

EDUCATING RECENTLY IMMIGRATED STUDENTS: EXPLORING THE SUITABILITY OF SCIENTIFIC MODULES IN SECONDARY EDUCATION

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ABSTRACT

Background: Over the last few years there has been a surge in the number of recently immigrated students to Germany. Schools often educate these students in separate language learning classes to facilitate integration, as immediate integration can be perceived as frustrating, boring and associated with language-use anxiety.

Purpose: Using short-term science modules as an intervention method can possibly circumvent several negative emotions such as frustration, boredom, and language-use anxiety, as well as encourage scientific interest.

Sample/setting: Students enrolled in nine preparation classes at seven different secondary schools in Germany (N=137, mean age = 13.9 years) participated in a module lasting three to four days.

Design and methods: To provide a range of topics, three modules in zoology, botany and electricity were offered. Each module could be chosen by each participating school and taught using the content and language learning (CLIL) concept combined with an action-oriented approach. A pre-post-design surveyed student perspectives with questionnaires before and after the module.

Results: After the module, we observed a significant decrease in boredom and language-use anxiety in the regular class, and a comparable trend was seen in frustration and perceived language barriers. However, we saw a significant increase in scientific interest.

Conclusions/Implications for classroom practice and future research: Content learning should be used in language preparation classes to ease the integration process for recently immigrated students. In particular, modules provide the opportunity for students to experience both the subject-specific content and language level necessary to participate in regular classes. These modules are easy to implement, as schools do not have to reorganize their preparation classes. Future research should examine differences in language level and knowledge gain, as well as add positive constructs such as “joy” to better grasp how international student perceive their regular classes.

Keywords: recently immigrated students, science education, modules

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1 INTRODUCTION

In Europe, the number of recently immigrated students has increased tremendously during the past few years [1]. These students have the right to education and must be integrated into the school system [2], [3]. This presents a challenge as they often do not speak the official language of their new residence. In Germany, numerous schools establish additional classes (often called the “preparation class”, “international class” or “welcome class”) to foster language acquisition before integration into the regular school system [4]. Various models exist, differing in the amount of subjects taught and the organization of the

integration process [5]. First, many schools argue that language acquisition should dominate, and suggest that only the German language should be taught in these classes. However, schools may decide to integrate alternative subject content, although there is no mandatory curriculum to teach different subjects in preparation classes. Second, schools either separate the students until they reach a certain level of German and then begin integration, or, they gradually increase the amount of hours spent in regular classes (e.g. starting with two hours of sports, then slowly adding more subjects when the student improves their German).



Research has shown that immediate integration can leave a negative impact on immigrated students (see e.g. [6], [7], [8]). One pilot-study demonstrated that in comparison to their preparation class, students experience frustration, boredom, and language-use anxiety in regular classes [9]. These emotions can severely hinder language acquisition [10] and therefore, the integration process. The following study aims to teach science using a short-term intervention in preparation classes to simultaneously promote both content and language learning, which is valuable and necessary for integration.




2 THE PROJECT „BIOLOGY FOR EVERYONE“

“Biology for Everyone” was initiated in August 2016 at two partner schools in Bielefeld, Germany. Both schools have science preparation classes for recently immigrated students, which help to test topic suitability, teaching material and methods [6]. This study looks at implementing three short-term modules into preparation

classes with different topics that are covered in the school curriculum (zoology with a focus on invertebrates, botany with a focus of germination and electricity). Each module was designed to last between three to four days, although the module can be completed in a week or spread across several weeks.

The project is based on the CLIL-concept (*content and language integrated learning*) and has a dual-focused approach on content and language learning [11]. To ease content learning, lessons follow an action-oriented approach [12] using numerous hands-on activities such as working with animals or conducting experiments. Hand-on activities and experimenting have been shown to ease the learning process (see e.g. [18], [19]), increase interest [20], and have a positive influence on motivation [21], motoric and social competency [21], [22]. During the module, common grammatical structures and subject-specific texts are explicitly covered, supplemented with methods such as scaffolding and the transition from action to erudite language [14], [15] (see Tab. 1). This approach particularly helps students that face language barriers in school, as it improves their language skills and increases their knowledge and understanding of the topic [13].

Tab. 1. Description and depiction of three modules with subsequent content and language aspects. The authors developed all of the modules.

	Module	Content	Language
Zoology	 <p>Fig. 1. A student observes a giant African snail.</p>	<ul style="list-style-type: none"> • Morphology of insects, snails and spiders • Different senses (e.g. compound eyes of insects, smelling sense of snails) • The snails' radula • Spider webs 	<ul style="list-style-type: none"> • Descriptions of different animals • Writing a lab protocol • Subject-specific words (e.g. compound eye, radula)
Botany [16]	 <p>Fig. 2. Different germination factors such as light and water are examined.</p>	<ul style="list-style-type: none"> • Structures and function of seeds and blossoms • Germination process • Pollination 	<ul style="list-style-type: none"> • Writing a lab protocol • Presenting results in a “research conference” • Subject-specific words (e.g. carpel, stamen)
Electricity [17]	 <p>Fig. 3. Materials provided in “Experimenting boxes” to perform conductivity experiments.</p>	<ul style="list-style-type: none"> • Conductivity of different materials • Different electrical circuits (e.g. parallel and series circuit) • Switch mechanics • Truth-tables • Electric symbols • Building a small robot 	<ul style="list-style-type: none"> • Description of experimental set-ups • Reading comprehension • Article about the module for the school newspaper • Subject-specific words (e.g. conductor, positive and negative pole)

3 THEORETICAL BACKGROUND

3.1 Language-use Anxiety

According to Oxford [23], language-use anxiety is an influential emotional factor in language acquisition and is defined as “the worry and negative emotional reaction aroused when learning or using a second language” [24]. Therefore, it is unsurprising that language-use anxiety is heavily researched in parallel [25] and associated with negatively affecting language acquisition and learning outcomes ([10], [26], [27]). On the contrary, positive emotions also have the potential to foster language acquisition [28].

Many students that are confronted with language-use anxiety in regular classes feel incapable of adequately expressing themselves and prefer to remain quiet [7], [29]. However, they seem to experience lower language-use anxiety in preparation classes [9]. One explanation may be that the teachers and students are aware that all of the students are in the language acquisition process together [30].

3.2 Boredom

Although interviews have shown that recently immigrated students are motivated to graduate, they still face challenges with boredom in their regular classes [31]. Boredom is defined as an aimless activity [32] which can include drawing pictures instead of getting enough help to cope with the content. Fast speech rate and technical terms prevent understanding and can lead to boredom if students are frustrated and cannot keep up [6]. Boredom has a deactivating effect and can impede the learning process [33].

3.3 Frustration

Recently immigrated students in preparation classes are relatively heterogeneous in regard to age, native language, cognitive ability and educational background. For students with decent prior schooling and positive academic self-concept, regular classes might be frustrating. These students are confident in their cognitive ability and might already have the knowledge; however language deficits and/or language-use anxiety may prevent them from achieving their full potential. Frustration can occur when positive expectations are not met or performance is sanctioned [34].

4 METHODS

4.1 Research questions and hypothesis

This study investigates the effects of short-term science modules for recently immigrated students, their perspective of regular classes and their general interest in

science. Since content from the modules is part of the national science curriculum, students will experience long-term benefits. Furthermore, although subject-specific language is used, the language skills acquired are not only applicable to the specific topic but are helpful in all branches of science.

1) *How does the perception of regular classes change after the module?*

H1: Frustration decreases in regular classes from the beginning to the end of the module.

H2: Boredom decreases in regular classes from the beginning to the end of the module.

H3: Language-use anxiety decreases in regular classes from the beginning to the end of the module.

H4: Perceived language barriers decrease in regular classes from the beginning to the end of the module.

2) *How is an interest in science influenced by the module?*

H5: Scientific interest increases from the beginning to the end of the module.

4.2 Sample and design

Local secondary schools in the area of Bielefeld received a pamphlet of modules included in the project. Teachers responsible for preparation classes could choose to take part in the project and schedule a 12-hour module, which could be split between three or four days. Sample randomization could not be enforced, as each school decided if they wanted to participate and their preferred module.

A total number of 137 students in seven different schools¹ participated (mean age = 13.9 years, 36.5% female, 58.4% male, 5.1% not specified). The most popular module chosen by teachers was zoology (n=85) followed by electricity (n=28) and botany (n=24). Students were divided into four groups based on the amount of time they spent previously learning German, which was often answered with a time span (e.g. 7-9 months), separated by six month intervals² (see tab. 2). 15 different native languages were spoken, with a majority of Kurdish (34.3%) and Arabic (16.1%), which is in accordance with the latest influx of asylum requests.

Tab. 2. Participant distribution based on the amount of time they previously spent learning German.

Timespan of German acquisition	n
≥6 months	12
>6 > x ≥ 12 months	34
>12 > x ≥ 18 months	18
>19 months	65
Not specified	8

In a pre-post-design, one survey was conducted before and another after the module was completed. Students who finished both questionnaires were included in the

¹ The schools consist of three “Gymnasiums” (highest level of high school, where passing the final exam allows the student to later attend university), one “Gesamtschule” (similar to an US-American high school, covering all different learning levels) and three “Realschule” (intermediate level of high school).

² It is important to note that the timespan of language learning is not equivalent to language competency; it displays a variation in language skill from A1 to B2.

analysis. The first research question was only answered by students currently enrolled in at least one regular class ($n=91$, $n=46$ not specified³).

4.3 Test instrument

The questionnaire consists of 46 items, in which 23 items are discussed in this article. Each item is ranked on a 6-point Likert-scale (from completely disagree (1) to completely agree (6)) and discusses the relevance of content and language integrated learning and the perspective of the preparation class. Each section begins with an introduction asking the students to describe their perspective (e.g. “Read the following sentences and think about your regular class”). The items are split into the following scales: “interest in science” (module-dependent with either biology or physics), “frustration”, “boredom”,

“language-use anxiety” and “language barriers” (see tab. 3). The last two constructs differ by contrasting competence between the native and foreign language (e.g. knowing terms in the native language but not in German which creates the feeling of a “language barrier”) and exploring associated emotions when using the foreign language (e.g. being scared to speak German). Factor analysis still have to be carried out in depth but first results hint that the items measure two different constructs.

Tab. 3. Description of questionnaire constructs including two example items, the total number of items and Cronbach’s α at both time measurements.

Construct		Example items	Number of items	Cronbach’s α (t_0)	N	Cronbach’s α (t_1)	N
Interest in science (biology/physics)	Adapted from [34]	I like to talk about biology/physics.	5	.849	106	.865	110
		Biology/Physics is fascinating.					
Frustration	Adapted from [34]	I understand so little in my regular class that it makes me sad.	5	.641	64	.665	87
		The regular class is way too hard for me.					
Boredom	Adapted from [34]	I am often somewhere else with my thoughts.	4	.658	65	.770	92
		The class often feels like it never ends.					
Language-use anxiety	Retrieved from [35]	I think the other students are laughing at me when I speak German.	5	.641	65	.751	89
		I feel uncomfortable when my teacher asks me a question.					
Language barriers	Based on qualitative results [6], [7], [36]	I cannot properly participate in class because I don’t know the words in German.	4	.740	70	.646	93
		I know plenty but I cannot show it in German.					

4.4 Statistical analysis

To compare pre- and post-test differences, means and their 95% confidence intervals (CI) were calculated for all three modules combined⁴, along with a set of effect sizes which 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)

Data from all three modules were combined to focus on the general suitability of using CLIL-based modules for recently immigrated students. However, future studies with bigger sample sizes should also investigate possible differences between the modules. Furthermore, recently

immigrated students get allocated to a secondary school not according to their cognitive abilities but to availability [5]. Therefore, we did not differ between different school types since the preparation classes do not follow the selection procedure as the regular German students.

5 RESULTS

In addition to confirming previous results investigating emotion [9], we sought to examine how the modules impact the perspective of regular classes. We observed a significant decrease in frustration (mean difference = 0.33, 95% CI: [0.092; 0.568]) and language

³ This number consists of students not enrolled in a regular class (e.g. due to insufficient language competency) or did not specify which regular class they were enrolled in.

⁴ Significance tests are not calculated since this “quasi-experimental” study design is not suitable for conventional

statistical inference. As recommended by [45] and [46], confidence intervals are reported instead.

barriers (mean difference = 0.34, 95% CI: [0.067; 0.625]) after the module, and a similar but not significant trend was seen in boredom and language-use anxiety (cf. tab. 4

and fig. 4). Furthermore, there was a significant increase in scientific interest after the module (mean difference = -0.41, 95% CI: [-0.650; -0.176]).

Tab. 4. Comparison of frustration, boredom, language-use anxiety, language barriers and scientific interest in the regular class before and after the module by calculating mean differences and 95% confidence intervals.

Construct	N	Mean	SD	Mean differences	Effect size d_{Cohen}	95% Confidence interval (CI) of mean differences
Frustration	t ₀	69	3.16	1.09	0.33	[-0.301
	t ₁	69	2.83	1.10		
Boredom	t ₀	69	3.01	1.27	0.29	[-0.109; 0.698]
	t ₁	69	2.72	1.29		
Language-use anxiety	t ₀	69	3.01	1.16	0.18	[-0.095; 0.449]
	t ₁	69	2.83	1.18		
Language barriers	t ₀	67	3.49	1.29	0.34	[0.067; 0.625]
	t ₁	67	3.15	1.15		
Scientific Interest	t ₀	105	4.51	1.28	-0.41	[0.346
	t ₁	105	4.92	1.08		

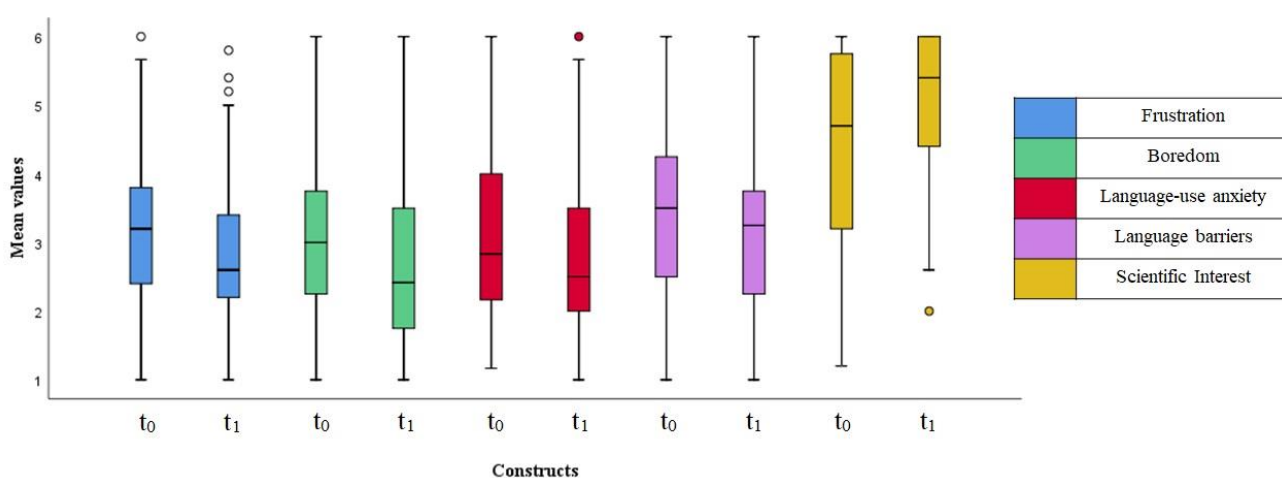


Fig. 4. Boxplot showing the construct means and standard deviations from pre (t₀) and post (t₁) measurements. Different constructs are displayed by different colors as depicted in the legend.

6 DISCUSSION AND CONCLUSION

Short-term science modules for recently immigrated students positively impact their perspective of regular classes and their general interest in science. We saw a significant decrease in perceived frustration after the module. Since a lack sufficient language skills may lead to frustration and hinder integration, providing them with our modules may have allowed them to participate in content learning without being fluent in German [9], [29], [38]. With this positive experience, regular classes do not seem to be as frustrating. Additionally, since lasting frustration increases the risk of aggression, it is of great interest to decrease frustration in an educational context [39], [40].

Perceived language barriers reflect cognitive and linguistic differences among students [6], [7], [8]. Students in the preparation class often complain that a lack of subject-specific vocabulary knowledge prevents them from succeeding in regular classes [29]. After our module was completed, students perceived less language barriers in regular classes; they may have noticed that their language competence was sufficient enough to deal with the content, and over time, they developed strategies

to deal with difficult texts (e.g. writing a lab protocol or retrieving information from a technical text). The modules should help interactions with these concepts in the future, as the topics are part of the national science curriculum and introduce subject-specific vocabulary.

We observed a slight decrease in boredom and language-use anxiety after the intervention. Although students might come into contact with exciting lessons during the module, their regular classes do not change, possibly maintaining boredom and language-use anxiety [40] (see [42] for a systematic overview concerning impact factors and language-use anxiety). This could also increase boredom; the teaching method in the module might be different to regular classes and now they no longer look forward to their regular classes. Furthermore, if there is only a short-term change in class atmosphere or teacher, this might increase or barely affect language-use anxiety in the long-term. In general, decreases in boredom and language-use anxiety positively influence their overall emotional experience in regular classes.

Without a doubt, our study concluded that students were more interested in science after the module ended. We suggest that hands-on activities and the dual-focus on content and language learning is successful for fostering interest, supporting previous studies [20]. This improves participation, effort and increases the willingness to learn [43]. Afterwards, interested students may feel more encouraged to participate in their regular science classes, leading them to work considerably hard to succeed.

Additionally, interest is highly linked to a higher level of commitment to achieve goals [44].

Although this is only an exploratory study to investigate the suitability of short-term modules, some results must be interpreted with care. The current experimental design has several issues: (1) it takes place within the school, leading to a multitude of confounding effects (e.g. positive experiences in regular classes between the different dates of the module), (2) it does not include a control group, so it is difficult to assess subsequent module effects, (3) it does not explore the suitability of different content, and (4) the data only represent subjective student perspectives. Furthermore, we could not differ between different school types as recently immigrated students are allocated to a secondary school based on availability and not cognitive ability [5]. Follow-up tests are required to observe long-term changes; due to the timing of the study, follow-up tests were not possible as some students switched schools after the summer break. Further research is encouraged to investigate differences between modules.

The explorative character of our project highlights the potential suitability of using modules in preparation classes to affect recently immigrated students' perspective and emotional experience in regular classes. This may lead to an increase in academic self-concept and subject-specific language competence. The modules are flexible and can easily be introduced, discarding the need for schools to change their organizational model of the preparation class. We also advise to introduce a longer-term CLIL-course, covering different topics and subjects throughout the school year. The extent to which our study can be transferred to other subjects is still unclear, but we assume similar results will be achieved. Nevertheless, the results indicate that content learning for language learners has the potential to decrease negative emotions towards regular classes and therefore, can beneficially impact the integration process.

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