natives pupils in the target language; 3) no significant loss in the

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other school discipline was identified; 4) cognitive creativity and flexibility were detected by pupils of immersion projects and 5) less prejudice and more adaptation capacity was noted by bilingual children.

Since the beginning of the 20th century, different researchers have tried to define bilingualism. Bloomfield (1933) and Lebrun (1982) used to describe it as a perfect command of two languages. This definition would exclude many speakers of the bilingual denomination. Grosjean (2015) proposes a definition focused on the use of languages in everyday situations. According to him, someone is bilingual or plurilingual as soon as he or she uses more than one language. This definition has the advantage of avoiding the proficiency matter and of being based exclusively on the use of language, which is easier to observe in someone's practices.

As the necessity of speaking more than one language has become clear for most people in Europe and around the world, the number of immersion projects has greatly increased in the past ten years. In Switzerland, most projects were implemented at high school or University level (from 16 years-old up) at the beginning. However, some new projects were recently implemented at the primary (4 to 12 years-old) and secondary (12 to 16 years-old) levels. The degree of immersion varies from one project to another but the two most immersive systems which could be experienced are: 1) the partial immersion (school program in which school disciplines are taught in the target language (TL). The number of periods in TL is defined in every project) and 2) two-way immersion (school program based on a usually balanced repartition of school disciplines between two or sometimes more languages. The presence of pupils of both linguistic communities allows interactions not only from teacher to pupil but also among the children themselves).

An important aspect of immersion projects is that the target language is not taught as a separate subject but it is assumed through contents of school disciplines. There are no hierarchies between language and content and both are central for the teaching. However, the emphasis is often given to the content, using the language mainly as transmission channel. In that sense, some authors insist on the difference between "foreign language instruction" identified in most schools around the world and "instruction in a foreign language" specific to the immersion context (cf. Steffen, 2013).

3. FiBi: a project concerning a bilingual section

In 2010, the city of Biel/Bienne launched the FiBi with two kindergarten classes (about 40 children 4-5 years-old) applying the model of two-way immersion. Le Pape Racine and colleagues (2010) explained that the classes will be set up with 50% of pupils with German as main language and by 50% of pupils with French as a main language. With the expression "main language" the authors mean the language in which the parents would have enrolled their kids if the FiBi project did not exist. Of course, according to the statistics of the city, approximately one third of those pupils also speak another language at home. The school discipline should also be taught half in French and half in German using the idea of "one person – one language" (1P/1L). In 2014, the project was evaluated and it was decided to continue the project until 6th grade (12 years-old) opening two new classes every year. In 2017, this project has more than 300 pupils aged 4 to 8 years-old.

4. Aim of the study

This article aims to verify the proficiency in the target language and the impact on mathematics results of the FiBi-pupils. Therefore, we hypothesize that the FiBi project has a significant impact on the L2 proficiency in general, and on the four communicative competences described by the Council of Europe (2001). In our view, having an important subject such as mathematics taught in another language does not significantly affect the assessment of the results.

4.1. Methodology

As the oral productive skills of FiBi-pupils aged 4 to 7 years-old were already tested (Buser, 2004), the main goal here was to test the general communicative competences of pupils aged 10 to 12 years old, including receptive and productive skills, in a written as well as in a spoken form. Although literature shows that bilingual education has no negative impact on non-linguistic disciplines, some fears remain and sceptical people sometimes may think that having a school subject taught in another language will strongly hinder the understanding of its content and hereby negatively affect the results in this discipline. To date, little is known about the true effect of two-way immersion on mathematics, especially in the specific context of Biel/Bienne. Consequently, we chose to emphasize the result in L2-Proficiency and in mathematics for the 8 to 12 year old pupils, a population that had not been tested yet. The four communicative competences described by the Council of Europe (2001) should enable us to get an overview of the L2-Proficiency of FiBi-pupils compared to students of similar ages from regular classes. The discipline of mathematics was chosen for various reasons: 1) it is an important discipline in terms of educational policies for example for a qualification at the end of 6th grade; 2) after comparison of the Swiss-French and Swiss-German educational policies for mathematics, similar goals were noticed; 3) every class taking part in the study has the same number of lessons of mathematics per week (5) and 4) short working instructions minimises the

effect of the language on understanding and this is an advantage as we aim to test the mathematics-competences especially.

4.2. Participants

This paper presents a comparative explorative study based on tests of competences of 65 children and on their answer to a closed-ended questionnaire, providing information about gender, age, citizenship and linguistic profile. All FiBi-pupils from 5th grade (n=41) were tested as well as 24 pupils from two regular classes of the same area and with similar composition (regarding socio-economic status and citizenship). The study sample (n=65) is summarised in Table 1.

Table 1. Overview of sample

Characteristic	FiBi	Regular classes	Total
Gender			
Masculine	16	17	33
Feminine	25	7	32
Total	41	24	65
Average age	10.59	10.88	10.735
Citizenship			
Swiss	15 (37%)	8 (33%)	23 (35%)
Swiss + other	10 (24%)	7 (29%)	17 (26%)
Other citizenship	16 (39%)	9 (38%)	25 (39%)
Total	41	24	65
Linguistic profiles			
Monolingual German-speaking	7 (17%)	7 (29%)	14 (22%)
Monolingual French-speaking	6 (15%)	9 (38%)	15 (23%)
Plurilingual German-speaking	4 (10%)	4 (16%)	8 (12%)
Plurilingual French-speaking	10 (24%)	3 (13%)	13 (20%)
Bilingual French-German	14 (34%)	1 (4%)	15 (23%)
Total	41	24	65
Languages spoken in all four classes	French, German, Spanish, Albanian, Turkish, Arabic, Italian, Croatian, Serbian, Bosnian, Portuguese, Tamil, Brazilian Portuguese, Vietnamese.		

Inclusion in the different linguistic profiles was determined depending on the answer to the four following items:

- 4.1. What language do you most often speak at home?
- 4.2. What language do you most often speak in your free time?
- 4.3. What language do you most often speak with your friends?
- 4.4. What language do you most often speak at school?
- 4.5. In what language do you feel most comfortable in general?

Concerning the language and mathematics tests, the study has considered the following elements: language tests were adapted and translated from Lenz and Studer (2014). Their large collection of language tests based on the Common European Framework of Reference for languages (CEFR) provides opportunity to evaluate the L2-Proficiency of young people according to the level A1 to C2 described by the Council of Europe (2001). The tests were established with the cooperation of more than 200 teachers and pretested in various contexts. The mathematics tests are based on tests developed by Humboldt-Universität Berlin (2013) aiming to evaluate the national level of 5th grade students in mathematics. After the comparison of the pedagogical objectives, some other exercises from the current official Swiss mathematics tools were chosen to complete the preparation of tests. Those were pretested twice on children of similar age in another region of Switzerland.

4.3. Analysis

The key variables for this study were the results in the mathematics test and in the language test. In order to use the variable "L2-Proficiency" we calculated the mean value of the four language tests (written comprehension, oral comprehension, written expression, oral expression). We then compared the results of the two groups (FiBi and standard classes) using Student *t*-Test. For the second question, we used again a Student *t*-Test to compare the results of the test in mathematics of the two groups. Then, we mixed the pupils of both groups and reorganized them into the already mentioned five linguistic profiles. We finally compared the results in mathematics and language tests of those groups using ANOVAs.

One limitation of this study is the small number of participants in the regular classes. In order to have a more representative sample, we would have needed more people chosen randomly in the 5th grades of the entire city. However, the two classes taking part in this study had similar characteristics as the FiBi population regarding the socio-economic status and the number of immigrants in the class. An additional limitation is the total of 65 children, which should be increased for this research in order to have a larger sample and allowing more stringent statistical results. However, the 41 participants of the FiBi-group are representative for this study as there were not any more children of that age involved in the project.

Thus, this data allows us to show a first examination of L2-Proficiency and mathematic competences resulting of the two-way immersion in Biel/Bienne, which will be expand in a further research.

5. Results

5.1. Differences in L2-Proficiency between FiBi and regular classes

The Student *t*-Test shows significant differences between the two groups in each communicative competence. The greatest difference is visible in the oral expression (3.50), then written expression (3.14), followed by written comprehension (0.97) and lastly oral comprehension (0.97). The value of *p* indicates very highly significant differences for all four comparisons.

Table 2. Results of the two groups in the four communicative competences out of a maximum of 7 points.

Competence	Result	Class	N	Mean	Difference	Sig. (<i>p</i>)
Comprehension	Written	Standard	24	2.08	0.97***	<i>p</i> <.001
		FiBi	41	3.05		
	Oral	Standard	24	1.83	0.90***	<i>p</i> <.001
		FiBi	41	2.73		
Expression	Written	Standard	24	1.42	3.14***	<i>p</i> <.001
		FiBi	41	4.56		
	Oral	Standard	24	2.33	3.50***	<i>p</i> <.001
		FiBi	41	5.83		

* significant difference (*p*<0.05) ** highly significant difference (*p*<0.01) *** very highly significant difference (*p*<0.001)

5.2. Differences in mathematics between FiBi and regular classes

The results in the mathematic tests of both groups are not significant, as the value of *p* in the Student *t*-Test is higher than 0.05. The maximal number of points for this test was 54 thus the difference between the two groups is small. This result also reveals a slightly better result for the FiBi-group, which will not be further analysed because of the non-significant differences obtained.

Table 3. Results of the two groups in the mathematic test out of a maximum of 54 points.

Result	Class	N	Mean	Difference	Sig. (<i>p</i>)
Mathematics	Standard	24	25.10	2.41	.35
	FiBi	41	27.51		

5.3. Differences between the different linguistic profiles

As for the mathematic tests, no significant differences emerged of the ANOVAs used to compare the results of the five different linguistic profiles. However, the means shows that some groups had in general better results. For example in mathematics, the groups Monolingual German-speaking, Plurilingual German-speaking and Bilingual French-German obtained results higher than 26 points whereas the groups Monolingual French-speaking and Plurilingual French-speaking had less than 25. In L2-Proficiency, the same group (Monolingual French-speaking) had a lower result and two of the three groups with the best results in mathematics had more than 3.4 points out of a maximum of 7.

Table 4. Results in mathematics and L2 of pupils of different linguistic profiles.

	N	Mathematics (max = 54)			L2 (max = 7)		
		Mean	Minimum	Maximum	Mean	Minimum	Maximum
Monolingual German-speaking	14	30.50	13.50	45.00	3.02	.75	5.25
Monolingual French-speaking	15	24.13	8.50	43.00	2.38	.75	4.75
Plurilingual German-speaking	8	27.69	16.50	39.50	3.47	2.00	5.25
Plurilingual French-speaking	13	24.58	10.00	38.50	3.37	.75	5.00
Bilingual French-German	15	26.70	13.00	40.50	4.15	2.50	6.00
Total	65	26.62	8.50	45.00	3.26	.75	6.00
Sig. (Value of <i>p</i>)		<i>p</i> = .34			<i>p</i> = .28		

6. Discussion and conclusion

The efficiency of the two-way immersion project to learn the L2 has been significantly confirmed through the findings of this research. The productive competences (writing and speaking) seem to have been the most enhanced skills as well as the receptive competences (reading and listening). The quite

similar results of both groups in mathematics test supports the hypothesis that learning a school-subject in immersion does not affect its comprehension and the acquisition of competences in that discipline. In this case, the FiBi-pupils even show slightly higher results, possibly indicating that immersion positively affects the learning of school subjects as the pupils have to translate, reflect and interact with the contents. This is in line with other studies (Coste, 2000 or Cavalli; 2005) although the results in both tests between the different linguistic profiles did not show any significant results. Thus, this finding should be interpreted with caution. The monolingual French-speaking group had lower results in mathematics as well as in L2 and this can lead us to different questions. For example, the additional difficulty for this group in learning a L2 may be the diglossia observable in Switzerland, which means the presence of the German language for formal situations and the presence of the very different dialect of Swiss-German for informal situations, largely used in non-official school situations. This represents an interesting topic that should be analysed in further research.

Implications for teachers, researchers and policy makers may be inferred out of these results. First, as many other recent works on bilingual schools, the outcome of this research encourages policy makers to start new immersion projects according to the local conditions. Already existing projects should be supported as an efficient tool for L2-Proficiency, one major goal of education in Switzerland. Bilingual education does not seem to have negative collateral effects on the learning of other school subjects, but this question should be researched in many more aspects in order to ensure a wider view of the linked questions. Finally, this paper is pointing the way to further research about bilingual education and a larger study following the same methodology and the same question has already been launched in order to collect more data in the specific context of Biel/Bienne. A qualitative analysis of the written and oral productions will give the opportunity to observe what succeeds by subjects with interesting linguistic profiles. There still are many challenges linked to immersion and bilingual education. and the FiBi-school is an on-going project. Results from further research will help consider new aspects before adapting existing projects or even opening new two-way immersion projects, as certain regions of Switzerland start thinking about following the example of Biel/Bienne. They finally should help policy-makers, researchers, teachers and parents to work together on the next French-German two-way Immersion project at secondary school level in Biel/Bienne.

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