

Using service learning to foster diversity competency of pre-service chemistry teachers at the University of Vienna

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Abstract

In order to feel better prepared for the challenges of teaching chemistry in multicultural and multilingual classrooms, the Institute of Chemistry Education (IDC) at the University of Vienna has launched a teacher training course in which pre-service teachers get the opportunity to engage in service learning at the UniClub. The UniClub is a programme offering learning support for pupils at upper secondary level with refugee and/or migration experience. The results of the qualitative evaluation study show that the course covers topics unique within the chemistry teacher training programme and provides insights into culturally and language sensitive teaching. It raises pre-service teachers' awareness for the needs of multilingual and multicultural learners and leads to a more reflective use of language in the chemistry classroom. The results also show that, although the course is an important step towards the development of diversity competency, the pre-service teachers still do not feel fully prepared.

Keywords: service learning; diversity competency; STEM education.

1. Introduction

Wars and social crises have led to an increase of migration in recent years. In Austria, current figures show increasing diversity in classrooms across the Austrian educational system (Statistics Austria, 2022). Therefore, monocultural and monolingual learners are little more than a misconception of the Austrian German-speaking majority society. Although 'Intercultural Education' has been anchored as an interdisciplinary and cross-curricular teaching principle in the curricula of all general education schools since 1992 by the Federal Ministry of Education Science and Research (BMBWF, 2023a), the acquisition of diversity competency has received little attention in science teacher training and particularly in the field of chemistry teacher training.

For this reason, the IDC at the University of Vienna has launched a teacher training course, in which pre-service teachers get the opportunity to engage in service learning at the UniClub of the University of Vienna, which offers learning support for students at upper secondary level with refugee and/or migration experience. This service learning approach aims at providing first-hand teaching experience in linguistically and culturally diverse settings in order to increase pre-service teachers' diversity competence and thus advance their self-efficacy with regards to managing classroom diversity (Resch & Schrittwesser, 2023; Amaro-Jiménez, 2012).

2. Diversity competency & 'Intercultural Education'

Cross et al. (1989) identified the awareness of the wide array of difference as well as knowledge and acceptance of these individual differences as basic skills for successfully dealing with heterogeneity.

Diversity competency can, therefore, be regarded as a set of various competencies related to managing similarities and differences, including the ability to develop adequate and diversity-sensitive approaches and interventions. It also requires multidimensional and intersectional perspectives, comprising thorough knowledge of the concept of diversity as well as systematic and continuous reflection on one's own diversity. This involves knowledge, self-reflection skills, social competence and diversity-sensitive attitudes as well as action competence (BMBWF, 2023b; Thomas, 2006).

All these skills are summarized in the Austrian school curriculum as the interdisciplinary and cross-curricular principle 'Intercultural Education', which explicitly calls for the development of empathy and tolerance of ambiguity, a relaxed attitude towards heterogeneity, a critical and appreciative attitude and a constructive conflict culture without cultural attributions. It aims at respect towards social change processes, such as migration or diverse biographies, and lifestyles in order to create a framework for responding appropriately to the challenges and opportunities that arise from this in the school system (BMBWF, 2023a). Prospective teachers, therefore, need to sharpen their awareness of the heterogeneity of their future students by consciously perceiving diversity in the classroom (Anton, 2014). They need to become aware of their own attributions, stereotypes and generalizations and critically question and challenge them, in order to help ensure that learning in linguistically and culturally heterogeneous school environments can take place in an appreciative and respectful manner. Hence, teachers and learners shall develop intercultural skills regardless of origin, social status, age, gender etc. in order to contribute to combating exclusion and othering (BMBWF, 2023a).

Interculturally or culturally reflective competency is not only about rationally applicable knowledge though, but also about practical skills and an attitude that takes the complexity of human interactions into account, which are influenced by personal interests and desires, social positions, power relations and situational demands. Schondelmayer (2018, p. 52) argues,

however, that precisely this is not a skill "that can be taught in training courses in such a way that the people trained can deal appropriately with the experience of difference in every situation".

Nevertheless, diversity competency and intercultural sensitivity can be practiced by reflecting on one's own opinions and assumptions, as well as one's personal experience, in order to create an awareness of different interpretations of situations. At the same time, practical experience of cultural and linguistic diversity enables access to different patterns of interpretation and thus the development of intercultural as well as diversity competency (Doğmuş et al., 2016).

In order to feel prepared for managing the increasing cultural and linguistic diversity in the Austrian educational system, however, pre-service teachers need to acquire diversity competency, not only in theoretical teacher education courses, but also through organized encounters with people and joint action (Resch & Schritteser, 2023).

3. The course *Intercultural Chemistry Teaching*

Pre-service teachers of science subjects often tend to neglect the importance of culture and language for learning, although these can have significant impact on the learning process (Rincke & Markic, 2018) and consequently on the understanding of subject knowledge. Consequently, the IDC at the University of Vienna has designed a teacher training course in which pre-service teachers are presented with the opportunity to engage in service learning at the UniClub of the university in order to gain better understanding of the needs of culturally and linguistically diverse learners.

3.1. Course Design

The objective of the course *Intercultural Chemistry Teaching* is to develop a competent approach to diversity in the migration society as part of the professional self-perception of pre-service chemistry teachers. Experience and attitudes related to migration, diversity and education shall be examined in order to understand mechanisms of inclusion and exclusion. At the same time, pre-service teachers acquire diversity competency by developing expertise on the topic of intercultural education and find methodological and didactic approaches for chemistry teaching (Marshall et al., 2015). Moreover, the course aims at combining the acquisition of technical, methodological and social skills with social engagement.

In order to bridge the gap between theory and practice, the course is designed according to the principles of service learning. The course *Intercultural Chemistry Teaching* links theory and practice by giving students the opportunity to participate in authentic service learning activities at the UniClub (see 3.2. UniClub) for about 25 hours (=1 ECTS) and to reflect on this involvement in class in order to gain deeper understanding of the underlying theory (Bringle &

Hatcher, 1996; Eyler & Giles, 1999). This way the pre-service teachers gain the often requested practical experience in authentic learning situations and develop strategies as well as a sense of self-efficacy in terms of dealing with the increasing heterogeneity in Austrian classrooms (Stewart, 2012). By supplementing the theoretical seminar content with practical experience at the UniClub, the students have the chance to successfully transfer conceptual knowledge they have acquired earlier to real teaching and learning situations. The reflection processes triggered by the new experiences will lead to lasting insights into the teaching and learning process (Butler & Christofili, 2014).

The seminar part of the course is structured in five theory blocks of three units, taking place approximately once a month for one semester. These units are designed to provide pre-service teachers with space for exchange and reflection on the one hand, and to enhance their pedagogic content knowledge on specific aspects of dealing with multilingual and multicultural students on the other hand.

Specific content includes basic considerations of culture and intercultural education based on the Intercultural Education Policy Decree (BMB, 2017). Furthermore, the dimensions of diversity in combination with different biographies and life plans associated with it are discussed in order to develop awareness of heterogeneity in schools and understand the opportunities and challenges this presents for chemistry education. To establish a foundation for mutual understanding across language and cultural barriers, a focus is set on multilingualism and linguistic diversity (Busse, 2017; Keim & Tracy, 2006) as a school reality as well as on the didactic principles of language-sensitive chemistry teaching (Schmölzer-Eibinger et al., 2020).

Additionally, aspects of trauma-sensitive pedagogy relevant for dealing with students having experienced refugee movements and/or migration are addressed in order to give pre-service teachers basic knowledge on the concept of trauma and potential trigger factors that might occur in everyday school life. In this context, it is particularly important to present pre-service teachers with various options when working with traumatized young people, where they can receive appropriate support, but also recognize and accept their limits regarding this matter (Siebert, 2020).

3.2. Uni Club

The UniClub is a learning support programme for young people between 13 and 20 years with refugee and/or migration experience attending upper secondary school in Austria (Children's Office of the University of Vienna, 2024). It offers three different support formats: StudyBuddies, LernClub and IntensivClub. StudyBuddies provide one-on-one learning support for approximately two hours per week for one particular student. Depending on the needs of the pupil, the study buddy helps reviewing school material, preparing for exams, tests, etc., and

organizing study time. This provides the opportunity to build and develop a personal (learning) relationship over the course of a semester.

In contrast, the LernClub is an open learning space for pupils taking place twice a week in the afternoon. Pre-service teachers usually work in pairs to help pupils with their studying and homework. The LernClub afternoons are coordinated by the UniClub team, so that the pre-service teachers can focus on the need of the pupils. There they work with different young people and having to adapt spontaneously to their specific needs. Last but not least, IntensivClubs are a particularity of LernClub offered primarily in Maths, English and German, focussing on supporting pupils preparing for their final exams. Pre-service teachers who take part in an IntensivClub regularly work with a small group of young people for about two hours a week (Children's Office of the University of Vienna, 2024).

4. Course evaluation and first results

4.1. Course evaluation: data collection, sample & data analysis

The evaluation of the course is based on a questionnaire with a four-level Likert scale (1=fully agree; 4=fully disagree) and the analysis of the participating pre-service teachers' product portfolios. Each portfolio contains a tabular overview of all learning units held at the UniClub as well as reflection papers on three specific learning units and an overall reflection of the course, including the interpretation and critical evaluation of their teaching methods and learning gain.

Since the chemistry teacher program is considerably small, the number of participants in the course and therefore the sample size was rather small with just N=6 pre-service chemistry teacher students at different stages in their studies. The portfolios were evaluated and interpreted employing qualitative content analysis (Kuckartz, 2018), with inductively developed categories. As for the questionnaire, a simple frequency analysis of answers was carried out.

4.2. First results

The results of the questionnaire show that the course is unique in the canon of chemistry teacher education at the University of Vienna. All participating pre-service teachers fully agreed with the statement "In the seminar, content was discussed that is not discussed in any other course in the chemistry program" without exception (M=1,0). At the same time, the experience at the UniClub is also regarded as very positive, as the pre-service teachers can gain practical experience in the field (M=1,2) and are able to become aware of their own strengths (M=1,6) and weaknesses (M=1,2), but also get to know approaches for dealing with students with refugee and/or migration experiences (M=1,4).

It also turns out that the pre-service teachers are aware of the importance of language and culturally sensitive teaching (M=1,2), but they do not feel fully prepared and still see need to deepen their methodological knowledge in this area (M=2,6).

The reflection papers confirm that the pre-service teachers understand the importance of language and diversity competency for chemistry teaching. A majority of them says that they experienced the need to pay attention to their own language for the first time and recognized its significance for successful teaching and learning. All pre-service teachers state that they now use and reflect on their own language more consciously in teaching and learning situations, as a result of the course and their experience at the UniClub.

In addition, the work at the UniClub showed all pre-service teachers the importance of a systematic approach to teaching subject matter and that a didactically reflective approach is crucial for students' success. In this context, all pre-service teachers come to the conclusion that detailed subject knowledge alone is not enough to teach a subject. At the same time, they also realized that understanding larger contexts is much more important for long-term retention and the ability to explain content than highly detailed reproductive knowledge. This became particularly clear to the pre-service teachers when having been confronted with detailed questions and detected gaps in their own technical knowledge. Although they were not able to answer these questions spontaneously, the (mostly collaborative) research with the learners was sufficient not only to find correct answers, but also to frame and explain them to the learners.

5. Conclusion & Outlook

The results of the evaluation clearly show that the course *Intercultural Chemistry Teaching* was able to provide students with new insights in the area of language and culturally sensitive teaching. The experience at the UniClub made the participating pre-service teachers realize that language plays an important role in chemistry education, as it is not only a means of communication but also an obstacle to learning. They also understood that teaching chemistry involves much more than simply teaching students how to read and write chemical formulas and that subject-specific learning objectives can only be conveyed with the help of language. Especially for learners whose first language or current family language is not German, a lack of linguistic resources can lead to difficulties in dealing with specific chemical content. These findings show that language and culturally sensitive teaching contributes significantly to understanding the content of a lessons. The promotion of language education must consequently be a concern for all subjects and not only of the designated language subjects. By participating in the course described, the pre-service teachers had to reflect on their own language behaviour as well as attitudes towards culture, language and multilingualism.

Although the evaluation results show that one course alone is not enough to provide students with sufficient knowledge and methods to feel adequately prepared for the challenges of a

multilingual and multicultural classroom, they have been sensitized to the importance of language in chemistry education. The pre-service teachers also recognized the need for good subject-specific and didactic training for the professionalization of teachers in general, but also for themselves and their future teaching activities. This insight will hopefully contribute to a greater acceptance of theory in teacher education and, as a result, of in-service training in the sense of continuous professionalization.

As the sample size was rather small, further research will have to be carried out and the results from courses of different semesters must be compared and contrasted. Additional information about the specific needs of pre-service teachers when dealing with multilingual and multicultural learners must also be collected. This way it is possible to address these particular aspects in greater detail in future courses and to help pre-service teachers to feel better prepared for language and culturally sensitive chemistry teaching.

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