



Content and Language Integrated Learning for Recently Immigrated Students Benefits of a Short-Term Intervention for Content and Language Skills

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Abstract

Previous research on education for recently immigrated students focused on the suitability of content learning in terms of interest, motivation, and possible advantages for the transition into the mainstream classroom. However, it is yet unclear to what extent students with limited language competencies actually learn “something” from early content instructions in their preparation classes. This study investigates student’s language and content knowledge in a pre-post design. The intervention group (n=15) participated in project days about the animal kingdom, whereas the control group only received traditional language learning (n=12). Due to the ongoing COVID-19 pandemic, only preliminary results could be collected, however, they indicate advantages in terms of subject specific vocabulary and content knowledge in favour of the intervention group.

Key words: Biology education; CLIL; knowledge; recently immigrated students

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1. Introduction

The majority of factors that lead to environmental degradation are caused by humans. Environmental education has thus gained “significant recognition” in recent years (Koutsoukos, Fragoulis & Valkanos, 2015, p. 23). Environmental education means raising awareness, as well as encouraging the adoption of environmentally friendly behavior (International Union for the Conservation of Nature, IUCN, 2003). As an outcome of the world’s first intergovernmental conference on environmental education in 1977, the Tbilisi Declaration marked the beginning of environmental education (Parker & Prabawa-Sear, 2020) and lists the goals of environmental education as the following

Around Europe schools face the challenge to integrate immigrated students into the national school system, particularly in the last few years as there has been a high influx of refugees (BMBF 2018). Legal obligations are provided by the UN and EU (UN – Convention on the Rights of the Child 1989, EU 2013), however, specific implementations vary between countries and even within the same country. In Germany, numerous schools establish additional classes, often called “preparation” or “international” classes, to create a safe environment for language acquisition before students enter regular classes (Massumi et al., 2013). The core pedagogical concept varies in two main aspects (Ahrenholz, Fuchs & Birnbaum, 2016):

- (1) The ratio of separation into the “preparation classes” and integration into the “regular classes”.
- (2) The ratio of “just” language learning and integrating content-learning in the “preparation classes”.

Different methods of separating immigrated students have a long “tradition” in German education (e.g. Emmerich et al., 2017, Karakayali et al., 2017). Studies have critically discussed both positive and negative effects of the integration/transition process (e.g. Nilsson & Axelsson, 2013; Blumberg & Niederhaus, 2017; Havkic et al., 2018; Authors 2018 and 2019).

However, few studies look at content-learning in “preparation classes” to combine the language and content learning processes (Birnbaum, Erichsen, Fuchs & Ahrenholz 2018, p. 234). Language-sensitive teaching concepts and bilingual education have been shown to be suitable for recently immigrated students (Schmiedebach 2019). Theoretical and practical experiences within *content and language integrated learning* (CLIL) could foster content knowledge in “preparation classes” (Sudhoff 2011). Cornely, Harboe and Mainzer-Murrenhoff (2016) assume that erudite and technical language competencies can be acquired in parallel to everyday language and argue that content learning should start early on. Furthermore, Krüger (2018) showed that domain specific vocabulary and listening comprehension can be significantly improved in language-enriched PE lessons for refugee students. However, it is often challenging for schools to ensure content-learning in “preparation classes” for an entire school year. “German as a Foreign Language” teachers are not used to teaching other subjects such as science or social studies (Karakayali & zur Nieden 2018, p. 296). Regular teachers are also unavailable because they are either needed for regular classes or do not feel prepared to teach students with limited German proficiency as there is often a lack of teaching material (Becker-Mrotzek et al., 2012; Morris-Lange et al., 2016).

This study presents a project about the animal kingdom for local schools to integrate content learning in “preparation classes”. To close the current gap and tackle existing doubts about content learning in “preparation classes”, we investigated changes in content and language knowledge by providing a short-term intervention for two “preparation classes”.

2. Combing Content and Language Learning

The study presented is part of the project [name of the project] and focuses on the suitability of short-term modules for recently immigrated students in “preparation classes”. Schools often hesitate to establish weekly content learning in these classes, especially within certain subjects.

Besides German, it is common to teach math and English, but social studies and science subjects are often left out. Previously, the project [name of the project] offered weekly science education at three partner schools by providing a teacher and necessary teaching materials. Since this is not intrusive, project days for schools were developed to reach students without massive organizational changes in school.

2.1 Conceptual framework of [name of the project]

The project [name of the project] has been positively evaluated by students in weekly science classes (Author 2019) and consists of four main aspects (cf. figure 1):

(1) The lessons should combine language and content learning.

CLIL (*content and language integrated learning*) is well-established for bilingual education throughout Europe and can be adapted to a second language setting (Sudhoff 2011). Many studies focus on bilingual education, by teaching a subject in a foreign language (e.g. geography in English in a German school). Although researchers have compared CLIL and non-CLIL students in terms of language competency, knowledge, motivation and interest (see Ohlberger & Wegner 2018 for a systematical review about CLIL studies), it is of great interest to investigate if CLIL students experience the same knowledge growth as their non-CLIL peers. Most studies have shown that CLIL students achieve higher language competency in vocabulary, speaking, language production, listening and reading comprehension (e.g. Navarro Pablo & Garcia Jimenez 2018, Madrid & Barrios 2018). They also do not suffer from a loss in content knowledge, which emphasizes the suitability of CLIL courses since these students mostly benefit from these courses (e.g. Bonnet 2004, Kondring & Ewig 2005, Gonzalez Gandara 2015). It is assumed that we could observe similar beneficial effects in using CLIL with recently immigrated students.

(2) Methods supporting language sensitive teaching should be used to ease understanding and build new linguistic structures.

Language-sensitive methods, such as scaffolding (Gibbons 2002), offer necessary helpful structures. Students should work in the *Zone of Proximal Development*: Provided tasks should be challenging but manageable, as the combination of high demand and support results in positive effects on motivation and learning (Vygotsky, 1978; Mariani, 1997; Pineke-Fischer 2017, p. 84).

(3) Module topics should reflect the national curriculum in biology, chemistry and/or physics.

Students in “preparation classes” will eventually transfer into regular classes. Therefore, it is important to provide them with substantial background knowledge to prepare them for the regular classes they must attend to obtain a diploma. The sciences have a spiral curriculum and topics recur (e.g. cell biology in grade 6 focus on a basic level differing between animal and plant cells, whereas, in higher grades different structures or processes within the cells are addressed). Hence, it helps the students once they are placed in the regular class (Authors 2019).

(4) Lessons should follow an action-oriented approach by integrating experiments, observation, and other hands-on activities.

In an action-orientation setting, students actively take part by conducting experiments to follow the stages of inquiry-based learning (e.g. Gropengießer, Kattmann & Krüger, 2010, p. 74; Brandt 2005, p. 31; Pedaste et al. 2015). Action-oriented lessons have been shown to ease the learning process (Adamina & Möller, 2013), motivate students (Wagener, 1992) and increase interest (Greinstetter, 2008). Furthermore, the use of living animals is often encouraged since it evokes positive emotions such as interest and motivation and diminishes negative ones such as fear or disinterest (Hummel & Randler, 2010). Therefore, our intervention focuses on different animal kingdoms by integrating live animals during teaching.

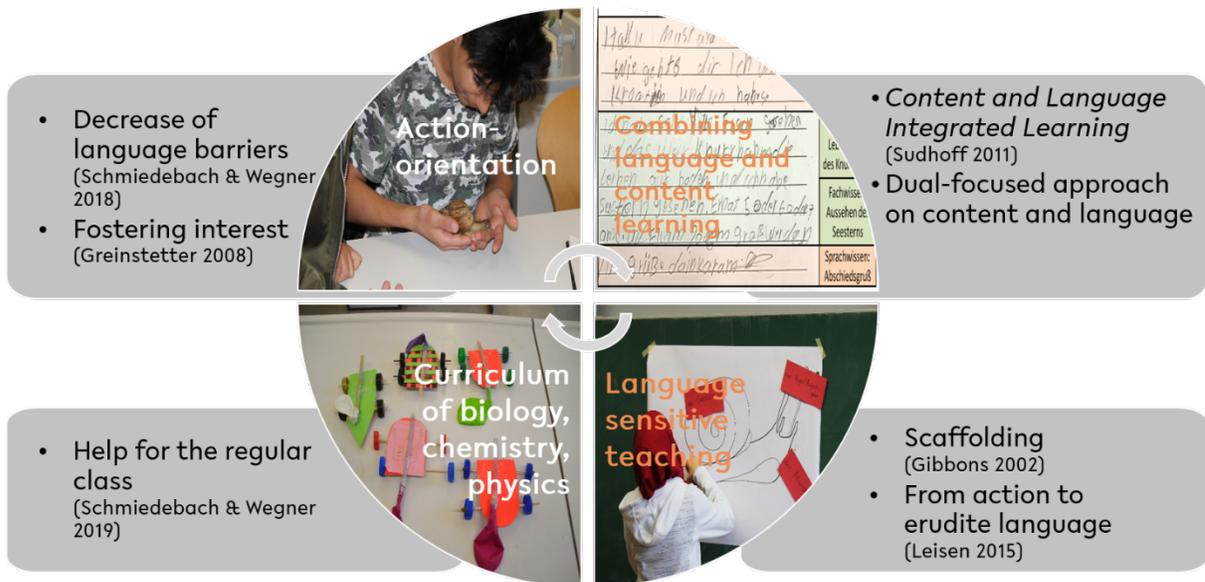


Figure 1. The concept of “Biology for Everyone”.

2.2 “A journey through the animal kingdom”

The intervention “A journey through the animal kingdom” was established as a three-day project for “preparation classes” in [name of the city], Germany. Schools can apply to participate in the project, and this will not interfere with the organization of the “preparation class”. In the first two days, one of the authors and a student assistant run a workshop for 4 hours each day. On the third day, the classes come to the university for 5 hours. Throughout the project, students observe live animals and perform experiments (see Table 1).

Table 1. Schedule for the project “A journey through the animal kingdom”.

Day 1	
<ul style="list-style-type: none"> • Pre-test (interest, content and language knowledge) • Activating previous knowledge • Grouping the animal kingdom • Rules for working with live animals • Insects I: <ul style="list-style-type: none"> ○ phenotypical characteristics ○ visual sense 	 <p>Figure 2: Ghost insect on a student’s hand.</p>
Day 2	
<ul style="list-style-type: none"> • Repetition • Insects II: <ul style="list-style-type: none"> ○ developmental cycle • Gastropods: <ul style="list-style-type: none"> ○ phenotypical characteristics ○ locomotion ○ ingestion ○ senses 	 <p>Figure 3: Giant African snail on a student’s hand.</p>

Day 3	
<ul style="list-style-type: none">• Repetition• Scavenger hunt in the university animal caretaking facilities• Comparing reptiles, fish and amphibians:<ul style="list-style-type: none">○ body-temperature○ developmental cycle○ locomotion• Post-test (interest, content and language knowledge)	 <p>Figure 4: A student feeding a chameleon.</p>

3. Methods

3.1 Test instrument

The questionnaire consists of demographical data (age, gender, native language, and duration of German acquisition) followed by of three sections:

- “My opinion about biology” - five items rated on a six-point Likert-scale (from completely disagree (1) to completely agree (6)) about scientific interest, retrieved from Wegner (2008).
- “My knowledge about animals” - 12 multiple-choice questions about the characteristics of insects, snails, reptiles, amphibians and fish.
- “Fill-in-the-blank text” - three different C-Tests², in which two tests are language-based from levels A2 and B1 (“fear of the new school” and “the book bus”, retrieved from Baur & Spettmann [n.d.]) and the third focuses on technical terms such as a “compound eye” or “reptiles” (“A journey through the animal kingdom”).

Each part of the questionnaire was explained on each respective day to ensure that students began at the same time and had enough time. Although the questionnaire was in German, students were allowed to use dictionaries and ask for linguistic help.

3.2 Research question and hypothesis

The study of this paper is a follow-up investigation (Authors 2020) to explore if science education for recently immigrated students influences content knowledge and language competency. Previous research focused on affective constructs such as interest, boredom or language-use anxiety, however, it is debatable if the intervention was a fun activity or if students improved their knowledge. The following research questions and hypotheses are analyzed:

1) Do the students gain content knowledge throughout the project “A Journey through the Animal Kingdom”?

H1: Students participating in the project significantly increase their content knowledge after completing the project, whereas the control group experiences no change in knowledge test scores between both time measurements.

H2: There is no difference in knowledge test scores between the groups at the first measurement, however, post-test, the intervention group scores significantly higher than the control group.

2) Does interest in biology differ between the control and intervention group after the intervention “A Journey through the Animal Kingdom”?

² C-Tests are short, self-contained but “damaged” texts (Baur & Spettmann, 2008). The second half of every third word is removed (e.g. “te_” for text) and words with an uneven number of letters are removed by one more letter (e.g. “dama_” for damaged). C-Tests have been shown to be reliable and correlate with more extensive test instruments (Grotjahn, Klein-Braley & Ratz, 2002; Eckes & Grotjahn, 2006; Grotjahn, 2020).

H3: The intervention has a positive effect on interest in biology, demonstrating that there is a significant increase of interest in the intervention group between the two measurements, with no difference for the control group.

H4: There is no difference in interest in biology between the groups at the first measurement, but the intervention group scores significantly higher post-test than the control group.

3) How does language competency develop throughout the project “A Journey through the Animal Kingdom”?

H5: Students participating in the project significantly increase their language competency regarding topic-specific vocabulary, as measured by C-Test number 3. Hence, the test score significantly increases for the intervention group, whereas there is no significant difference for the control group over time.

H6: Both the intervention and control groups do not increase their C-Test number 1 and 2 scores.

3.3 Sample and study design

A total number of $N = 27$ students (Control group: $n = 12$, 50% female, mean age: 14 years old; Intervention group: $n = 15$, 53% female, mean age: 14.53 years old) participated in the study³. Both groups consisted of recently immigrated students in “preparation classes” with various native languages (e.g. Arabic, Spanish, Bulgarian, Turkish, Albanian).

In a pre-post design, both groups filled-out the questionnaire (figure 2). The intervention group participated in three project days with the topic “A Journey through the Animal Kingdom”, whereas the control group continued their regular teaching schedule. The time between both measurements was 1.5 weeks.

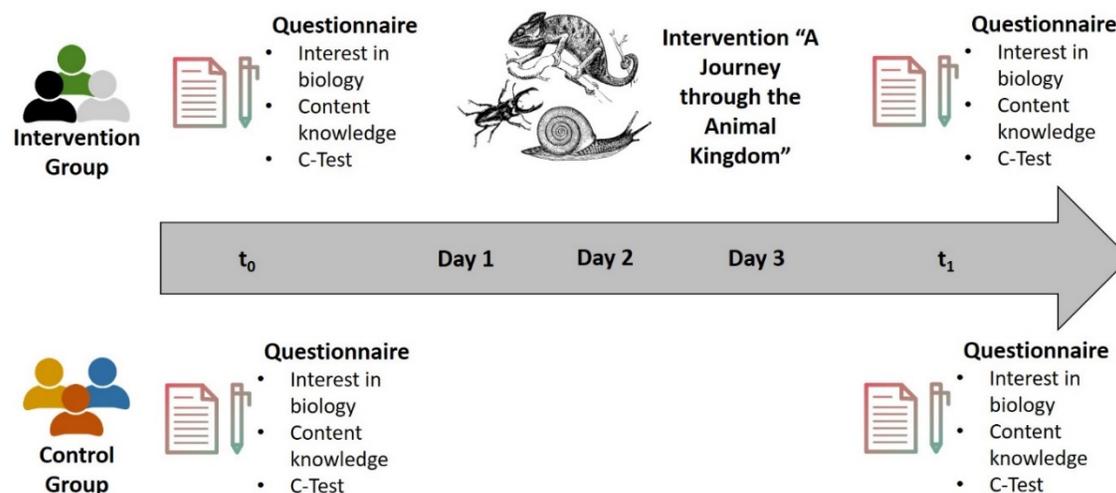


Figure 2. Study design.

3.4 Statistical analysis

Due to the small sample size, our data is not normally distributed and was assessed using the Shapiro-Wilk-Test to calculate differences between groups and time. Significance level was set at $p \leq .05$ and effect sizes were considered high if Cohen’s d was $|d| \geq 0.8$, medium if $0.5 \leq |d| < 0.8$ and small if $|d| \geq 0.2$. (SPSS ver. 24.0)

³ Due to the current COVID-19 pandemic, the study could not be completed with more participants. Schools are currently trying to minimize the number of external visitors. Since it is unclear when it is possible to start projects, the current study presents interim results.

4. Results

A Wilcoxon rank-sum test was calculated to determine differences in interest and knowledge test scores between both measurement points for the intervention and control groups (table 3). For an alpha level of .05, mean ranks in the intervention group between t_0 and t_1 were significantly different for both interest and knowledge test score (interest: $z = -2.147$, $p = .033$, $d = 1.58$; knowledge: $z = -3.074$, $p < .001$, $d = 3.85$). There was no difference in either construct in the control group (interest: $z = -1.980$, $p = .055$; knowledge: $z = -0.103$, $p = .959$).

Table 3. Comparison of intervention and control groups for interest and knowledge test scores.

	Interest		Knowledge Test		
	Intervention Group	Control Group	Intervention Group	Control Group	
Mean	t_0	4.17	5.42	7.00	7.73
	t_1	4.90	5.11	12.21	7.81
Z		-2.147	-1.980	-3.074	-0.103
Sig.		.033	.055	<.001	0.959
Effect size		1.58	1.488	3.85	0.062
N		12	11	12	11

A Mann-Whitney-U-Test was calculated to determine differences in interest and knowledge test scores between the intervention and control group. At t_0 , the control group had a significantly higher interest score ($U = 17.50$, $Z = -3.002$, $p = .003$), however there was no difference between groups at t_1 ($U = 60.50$, $Z = -0.342$, $p = .732$). Interest increased in the intervention group, whereas it decreased in the control group between both time points. There was no difference between groups at t_0 for knowledge test scores ($U=44.00$, $Z = -1.630$, $p = .103$), however, the intervention group had significantly higher scores after the intervention ($U=0.00$, $Z = -4.184$, $p < .001$).

Since C-Test number 1 and 2 measure general German language competencies, the sum of both test scores was calculated (maximum combined score is 40). The sum and C-Test number 3 score (language competency regarding topic-specific vocabulary, maximum score 20) were analyzed with a Wilcoxon rank sum test to determine differences in German language competencies between the two measurement points for both groups (table 4). For each C-Test, two scores were determined: the CF-score is the number of fully correct answers, whereas the WD-score is the number of correctly detected words, omitting spelling and grammar (e.g. “reptil” scores 0 points for the CF-score, however 1 point for the WD-score).

For an alpha level of .05, mean ranks in the intervention group between t_0 and t_1 were significantly different for both scores concerning topic-specific vocabulary language (CF: $z = -2.602$, $p = .005$; WD: $z = -2.316$, $p = 0.21$). However, there was no difference in general language C-Tests scores for both groups (CF: $z = -1.692$, $p = .097$; WD: $z = -1.487$, $p = .160$).

Table 4. Comparison of intervention and control group for general and topic-specific vocabulary language test scores.

	General language				Topic-specific vocabulary language				
	Intervention		Control		Intervention		Control		
	CF	WD	CF	WD	CF	WD	CF	WD	
Mean	t_0	20.83	28.08	17.5	25.25	10.25	12.25	8.83	10.33
	t_1	22.83	30.00	18.67	27.58	12.83	14.58	10.00	13.25
Z		-1.692	-1.487	-0.275	-0.668	-2.602	-2.316	-0.551	-1.730
Sig.		.097	.160	.803	.532	.005	.021	.613	.092
N		12		12		12		12	

A Mann-Whitney-U-Test was calculated to determine if there were differences in the different C-Test scores between intervention and control group. There is no significant difference between the groups at neither time point nor at neither C-Test with CF: $U = 62.00$, $Z = -0.872$, $p = .383$; WD: $U = 61.50$, $Z = -0.901$, $p = .368$ (General language t_0), CF: $U = 64.00$, $Z = -1.040$, $p = .298$; WD: $U = 79.00$, $Z = -0.259$, $p = .796$ (General language t_1), CF: $U = 71.50$, $Z = -0.355$, $p = .723$; WD: $U = 66.50$, $Z = -0.627$, $p = .531$ (topic-specific language t_0), and CF: $U = 64.00$, $Z = -1.038$, $p = .299$; WD: $U = 77.00$, $Z = -0.364$, $p = .716$ (topic-specific language t_1).

5. Discussion

The results are in line with most of our hypotheses. In the beginning, both groups achieved relatively low scores in the knowledge test since they either did not study the topic beforehand or have the content-specific language competency. The extent to which the short intervention might increase knowledge is unclear; the Wilcoxon rank sum test highlights that participating students had a significant increase in knowledge. However, it is hard to compare our results to previous CLIL-studies due to this study design. Common CLIL-studies compare students participating in a CLIL biology class with students in a native-language biology class learning the same content. In those cases, both groups achieve similar results concerning content learning (e.g. Bonnet, 2004; Mathelitsch & Hopf, 2011; Gonzalez Gandara, 2015). It is therefore necessary to stress that the aim of this study was to test whether students with limited German language proficiency learn some of the content, since it is debatable if content should be taught at such an early stage of language learning. However, our results indicate that content learning increases content knowledge and supports the suitability of science education for recently immigrated students (Schmiedebach 2019). Since the sample size is quite small, our results should be interpreted with caution. However, it is still evidence to start content learning with recently immigrated students early on. Since both groups scored similarly at t_0 , both groups seem suitable to compare their knowledge. However, it is important to keep in mind the underlying didactical concepts of the project. The lessons contain a lot of hand-on activities, which have been shown to ease the understanding of content (Adamina & Möller 2013). Future studies should investigate long-term effects of the intervention by testing knowledge after a longer time period in a follow-up test. Previous studies have shown that participating in a scientific module increases scientific interest (Authors 2020). The results of this study support previous findings, as an increase in biology interest was seen after the intervention. This can be explained by the methods and the topic, since handling living animals in the classroom has been shown to be positive (Klingenberg 2014). It is surprising that the control group had a high level of interest at the first time point, which decreased over time. This leads to a significant difference between both groups at the pre-test time point, which might be explained by different experiences with biology. The intervention evens the interest in biology in both groups, resulting in no difference at t_1 .

The third research question focused on language competency. The C-Test about general German skills with everyday language shows did not change over time. This is unsurprising since the intervention is short and did not specifically focus on everyday language. The students spoke German to each other in the same way they would in their regular lessons. Furthermore, there was no significant difference between groups, which shows us the suitability to compare both groups. However, the subject-specific language test results are of great interest. Not only did students in the intervention group score higher in the content knowledge test, they also significantly increased their subject-specific language skills. This combination highlights the possibilities of CLIL; students simultaneously increase both their content and language competency. This was not seen in the control group since they did not encounter specific words. When integrating recently immigrated students in the regular school system, it is important to strengthen their general language skills and train subject-specific vocabulary and text structures. Nilsson and

Axelsson (2013) state that recently immigrated students deal with subject-specific language issues once they transfer to the regular class if these topics were not covered before, such as writing lab reports and working with tables and figures.

6. Conclusion

Our results are limited when it comes to general statements about teaching content-learning to recently immigrated students. This is due to the small sample size of this interim report resulting from the ongoing COVID-19 pandemic which places restrictions on external researchers if they aim to conduct interventions in school. However, our results highlight the suitability of teaching science in preparation classes. Students benefit on multiple levels: they increase their interest in biology and content knowledge while strengthening topic-specific language skills. Future studies should focus on testing different topics to generate universal implications of using CLIL in recently immigrated students.

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