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Hands-on science for recently immigrated students: possibilities for language acquisition and motivation for science

Abstract

Schools have begun to face many challenges with the influx of recently immigrated students who are not able to speak the official language well enough to participate in class. To help integrate and accelerate language acquisition in German schools, these students are often enrolled in "international classes". Our project, "Biology for Everyone", teaches newly arrived secondary students science through the use of hands-on experiments. While addressing scientific content, students build new language structures and improve their German. Using 13 interviews, the concomitant research examines students' evaluations of the project in relation to science as well as language acquisition with a qualitative content analysis. Results show that students value this action-oriented approach as it helps them understand scientific concepts. Furthermore, they notice an improvement in their German and an increase in their science content knowledge. Therefore, such "international classes" should be considered for use in additional subjects in order to ease integration into the regular school system.

Introduction

As the number of immigrated students enrolled in the German school system has increased in recent years, the educational sector faces many challenges (cf. Meisterfeld, 2016). 745,545 asylum requests have been brought forward in the last year alone, with children between 6 and 18 years making up 20.6%, a number higher than ever before (cf. Bundesamt für Migration und Flüchtlinge, 2017).

Depending on the federal state and school, these newly arrived students begin their education in different ways. The most common path is to create separate classes for these students, often called "international classes" (other terms are "preparation classes" or "welcome classes"; cf. Mercator-Institut, 2015, p. 12). However, each school individually decides how to organize these classes. Two major aspects that are taken into consideration are how quickly the integration into the regular school system should take and the number of subjects that should be placed in the "international classes" (cf. Ahrenholz, Fuchs & Birnbaum, 2016). When speaking of an integration time period, schools can implement a continuous integration which starts at lower level subjects such as art and P.E., and transitions to a full-time integration in all subjects when a steady level of German is achieved. However, another method is to initially separate the students to study full-time in distinct "international classes" before an entire transfer to regular classes takes place. In terms of subject range, these classes can solely offer German or they may present a large variety of subjects (cf. Ahrenholz et al., 2016).

The integration of content during language acquisition can be found in bilingual programs such as teaching biology in English. In Europe, the integration of content and language is summarized and broadly evaluated using the acronym CLIL (*content and language integrated learning*, cf. Haataja, 2010). However, until now it has not been researched how students in "international classes" value the CLIL concept concerning its benefit for integration or its influence to motivate learning German. In order to examine this, the project "Biology for Everyone" began in August 2016 at two secondary schools in the East Westphalia-Lippe region. We focused on investigating students' motivation in relation to both science and German. Although motivation has been a highly researched topic in systematic language acquisition (e.g. foreign language classes in school), the field of language acquisition motivation in migrants (meaning the entire spectrum from working to a forced migration) has been largely neglected (cf. Fischer, 2014). However, Fischer (2014) did complete pioneer research on L2[1]-motivation in 8-year old students who have recently migrated. These students did not realize the extent to which their second language competency influences their success in school. However, they did believe that a second language is important to communicate with other peers, inferring that communication between peers is a major motive for second language acquisition. Fisher concluded that course-specific motivational aspects did not play an important role for this age range. Therefore, our study would like to examine the course-specific component, using the science classroom, in older students in relation to the relevance of their second language to succeed in school. Thus, the main aim of the article is to evaluate the project "Biology for Everyone" from the point of view of the newly arrived students concerning both the perceived language acquisition within science education and to what extent the fitted science education might have a beneficial effect on science motivation. Consequently, we want to discuss the benefits and limitations of the CLIL approach for educating newly arrived students.

Theory – Teaching science or German?

The project "Biology for Everyone"

Since a mandatory curriculum for "international classes" is not available, as they are relatively new and organized differently according to state and school, science lesson topics are chosen by the teacher. However, the choice of topics is greatly influenced by the national science curriculum; as this project aims to help students participate in the regular classroom, these topics must be similar to regular classes using the national science curriculum.

A major difficulty in choosing a topic is that international classes can consist of students varying in age. In our project, each international class consists of 16 to 18 students varying in age from 11 to 17. They may also have had different backgrounds of schooling experience. For example, many immigrated students from Eastern Europe have had a steady science education, but Syrian refugee students may have had interrupted schooling with sometimes little to no science education at all.

[1] L2 refers to second language.

This creates an issue, as topics have different difficulty levels and must be matched to students that have ended their education at numerous stages. Furthermore, German competency varies, which causes problems when creating suitable working materials. Another issue to consider is the amount of hands-on-experiments. To integrate students, hands-on activities have been shown to accelerate the learning process (cf. Fries and Rosenberger, 1973); they create memorable experiences that provoke discussions. However, these activities need to take in the consideration of age variation, as they must be age-appropriate.

Each teaching unit lasts two to three weeks and helps link together content, language, and the scientific method (cf. Schmiedebach and Wegner, 2018). The first few lessons are used to introduce a topic, which utilizes new vocabulary. Subsequent lessons use specific terms to describe experiments, depict observations, and explain phenomena. This allows students to actively start using and repeating new words. As studying vocabulary is just one part of learning a language, grammatical issues or linguistic characteristics of science are discussed as well (e.g. writing a lab report, using impersonal expressions, etc.). To clarify this procedure, the following presents an example teaching unit about plants.

The first lesson introduces new words such as "plant", "soil", "seed", and "root", to describe different plants from all over the world. During the teaching unit, students explore various topics by planning and conducting experiments. For example, to understand germination requirements they will test different growing conditions. Students must write a lab report to keep track of the experiment, their observations over a 1.5-week period, and their conclusions.

Before working on the lab report, the students discuss how they should formulate each part (e.g. using present tense for the methods section because an experiment is timeless and repeatable). By doing this, they learn about language aspects while writing their report, and about content as they work on the experiment and discuss their results. This illustrates how content and language integrated learning can take place using the scientific method as it becomes more complex throughout the teaching unit (cf. figure 1).

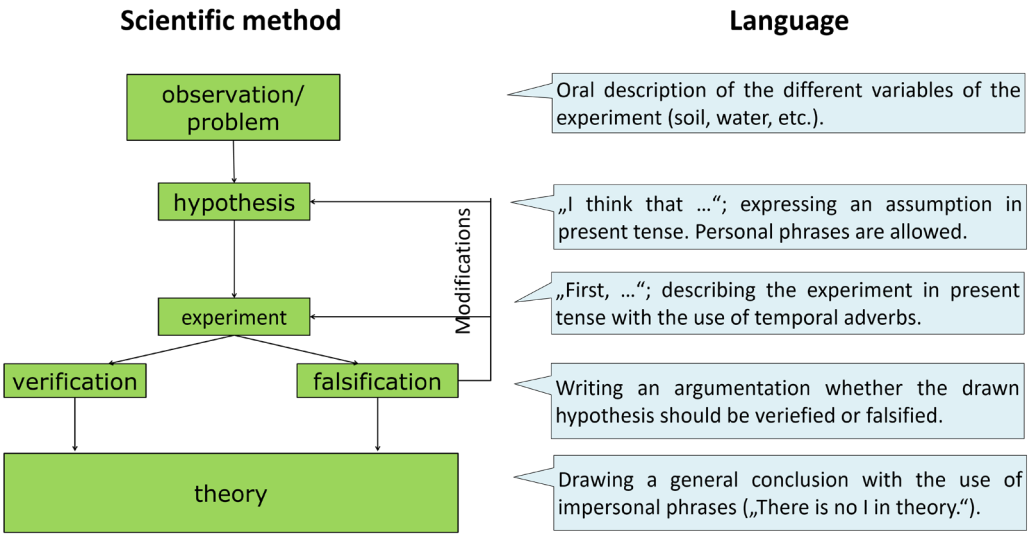

Figure 1: Integrating content and language into the scientific method.

CLIL - Content and Language Integrated Learning

The integration of subject content and a foreign language is not a new concept. Especially in Europe, there has been a push to research Content and Language Integrated Learning (also known as CLIL, cf. Haataja, 2010). Previous CLIL studies focus on English as the most common CLIL-language; however, there has been a recent shift to concentrate on different languages through the use of projects such as CLIL-LOTE[2] (cf. Haataja, 2010). In CLILiG[3], which concerns learning in German, Haider and Helten-Pacher (2009) distinguish between two different types. The first is CLILiG-bilingual, which examines students living in non-German countries that take part in a bilingual supplement and learn German as a foreign language. On the contrary, CLILiG-monolingual, takes place in German-speaking countries for students who have recently immigrated and are learning German as a second language. It must be noted that the first group is more homogeneous, as the students have a comparable language acquisition time and thematic curriculum, allowing for courses to better fit their needs. However, CLILiG-monolingual groups vary widely in their German language knowledge. They often do not have language lessons in their native language nor are they given specific individual lessons to improve their German (cf. Haider & Helten-Pacher, 2009). CLIL comes in many forms depending on language acquisition conditions and content, although there are similarities among programs. Above all, there is a dual-focused approach on content and language at the same time. CLIL does not value content over language or the other way around, as both are interwoven and held to the same degree of importance.

Motivation in second language acquisition and science education

When learning a language, three major aspects play an important role: the language with its specific structures, the learner himself and the learning environment. Each aspect can hinder or promote the language acquisition (e.g. (dis)liking a language, being anxious to use the language, getting rich input, etc.). Dörnyei's second language acquisition motivation theory (1994) takes all these aspects into consideration and provides three components covering different motivational aspects: the language and its specific structures is displayed as the *language level*, the learner as the *learner level*, and the language learning environment as the *learning situation level* (cf. Dörnyei, 1994). Since the newly arrived students in the project encounter both content and language at the same time in our learning environment, we consider Dörnyei's theory suitable to evaluate the CLIL concept for educating newly arrived students. As our project and research interest focus on a unique learning environment for educating newly arrived students, only Dörnyei's *learning situation level* is depicted here in more depth. We argue that Dörnyei's theory will shed light on how the designed course has an effect on the student's motivation concerning language acquisition. In order to broaden Dörnyei's model for our purpose, it is linked to theories of science education since that is the content area of our project (e.g. how is "interest" depicted in the field of science education).

Dörnyei's *learning situation level* is divided into three different parts; the course-specific, teacher-specific, and group-specific motivational components (cf. Dörnyei, 1994). Our project, "Biology for Everyone" is directly tied to his course-specific motivational component because we use a specialized science curriculum intended for an international class. This component covers the curriculum, teaching materials, exercises, and methods (cf. Dörnyei 1994). Therefore, one should take a closer look at how this component may be – according to Dörnyei – affected by different factors. Moreover, a connection between these factors and didactical approaches is investigated (cf. figure 2).

[2] *Content and Language Integrated Learning – Languages Other Than English*

[3] *Content and Language Integrated Learning in German*

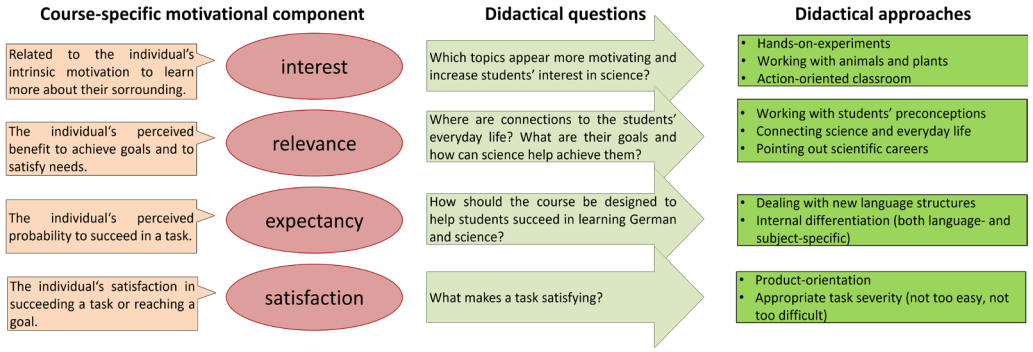

Figure 2: Different aspects of Dörnyei's course-specific motivational component in relation to some didactical questions and approaches.

Dörnyei integrated findings of Crookes and Schmidt (1991) to create the four subcategories of interest, relevance, expectancy, and satisfaction. The factor *interest* denotes an individual's intrinsic motivation to learn more about their surroundings (cf. Dörnyei, 1994); therefore, motivating topics must be included. For example, the use of animals has a positive effect on intuitive, emotional, reflexive processes, and even on social and communicative skills (e.g. Gebhard, 2013). The factor *relevance* describes perceived benefits to achieve goals and needs (cf. Dörnyei, 1994). To increase the perceived relevance, one can include preconceptions and create cognitive conflicts during teaching units. The third subcategory displays the learner's *expectancy* regarding the probability to succeed in a task. By working from an action-oriented approach, it is assumed that the students understand scientific concepts first before being exposed to technical terms and complex texts, therefore achieving a higher level of expectancy regarding science education. Furthermore, support from the teacher and fellow classmates can increase the expectancy to succeed. The last subcategory *satisfaction* consists of both intrinsic (e.g. the joy of experimenting) and extrinsic (e.g. working hard to get good grades) motives (cf. Dörnyei 1994).

Method - Research in "Biology for Everyone"

Research questions

The current study aims to investigate the evaluation of the projects' CLIL-approach regarding both language (German) and subject (science) with a special emphasis on motivational aspects related to the two areas. Therefore, two research questions and their justifications are presented.

(1) How is the science lesson perceived as a chance to improve German language acquisition?

It is assumed that students benefit from the integration of language and content for German acquisition if the connection between both branches is intentionally well-thought out and planned. If language is depicted in the science classroom (e.g. talking about science specific linguistic structures), students will notice the potential that the class could improve their language acquisition; this can help them integrate into regular classes.

(2) How do the students evaluate the project "Biology for Everyone" and to what extent might it be conducive for motivation?

To construct a motivating learning situation, it is important to evaluate the project from a student's perspective. We currently focus on an action-oriented approach supplemented with language sen-

sitive material to ease the understanding of scientific content. It is assumed that evaluations of the project will expose different motives, thus helping the future development of the project in order to increase students' motivation to learn science.

Participants

The project currently takes place in two classes at two secondary schools in Bielefeld (with 16 and 18 students, respectively). Student selection was influenced by both legal factors (e.g. signed consent form by a legal guardian) and language competence of the students. As the interviews are conducted in German, the interviewees must be able to communicate in German at a basic level in order to understand the questions and to answer properly. To estimate a student's linguistic competence, a German teacher graded each student according to the CEFR[4], as standardized tests did not seem to be a reliable or efficient measure. Starting German language levels of students vary immensely and each student works on their own individual tasks; this would provide challenges when using standardized tests due to differences in understanding. As international classes are highly heterogeneous, the selection also focused on displaying a wide background of students (cf. table 1). Heterogeneity concerns age, country of origin, language proficiency (both native language and German), and prior schooling. To lessen distress, not a lot of "in-depth" questions concerning prior schooling and experience from the home country were asked. Therefore, no systematical depiction of that is possible; however, information regarding enrollment in the German school system has been collected.

Table 1: Description of participants.

Participant	Gender	Age	Country of origin	L1	Time of Enrollment in the German school system	CEFR
1	m	12	Iraq	Kurdish	May 2016	A2
2	f	14	Kazakhstan	Russian	May 2016	B1
3	m	16	Syria	Kurdish	November 2015	A2
4	f	14	Iraq	Kurdish	March 2016	A2
5	m	13	Croatia	Croatian	March 2016	A2
6	f	14	Iraq	Kurdish	Not specified	A2
7	f	12	Iraq	Kurdish	Not specified	A1
8	m	16	Syria	Arabic	November 2015	A2
9	f	13	Iraq	Kurdish	April 2016	A1
10	f	14	Iraq	Kurdish	May 2016	A2
11	f	16	Iraq	Kurdish	May 2016	A2
12	f	17	Kenia	Swahili	May 2016	A2
13	m	13	Russia	Russian	May 2016	A2

Conducting the interviews

The research questions were examined using guideline-based interviews with eight female and five male students in November and December, 2016. One pilot interview was conducted beforehand to test the narrating impulses of the interview guideline for linguistic and content-based intelligibility. All interviews took place in a private room in the school by the same interviewer to ensure compa-

[4] Common European Framework of Reference for Languages

rability. The interviewer was introduced as a researcher from a local university who was interested in the science lessons and would like to talk about individual experiences and improvement. During the interviews, students had access to dictionaries in their native language and questions could be repeated, paraphrased, or skipped if necessary.

At the beginning of the interview, a narrative impulse to talk about the interviewee's biography is introduced ("First, I want to get to know you. Tell me something about yourself, such as 'How old are you?', and 'Where are you from?'"). One biographical aspect is the different languages the interviewees can speak, so the interviewer will draw a connection to learning German ("You told me, that you can speak (name language). Now you are learning German, tell me a bit about it. Do you like German? Is it easy for you?").

The third impulse covers the *learning situation level* as the interviewees are asked to describe their science lesson. This impulse has multiple sub-impulses which cover different components of the learning situation level (such as "What topics did you like most so far?", "How is your teacher acting in class?", and "Do you like experimenting in groups?"). To get a brief insight of the interviewee's personality, the fourth impulse covers self-evaluation ("You are getting grades in school. How do you behave in science class? Are you participating a lot? What do you think would your teacher say about you as a student?"). The final impulse discusses possible improvement of the science classroom ("Imagine you could change one thing about the science classroom. What would it be?").

The analysis

Interviews were recorded with the recorder Olympus LS-14 as *.mp3-files and last between 8 and 17 minutes. Afterwards, the interviews were anonymously transcribed with the program f4 according to standards described by Kuckartz et al. (2008). These transcribed interviews were analyzed by Mayring's qualitative content analysis using the method of summarizing (cf. Mayring, 2010), which looks at each case separately using three main steps of paraphrasing, generalizing, and categorizing.

In the first step, all meaningless utterances (e.g. "ehm") are erased and content-bearing text passages are paraphrased and transformed into grammatically correct sentences. Afterwards, the different text passages are raised to the same level of abstraction and referents of the paraphrases are generalized. Finally, reduction and categorization combines identical or similar statements to form a (sub-) category. It is important to re-test whether the categories still represent the starting material (cf. Mayring, 2010). After applying the steps to each case, all categories are compared to create a set of general cases (cf. figure 3). This allows different perspectives of the group to be adequately taken into account. Since the interview guideline is based on Dörnyei's model, it certainly influences the interview content and therefore the possible categories. However, the categories are developed inductively as they are based on the interview data instead of gathering them deductively from Dörnyei's model. By doing so we want to cover general aspects from Dörnyei's model (e.g. the learning situation level) but at the same time highlight the specific setting of a science classroom. Since CLIL is the theoretical foundation for the project's practical approach, it is part of the categories in terms of being the object of evaluation (e.g. how do the student's perceive the chance to improve their German in the CLIL classroom).

Methodological considerations

Guideline-based interviews are appropriate for this study as they are a qualitative approach used to gain insight from individual perspectives of the project. Since the participants are not fluent in German, a standardized questionnaire does not seem fitting as language barriers may be too severe. An interviewer is able to paraphrase impulses and adjust the language in each interview to ease understanding. Furthermore, the interview guidelines ensure comparability between each interview as the narrating impulses are the same; but at the same time, the interviewer can inquire about interesting

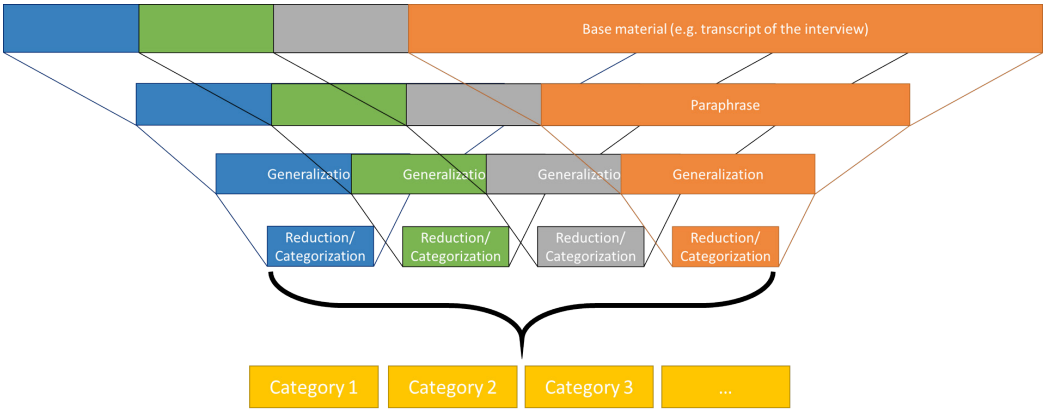

Figure 3: Using Mayring's qualitative content analysis method of "summarizing" (2010).

aspects individually. Concerning qualitative content analysis, one can argue that it allows us to paint a picture of an overall evaluation without concentrating too much on case studies. For future studies, case studies are planned in order to contrast students with different educational backgrounds, performance in class, and motivational factors. Once language competencies are sufficient enough, a quantitative approach can be considered as well in order to measure concrete motivational changes which would increase the significance of the study. Furthermore, a comparative study between CLIL and non-CLIL newly arrived students could be used to test language competencies and scientific knowledge in order to prove whether the project has a significant impact on language acquisition and increase in knowledge.

Results

To answer the two research questions presented, interviews were analyzed for aspects concerning language in science lessons and the evaluation of the science lessons. These statements are condensed into the categories "L2-Acquisition" and "science lesson". The first deals with the first research question, investigating how the science lesson may be perceived as a chance to improve German language acquisition. The second focuses on how the students evaluate the project "Biology for Everyone" and extent to which it might be conducive for motivation. As the interviews were conducted in German, direct quotes are translated into English without changing the content or fixing grammatical errors to provide an accurate impression of the students.

L2-acquisition

The category "L2-acquisition" embraces statements concerning second language acquisition in general, and specifically where German was mentioned. Moreover, both acquisition in the science classroom and ways to handle language-based problems are also part of this category. To guarantee intersubjective traceability (cf. Steinke, 2009), table 2 displays the three subcategories along with a short description and an anchor example.

Multiple students mention how their first or other languages influence German language acquisition. This influence is rated as either beneficial (e.g. transferring the meaning of similar words) or disadvantageous (e.g. an accent when speaking German). Furthermore, the frequent use of the L1 is seen as an obstacle when learning German ("[the classmates, MS] speak Kurdish not German [..., MS]. They

Table 2: Description of the three subcategories within the category "L2-acquisition".

Subcategory	Description	Anchor examples
Acquiring German in general	General statements about learning German, including some of the difficulties that are faced.	**P10** [Studying German] is better// it is good (laughs) yes. (Interview participant 10, l. 46)
Acquiring German in the science lessons	Statements about if and how German is acquired in the science lessons.	**I** What do you think? Do you improve your German in the science lessons? **P8** Yes [...] for example because auf worksheets in German. (Interview participant 8, l. 121-128)
Problem-solving strategies	Statements about how students deal with language barriers in class.	**I** What do you do when you don't understand something? **P4** Of course I raise my hand [...] and ask for help. (Interview participant 4, l. 67-70)

learn and practice not very good and fast (.) because they speak Kurdish", interview participant 1, l. 138-141; "And I don't like it [the classmates communication in the L1, MS] because (.) if you speak in German, our German improves", interview participant 4, l. 120f.). The students argue that their German will not improve – or at least not fast enough – if one does not use German. However, participant 10 argues that "sometimes we wri// eh explain Kurdish speaking for the children" (interview participant 10, l. 168); the L1 is used to help and support each other during class, e.g. when tasks are unclear.

Participant 2 is already partially integrated into the regular classes since her German and content-knowledge as sufficient enough to follow instructions. Nevertheless, she is still afraid to participate orally because of her German. She fears to make grammatical, not content, errors:

> **P2** Mhm I come// I go with another class// with normal #class here# [..., MS] in other subjects and I am so anxious for that because when I say not so correct Ger// in like German sentence and that is hard for me. (Interview participant 2, l. 228-232)

Further problems that arise when learning German include the articles[5], the alphabet, and grammar. Evaluation of worksheets and tasks during the interviews show that writing assignments are ranked as difficult. However, at the same time, those tasks are mentioned as beneficial for language acquisition.

Even though personal struggles in language acquisition exist, it appears that students value German and state possible support for German acquisition. Both actively using German (e.g. talking about experiments in class) and having contact to native speakers are appreciated and perceived as helpful learning opportunities.

> **I** And how is it there// why// in what way are you learning// [German in science, MS]
> **P3** Because I talk to the teacher good Ger// German, I write in German, I study in German, I study ehm (.) know the (.) things in German, for example ehm (.) the microscope or the (inc., 1) and ehm plants and trees [..., MS] (Interview participant 3, l. 109-112)

Furthermore, practicing grammar in science is evaluated as constructive ("A little bit grammar and articles as well we did a bit (.) I like that", Interview participant 11, l. 91f.). Participant 2 compares language acquisition during science with learning new vocabulary. Although she has already learned the content in prior schooling, she is given the chance to learn new German words in science class.

[5] In German, nouns are masculine, feminine or neutral.

I […, MS] How do you like the [science, MS] lesson?
P2 Yes, I like science (.) ehm I// I think this is like (.) an interesting lesson but first when I was in science ah I though that (.) I know everything but I (inc., 2) because in Kazakhstan my// I have (..) hm… studied four years #Biology.# […, MS] and here I have (…) a little bit here knowing// not everything because words is in German and difficult and when I study Biology here I learn mostly words than//
I You learn the German words
P2 //Yes more (…) ehm than subject.
I This means you learn mostly German in the science lessons?
P2 Yes. (Interview participant 2, l. 62-74)

Although most students talk about different ways of language learning during science class, participant 1 and 9 do not see any benefit of the science lessons for their German acquisition:
I So does the science education help you to improve your German?
P9 (…) I don't think so. (Interview participant 9, l. 101-102)

During class, students name problem-solving strategies to deal with language-based problems. This includes raising their hand and asking the teacher for help. Furthermore, the use of dictionaries (especially digital) is valued as a helpful way to understand tasks. The permission to use digital dictionaries, which are usually integrated in mobile phones, is stated as a good attribute of a teacher who encourages students to use all available resources.

Science lesson

This category examines the evaluation of the science classroom, including changes in acquiring knowledge, the evaluation of teaching methods, topics, and personal impact factors. To guarantee intersubjective traceability (cf. Steinke, 2009), table 3 displays four subcategories along with a short description and an anchor example.

Table 3: Description of the four subcategories within the category "science lesson".

Subcategory	Description	Anchor example
Knowledge increase	Statements that include explanations about gaining knowledge in the science classroom.	**P10:** [Science] is very good and we do things we haven't learned in Iraq and we came here and we learn this and then we know this is good for me. (Interview participant 10, l. 57-59)
Teaching methods	Students' feedback to teaching methods (e.g. experimenting).	**P13:** Eh (.) mine (..) I love lessons with animals. (Interview participant 13, l. 109)
Topics	Statements concerning teaching units. These can be units which have already been taught or units the interviewees would (not) like to have in the future.	**P6:** I want to (..) with // do everything with Biology and with animals and with humans […]. (Interview participants 6&7, l. 230-231)
Personal impact factors	Motives concerning the value of science lessons or science education for achieving personal goals.	**P6:** Yes it is very good that we study Biology (.) Biology is so good because we can// if one wants to (.) become a doctor or something like that he has to study Biology. (Interview participants 6&7, l. 51-52)

Evaluations of the science classroom are positive, found in every interview and based on different reasons. Concerning an increase in knowledge, participant 10 highlights that she learns many new things which she values as something good for her (cf. table 3). Possible advantages of science education in the international class are highlighted by participant 1 since he described the beneficial effect of the science classroom to participate in the regular classroom.

I What do you like the most [regarding the science classroom, MS]?
P1 It is very good and if you are in a different class a normal class and we know this.
I Ah (...) Because you know the topics// you can say something in class.
P1 Yes. (Interview participant 1, l. 74-78)

The most common positive evaluations were about the topic choices and teaching methods. The unit about the production of hand cream was ranked as particularly interesting; besides the interest in the production itself, there is value in being able to take the self-made cream home:

P1 Yes we did ehm (.) hand cream.
I Yes.
P1 And it was our (.) present.
I Did you like it?
P1 Yes. (Interview participant 1, l. 113-117)

Furthermore, previous work with animals (snails and insects) was praised and wished for in further teaching units. Participant 2 says that "the most (.) I like a topic with animals" (interview participant 2, l. 89) and she values that they were allowed to hold the snail (cf. interview participant 2, l. 93-95). Participant 3 does not remember the term snail but he recalls that one "must carry [the snail, MS] with two hands [..., MS] and eh (.) take very eh (.) careful and not allowed to lift at the shell but with eh (.) his foot." (Interview participant 3, l. 151-154). In his description of how to work with the snail, he uses the terms shell and foot correctly. Moreover, he describes how he has fed the snail and saw its tongue (cf. interview participant 3, l. 142-147).

Within the realm of topics, units about the microscope, plants, animals, and human biology were described as interesting (cf. table 3) and additional requests included physics. Participant 2 states that it is more difficult than biology and that since she has not studied physics in her home country, she would like to learn a lot about it:

P2 Mhm I want to study Physics the most because Physics is more difficult than Biology and in Kazakhstan I didn't do real grades in Physics and I want to learn, learn, learn and I want to learn Physics here as well.

(Interview participant 2, l. 298-300)

Personal impact factors include the comparison of previous schooling experiences with the current ones. Participant 2 portrays the teaching in Kazakhstan as "boring, monotonous" (interview participant 2, l. 202) whereas here she does "every day es// something interesting" (interview participant 2, l. 203). Moreover, she left her home country in the middle of a school year and thus "lost a topic" (interview participant 2, l. 289) which she wants to catch up on. Another participant (6) talks about the relevance of the science classroom for her wish to become a doctor:

I And what do you like most?
P6 Yes was very good we learn Biology (.) Biology is so good, because we can// if one want to become (.) doctor or something like that he has to study Biology.
I Mhm (affirmative)
P6 This is like (inc., 1) very good and Biology with others very good too.
I Do you want to become a doctor?
P6 Yes. (Interview participant 6&7, l. 50-56)

Discussion

Statements examining the opportunity for L2-acquisition in science lessons are overall immensely positive. However, two interviewees did not believe that the science lessons have an immediate benefit for learning German (e.g. cf. interview participant 9, l. 101f). One explanation may be a limited experience in prior science education, so that students tend to notice an increase in content knowledge but not for the language. An opposing perspective is mentioned by participant 2. Due to previous science education in Kazakhstan, she has a well-established basis and views the science lessons as a "special German course" (cf. interview participant 2, l. 62-74). In an interview study with recently immigrated students, Nilsson and Axelsson (2013) have found out that recently immigrated students deal with linguistic obstacles when trying to succeed in the regular classroom (e.g. using the right tenses in a lab report) rather than understanding the content itself. Their results underline participant 2's perspective that the science lessons in the international class help as an additional German lesson to learn linguistic aspects needed for the regular science classroom. Moreover, both the results of Nilsson and Axelsson (2013) as well as ours implicate the assumption that previous knowledge has a substantial influence on the perceived learning situation. If students have only limited scientific foreknowledge they tend to only notice an increase in content-based knowledge, whereas students with a more sophisticated experience in science education emphasize the increase in language-based knowledge; however, further research should be conducted to examine this connection. Therefore, the interviewer should ask about prior schooling experience, especially concerning science. These results allude to a stronger integration of language in the science lessons. By talking more about subject-specific expressions and contrasting every day and scientific language, the students' perception of language acquisition may increase.

Although language acquisition may not be immediately realized by all interviewees, they do recognize an increase in scientific knowledge. It is assumed that elements of "good science education" (cf. Wüsten, 2010) motivates students and therefore, positively influences learning. When students actively take part in the science lessons, this strengthens the learning situation level. The first motivating teaching method is the use of animals in the science class. Participant 2 states that she prefers working with animals because she may touch them (cf. interview participant 2, l. 89-95). Although the direct physical contact with the giant African snail is described as disgusting by participant 3, his reproduction of the discussed content is excellent. Although he doesn't remember the term "snail", he can still talk about the correct way to handle these animals and name different body parts using correct terms (e.g. shell) (cf. interview participant 3, l. 151-154). The primary experience by the encounter with the animal seems to have been memorable, motivating, and supportive for learning. Motivational effects of using animals have been seen in previous studies (e.g. Gebhard, 2013; Hummel, 2011). Morevover, Leisen (2015) advises to start with a concrete action to build up "action-language" as a basis, before increasing the degree of abstraction and introducing the formal language. By starting the teaching unit with animals, students can interact with the animals and experience their body and behavior using their own words before working on using scientific language to describe what they observe.

Not only do animal experiments help to increase students' motivation but action-oriented tasks that involve the production of something increase the students' participation and motivation to learn. One such example includes a teaching unit about "cosmetics" which involved the production of a hand cream. Although the topic was not evaluated, producing the cream itself was valuable enough (cf. Interview participant 1, l. 113-117). It seems that the gesture of endowment is more important than the topic itself. This could arise from a participant's background, as many did not have a continuous education and have a low income background as a refugee. Another leverage point is the product aspect of action-oriented education (cf. Jank & Meyer, 2009) which gives students the chance to develop and work on a product themselves. Even though instructions were provided to make the cream, the scent was individually chosen.

The topics of the teaching units belong to the course-specific motivational components of the learning situation level in Dörnyei's second language acquisition motivation theory. One aspect of this component is the students' perceived relevance as described in chapter 3.1. Participant 1 highlights how science eases the integration process into a regular class ("[science is, MS] very good and then when you are in other normal class and we know it all", interview participant 1, l. 75f.). Not only does the statement show the perceived relevance of the project, but also the possible positive effects it may have on personality traits such as self-esteem and language-use anxiety. It appears that personality traits hinder or foster language acquisition (e.g. self-confidence affects a person's motivation to learn and use a L2) (cf. Dörnyei, 1994) and this has been mentioned in some interviews concerning participation in regular classes (cf. interview participant 2, l. 228-232). Therefore, these attributes should be discussed further and integrated in interview guidelines, since they influence language acquisition and are part of Dörnyei's learner level.

Moreover, personal impact factors can be motivating in the science classroom because they strengthen the relevance of science in students' lives ("Yes it is very good that we study Biology (.) Biology is so good because we can// if one wants to (.) become a doctor or something like that he has to study Biology", interview participants 6&7, l. 51-52). By noticing relevance, students might be more encouraged to participate and as a result, profit from the lessons with the added bonus of language acquisition. Shin, Lee and Ha (2017) examined the influence of career motivation on science learning and found that it has a direct influence on several motivational factors such as self-determination and self-efficacy. Another personal impact factor is described by participant 2. She talks about the last teaching unit in anatomy she had in Kazakhstan before moving to Germany. Since she had to move, she "lost a topic" (cf. interview participant 2, l. 289) which she wants to catch up on now. It is possible that she was already interested in this topic in Kazakhstan, but this may also suggest that there is an emotional bondage attached to the topic as a connection to a feeling of "home".

Students' problem-solving strategies allow us to evaluate the teacher-specific motivational component. Since several students mentioned asking the teacher for help, we assume that the students did not feel afraid of the teacher and that there was a comfortable atmosphere in class. One problem-solving strategy, namely the use of (digital) dictionaries, makes students feel connected if a teacher has a positive attitude towards the productive use of mobile phones. It has been shown that students tend to prefer such an authority type of the teacher and value their task presentation if they are encouraged to use all their linguistic resources in comparison to teachers forbidding the students to speak their native language. Especially students with Kurdish as their mother tongue have faced oppression in their home country and were often not allowed to speak Kurdish in school. By creating such a learning environment, motivation increases and students tend to achieve higher learning achievements (cf. Montalvo, Mansfield & Miller, 2007). Since the students' attitude towards the teacher seems to be positive, one can argue for an affiliative drive. Even the allowance to drink during class is mentioned. These nonchalant situations seem to be of high value for the students and their attitude towards the teacher as they create a relaxing and complacent atmosphere. Furthermore, the beneficial use of the L1 is declared by participant 10. She highlights how helpful it can be to explain exercises in the L1 if other group members do not understand German well enough (cf. interview participant 10, l. 168). However, other students see the frequent use of the L1 as an impediment for language acquisition (cf. interview participant 4, l. 120f.). Past research claims that it is advantageous for the language acquisition process if students can use all possible linguistic resources (e.g. using their native language) instead of being inhibited to do so (cf. Hornberger, 2005). Therefore, it is important to discuss this topic with the students; the teacher needs to support and explain the usefulness of the L1. These observations can be linked to the subcategory teacher-specific motivational component in Dörnyei's learning situation level since the teacher can be seen as a role model for advocating certain believes, such as the benefits of using the L1 (cf. Dörnyei, 1994).

Taking our results into consideration, one can say that the students describe the science lessons as a chance to improve their German. The students claim to learn new words and train grammatical structures even though they struggle with exercises from time to time. However, the perceived impact of the science lessons for language acquisition varies between different students. One possible explanation may be the prior education they received. Some students had a decent education in science and these students in particular tend to benefit from the science lessons when focusing on German acquisition. These students do not need to concentrate as much on the content than the students with less experience in science education. To have a closer look at the role of prior schooling experience, further interviews must be conducted. Concerning our second research question, it can be concluded there are individual preferences regarding the evaluation of teaching units. However, the overall perspective of the project is positive. In particular, the action-oriented approach seems to motivate the students as we notice an increase in participation. It appears that the students have fun in class and – at least some – notice the relevance of the subject; either because it is related to their future career aspirations or because it helps them fit into the regular classroom. The latter is a crucial aspect of integration, as the students notice that they are capable of participating along with German students in regular science classes.

By comparing our results with the CLIL-concept, one can draw parallels. One central element of CLIL is the language triptych which displays the interaction of different "language levels". The statements concerning participation in regular classes can be associated with the *language for learning*. To some extent, the students see that some linguistic and subject-specific structures discussed in the science classroom will help them respond in a foreign environment (i.e., a regular classroom). Moreover, the increase in subject-specific vocabulary can be associated with the *language of learning* or *language through learning*. The introduction to new words at the beginning of the teaching unit displays the former, whereas newly learned vocabulary in the discussion parts of the lesson can be associated with the latter. Even though the CLIL-approach appears to be successful, its influence on second language acquisition motivation still needs to be further examined.

Implications for further studies and teacher education

The interview guideline will be adjusted in some passages for a second study to reveal more insight in second language and science motivation. Furthermore, the application of questionnaires will be tested as well (e.g. PANAS). The current narrative prompts successfully evaluate the science lessons and provide data concerning subject motivation. Regarding language motivation, basic information can be retrieved, however, the prompts should be adjusted to systematically investigate students' motivation concerning science education. The following prompts are suggested:

"How has your participation in the regular class changed since you have started studying science?"
"What do you need help with in the regular science classroom and how can we help you in your international class to cope with it?"
"Should other international classes be taught in science as well? If yes, why?"
"You said you like science. Would you say that you want to learn more German because of science?"
"You said you learn German in science as well. Would you say you are learning German faster because of science?"

Another aspect that should be further explored is prior educational experience. Even though this is already mentioned in some interviews, this type of information should be gathered systematically in additional surveys.

As the project only has two partner schools, few students can benefit from it. However, the positive results from our study justify starting an in-service training for science teachers to encourage them to start teaching action-oriented science in the "international classes". Furthermore, future teachers

will learn how to plan and teach science in these classes not only in theory but in practice as well. Therefore, it is planned to implement an internship to train new teachers. These trainees will receive a journal to examine their professionalization process throughout the different phases of the internship (e.g. what fears they have before starting the internships, what they rate as difficult when planning lessons, etc.). By doing so, we hope that more teachers can be encouraged to implement the project at their school to help benefit immigrated students from a language-integrated learning process.

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