Good practice report

Marina Hönig*, Lilith Rüschenpöhler, Julian Küsel and Silvija Markic

Coaching strategies in vocational orientation for promoting young women's self-concept and career aspirations in chemistry

<https://doi.org/10.1515/cti-2021-0006>

Received March 11, 2021; accepted May 5, 2021; published online June 11, 2021

Abstract: Females and students of non-dominant ethnicity are less likely to aspire to science careers. However, overcoming discrimination in science and chemistry is a challenging task, especially in vocational orientation. Thus, there is a need for strategies to support young women in their identity formation in science and chemistry. This article presents a scheme for supporting young women's science identity formation in conversations about vocational orientation. The goal is to support young women in developing a positive attitude towards careers in chemistry. This attitude is part of cultural chemistry capital. The scheme was developed based on a study conducted as part of the project DiSenSu. Here, coachings for vocational orientation for young women in science and chemistry are provided, following the idea of *Science in Public*. In the coaching, the attitudes towards science and chemistry were determined using quantitative data. Based on these results, coaches conducted conversations with the participants. Qualitative analysis of 11 conversations revealed strategies coaches used to support young women in their vocational orientation. The study shows how the participants' attitude towards careers in chemistry is used as a starting point for coachings. Also, it provides strategies that can be used to promote young women's cultural chemistry capital.

Keywords: chemistry capital; culture; gender; self-concept; vocational orientation.

Introduction

Vocational orientation should be integrated into chemistry education. In Germany, this requirement is formulated in curricula for chemistry lessons by the Conference of the Ministers of Education (Kultusministerkonferenz, 2017). This is the highest authority in education politics in Germany in which the Ministers of Education of all German federal states define structures for the education system. The 16 federal states define their individual education politics based on this general structure. Therefore, differences exist between the education systems of the federal states in Germany but also common structures in all states. For instance, all federal states have academic track schools and non-academic schools at different levels that prepare for different exams. Likewise, the agreement of the Conference of the Ministers of Education to integrate vocational orientation in teaching applies to all federal states.

Regarding vocational orientation, students should be enabled to decide on a profession independent of clichés (Kultusministerkonferenz, 2017). This should be enabled by all those involved in vocational orientation in and outside school, explicitly also by teachers and chemistry educators in out-of-school settings. This

*Corresponding author: Marina Hönig, Institute for Chemistry, Physics, and Technology, Ludwigsburg University of Education, Reuteallee 46, 71634 Ludwigsburg, Germany, E-mail: marina.hoenig@ph-ludwigsburg.de. <https://orcid.org/0000-0001-7725-2079>
Lilith Rüschenpöhler, Julian Küsel and Silvija Markic, Institute for Chemistry, Physics, and Technology, Ludwigsburg University of Education, Reuteallee 46, 71634 Ludwigsburg, Germany. <https://orcid.org/0000-0002-4684-9523> (L. Rüschenpöhler).
<https://orcid.org/0000-0002-9822-1607> (J. Küsel)

requirement has been translated into the curricula of secondary schools in Germany. For example, the curriculum of the federal state of Baden-Württemberg requires that students learn about occupational fields in which chemistry is important (Ministerium für Kultus, Jugend und Sport, 2016). Further, vocational orientation should be integrated into teacher training (Kultusministerkonferenz, 2017).

Research has shown that individual counseling about science careers is particularly important in students' vocational orientation (Rüschepöhler, Hönig, Küsel, & Markic, 2020a). However, this is very difficult for teachers to do in school due to the time constraints and the high number of pupils. To provide opportunities for individual counseling for vocational orientation in science, a different strategy is thus needed. Counseling outside school in the sense of *Science in Public* is promising because no time constraints apply, thereby allowing for individual support. Individual needs can be addressed. This type of counseling outside school could be carried out, for instance, at vocational orientation fairs, at various events, or during project weeks in schools.

The project “*DiversitySensitive Support: vocational orientation in STEM for female adolescents with a migration background in cooperation with parents (DiSenSu)*” offers such an intervention for vocational orientation in the sense of *Science in Public*. It addresses female adolescents from the age of 14 in their vocational orientation phase. The intervention combines chemistry-related tasks with a coaching conversation conducted by a trained coach. The goal is to raise awareness of chemistry- and science-related careers and to promote young women's attitudes towards careers in chemistry-related fields, i.e. a part of cultural chemistry capital. This paper presents several strategies the coaches used in the coaching conversations to reach these goals. The strategies can be used by educators in out-of-classroom activities. They could be interesting for educators in non-formal and informal education for reaching young women in career orientation in science and chemistry but also for teachers in out-of-classroom activities.

Theoretical background

A desired outcome of education is that young people should choose a career independent of clichés (Kultusministerkonferenz, 2017). This is particularly important in science and chemistry since here, powerful gender stereotypes exist (e.g. Koul, Lerdpornkulrat, & Poondej, 2016). Many girls enjoy science but cannot imagine working in science (Archer et al., 2010) and chemistry. Even in primary school, this is visible: while boys and girls differ little in their general attitudes towards science in primary school, developing a female science identity is difficult even at that young age (Archer et al., 2012). Being a scientist seems incompatible with the role that young girls experience as culturally desirable and acceptable (Archer et al., 2010, 2012). Science has male connotations, requires identification as ‘clever’, and is open to women only within narrow limits (Archer et al., 2010). These gender differences can be reinforced by the education system, such as a curriculum that is more responsive to the interests and values of boys (Jayaratne, Thomas, & Trautmann, 2003). Implicit and explicit gender expectations of teachers and parents can also have an impact (e.g. Archer et al., 2012; Thomas & Strunk, 2017). Teachers often explain high performance of girls in science with diligence, while high performance of boys tends to be interpreted as a talent (Archer et al., 2012; Carlone, 2004).

Chemical and scientific occupations are also associated with stereotypes regarding ethnicity (DeWitt et al., 2011) and social class (Archer, DeWitt, & Willis, 2014; Carlone, Webb, Archer, & Taylor, 2015). This results in the fact that female adolescents from weaker social contexts and of non-dominant ethnicity are less likely to aspire to a career in science (Archer et al., 2010, 2012). Middle-class boys of the dominant ethnicity are more likely to develop a positive attitude towards science than young people who are female, of non-dominant ethnicity, or who belong to lower social classes (e.g. Archer et al., 2014; DeWitt et al., 2011). In Germany, it has been shown that gender stereotypes can depend on the cultural background: while boys tend to have stronger self-concepts of chemistry among young people of the dominant ethnicity, girls tend to have stronger chemistry self-concepts among young people with a Turkish migration background (Rüschepöhler & Markic, 2020b).

These findings have led to the development of the science and chemistry capital approach (Archer et al., 2014; Rüschepöhler & Markic, 2020a). The concepts describe all resources a person can use in the field of

science or chemistry. These range from cultural chemistry capital (e.g. knowledge, attitudes towards chemistry) to social chemistry capital (e.g. contacts with chemists, social support) and chemistry-related activities (e.g. participating in a chemistry club, doing experiments at home) (Archer et al. 2014; Rüschenpöhler & Markic, 2020a). Self-concepts and career aspirations are part of a person's cultural chemistry capital (Rüschenpöhler & Markic, 2020a).

However, practical approaches for developing cultural chemistry capital are lacking. In particular, approaches for developing girls' and young women's self-concepts and aspirations in vocational orientation in chemistry are lacking. Especially extracurricular activities in the sense of *Science in Public* would be desirable. This is a gap in the literature that is addressed in the present project.

DiSenSu – the project for vocational orientation

The project “*DiSenSu – DiversitySensitive Support: vocational orientation in STEM for female adolescents with a migration background in cooperation with parents (DiSenSu)*” aims to promote self-concepts and career aspirations in science and chemistry among girls and young women, especially those of non-dominant ethnicity in Germany. In the project, a study was conducted analyzing young women's needs in vocational orientation. This investigation showed that females of non-dominant ethnicity tended to wish for information from different sources than males or young people of the dominant ethnicity. In particular, the young women appreciate direct conversations with a professional counselor and prefer formal sources like contacts with university or teacher feedback over informal sources such as YouTube videos. It thus seemed desirable to develop an intervention in which individual support by professional counselors could be provided in an out-of-school setting to better reach young women of non-dominant ethnicity (Rüschenpöhler, Hönig, Küsel, & Markic, 2020a). DiSenSu offers individual coachings by trained coaches for vocational orientation in science with a focus on chemistry. In the context of the present project, vocational orientation focus on encouragement of girls and young women to become aware of their own abilities and to strengthen their self-concept. To create an atmosphere free of pressure to perform and free of prejudices, which can be present in the school environment, the idea of *Science in Public* is adopted. Thus, the coachings are conducted in different out-of-school settings, on the one hand out-of-school at vocational fairs, or cultural events in public spaces and on the other hand during out-of-class events at school.

The coachings are divided into two parts:

- (i) In the first part, the participants work individually on a tablet with which they complete chemistry-related tasks (Markic et al., 2018). These include a mental rotation test with pictures of molecule models which tests the spatial visualization ability. Further, an exercise for practical laboratory skills is completed. Data on science self-concept, career aspirations, expected task performance, and the young women's reflections on their performance in the chemistry-related tasks were collected.
- (ii) Based on the individual results in the first part, a trained coach engages in a coaching conversation with the participant in the second part. In this coaching conversation, the participant's self-concept and career aspirations in science and chemistry, and personal interest in and experiences with chemistry and science are discussed. The experiences from the tasks are also covered. The coaches are mainly female pre-service science teachers, some of non-dominant ethnicity. Prior to conducting their work, the coaches had received training introducing them to the central challenges addressed in the research project and to the guide for the coaching conversations (Rüschenpöhler, Hönig, Küsel, & Markic, in preparation).

Information on how the first part of the coaching was conducted is described in more detail in (Markic et al., 2018). The quantitative data on the participants' career aspirations and self-concepts were analyzed in a separate article (Rüschenpöhler, Küsel, Hönig, & Markic, 2020b). In this study, we found on average that the participants in the DiSenSu coachings rated their self-concept in science and chemistry slightly weaker than the girls in the German PISA 2006 sample. Regarding career aspirations in science and chemistry, the female

participants of the DiSenSu coachings showed slightly stronger career aspirations in science and chemistry than the girls in the German PISA 2006 sample.

More information, as well as the coaching materials, can be retrieved from the project homepage.¹ This article focuses on the conversation strategies in the second part of the coaching. Further, it gives practical advice on how these strategies can be used in the context of vocational orientation.

Methods

The present study investigates the strategies that the coaches employed in the coaching conversations, based on the young women's self-concepts and career aspirations. This was done using a qualitative research approach. Semi-structured coaching conversations were conducted using an interview guide. In these coaching conversations, the data on the participants' self-concepts and career aspirations, obtained in the first part of the coaching, were discussed and compared with the reference group from the PISA study 2016 (OECD, 2009). This comparison allowed the coaches to get a feeling for the meaning of the participant's relation with chemistry and science. In several steps, the interview guide was improved based on the coaches' informal feedback after they had made their first experiences in the fieldwork. For this qualitative part of the study, 11 coaching conversations were recorded and analyzed. These 11 girls and young women were either over 18 years old or their parents had given their consent to the audio recording and data analysis. Based on these recordings, the strategies which can support cultural chemistry capital (Hönig, Rüschpöhler, Küsel, & Markic, 2020; Rüschpöhler, Küsel, Hönig, & Markic, 2020b) and that the coaches used in the conversations were analyzed. For this purpose, a summarizing qualitative content analysis according to Mayring (2010) was conducted. When paraphrasing the coaching conversations, particular attention is drawn to the students' thoughts and feelings about science careers (e.g. "participant doubts her abilities in chemistry" or "participant likes chemistry") and to the coaches' reactions to this (e.g. "coach asks about experiences with chemistry at school" or "coach emphasises the importance of self-assessments"). From this, in further steps, the category system is developed to analyse the strategies of conducting conversations to promote *Science Capital*.

Results

In the following, the strategies that the coaches employed in the coaching conversations are presented, followed by an illustration using one specific case which provides further practical insights into the use of the strategies. Several coaching strategies were identified that can be used for vocational orientation in science to support the acquisition of chemistry and science capital (Figure 1). The *(I) preconditions of the participants* form the starting point for the conversations. Adapted to these preconditions, coaches can choose from several *(II) strategies of the coaches* to find *(III) connecting elements* where deep conversations about vocational orientation in science can begin.

The coaching conversations are based on the *(I) preconditions of the participants*, which were assessed in the first part of the coaching, preceding the coaching conversation. The assessment was based on chemistry-related tasks and the questionnaires used in the coachings. These data were then discussed with the participants. Particularly relevant were the young women's (a) *career aspirations*, (b) *self-concept*, and (c) *interest in chemistry*.

- (a) *Career aspirations*. In the coachings, the participants' openness towards careers in science and chemistry was explored. Participants with specific career plans were asked to explain their reasons leading to their vocational interests. In this context, role models and experiences with science and chemistry seemed to be particularly relevant. Participants with less specific career plans were asked which aspects would be important to them in future professions, such as e.g. salaries, the type of workplace, etc.
- (b) *Self-concept*. The participants' evaluations of their science and chemistry abilities from the first part of the coaching were also discussed. Here, the participant's expectations were compared to the chemistry-related exercises they had solved correctly in the coaching (Markic et al., 2018). If large differences between a participant's expectation and her results occurred, these differences were discussed in the conversation. Here an important topic was how the participant explained her achievements. The young

¹ www.DiSenSu.de, in German.

Figure 1: Overview of the coaching strategies (Rüschepöhler et al., 2020b).

women explained their performance with diligence, science skills, or luck – a variety of explanations that can open the conversation for discussing alternative reasons that might also be appropriate. It appeared to be fruitful to focus on young women's self-evaluation to question typical patterns in their explanations for achievement in science. This could strengthen their confidence in their abilities in this field.

- (c) *Interest in chemistry.* Some of the participants indicated that they have fun and are generally interested in science and chemistry as well as specified topics in this field. The coaches asked for reasons, for example, whether the participants explain their particular interest with personality traits (e.g. 'I am a biology person') or with concrete experiences in the past. This appeared to be important because it gave room for considering alternative patterns, for instance, to focus on actual experiences instead of recurring to fixed

personality traits. This way, it is possible to raise awareness of science careers in a participant who has a great interest in chemistry but aspires to a career in a different field. This interest can be used in the coaching conversation as an opportunity to talk about science or chemistry careers.

In the recorded coaching conversations, a total of six different (II) *strategies of the coaches* (Figure 1) could be identified that the coaches used in the conversations with the young women. The use of these strategies depended on the described (I) *preconditions of the participants*. In the following, these six coaching strategies are described. The goal of these strategies is to engage in sincere reflections on the participant's relation with chemistry and science and occupations in this field, to question stereotypes and thinking patterns, and to support science identity formation.

- (a) *Asking for reasons.* The participants often talked about their thoughts or feelings on specific topics or reported on past experiences. Such statements included, for example, the participant's reasons for her specific career aspirations or personal opinions about science and chemistry. One strategy was to question these explanation patterns. The coach asked the participant to explain her comments especially if she justified them negatively referring to stable personality attributions, e.g., "I am bad in science". Through questioning this kind of explanation pattern, the coach tries to identify points at which change could be possible to question fixed negative attributions and to create room for new, more constructive ways of defining oneself.
- (b) *Informing about chemistry-related careers.* A second strategy to support the identity formation was to provide the participants with factual information. This comprises pointing out the importance of chemistry in a variety of careers that are rarely associated with chemistry. Further, benefits of certain science and chemistry careers were pointed out, such as a high income or good chances on the job market. Another possibility was to connect chemistry and the benefit for society, such as pharmaceutical drugs, the development of safer products for everyday consumption, or uncovering the misuse of chemicals in the industry. If a participant showed an interest in science or chemistry, further career options were discussed to broaden the participant's range of possible career paths. At this stage, a solid knowledge of the diversity of careers in science and chemistry was indispensable for the coach. Further sources for information on science careers were recommended to participants, such as the local employment office.
- (c) *Reflecting on the participant's self-perceptions.* In the conversations, the participants' performance in the chemistry-related tasks was discussed. Some participants did not perform well in the exercise for practical laboratory skills and/or in the spatial visualization task with the molecule models in the first part of the coaching, or their expected performance deviated from their actual performance. In such a case, some of the coaches showed the participant alternative interpretations of her results. The coaches focused on the discrepancy between the participant's results and her self-evaluation of her performance in the tasks. For instance, if the participant had shown progress, the coach referred to a learning process she might have gone through and highlighted her ability to learn and improve in chemistry. In case of poor performance in the tasks, the coach considered if external factors might have played a role (e.g. some participants used a pipette for the first time). This was done to engage the participants in a differentiated reflection of all kinds of factors that might be relevant in explaining their performance in chemistry and science.
- (d) *Encouraging.* The coaches often encouraged participants in the conversation to be more open to chemistry careers or to trust in their science abilities. This strategy was chosen especially if a young woman already had a very specific career plan in a non-chemistry-related field but at the same time had shown very good skills in the exercises. If the participant seemed not to trust in her skills, a strategy was to encourage her to have more confidence in her abilities. In these cases, the coach could point out the good results in the exercises and present them as an indicator of chemistry skills. If the coaching conversation revealed that a participant was still undecided about her career choice, she was encouraged to engage in more or different types of activities in vocational orientation.
- (e) *Presenting oneself as a role model.* Sometimes there were opportunities for the coach to present him- or herself as a role model. If a participant reported on her experiences in school or vocational orientation or on concrete events, some coaches took up the topic and talked about their own experiences with

chemistry. For example about his or her phase of career orientation (e.g. about the reasons for choosing his or her profession), the things that did not turn out as expected, and what could have been done differently. At this point, it was possible for a female coach to express her enthusiasm for science and chemistry and to show that there are women in science who do not conform to prevailing stereotypes. The intention was to encourage female participants to consider careers in chemistry-related fields. This way, in some cases, a personal connection with the participant could be created. This type of personal bond can provide a basis of trust allowing participants to take the coach's encouragements and new interpretations seriously and to engage in new ways of thinking together with the coach.

- (f) *Giving emotional feedback.* If the participants showed a lot of doubts, some coaches tried to give emotional feedback. They praised the participants' achievements and attempted to draw attention to her success in the tasks. This way, the coaches tried to shift the participant's focus towards progress and learning and to support her self-confidence regarding her abilities.

The conversations revealed that for successful coachings, the strategies need to be employed wisely. This was conceptualized by defining the (III) *connecting elements* (Figure 1). They show in which contexts the six coaching strategies can be used successfully. These connecting elements represent situations in which participants show an openness for a vocational orientation in chemistry. If connecting elements emerge in a conversation, the coach can use them to engage in deeper reflections with the participant and to develop, among other things, a greater awareness of chemistry-related occupational fields. A broad range of connecting elements is possible. The following list presents some examples:

- The career aspirations of the participant are not yet fixed, or she is undecided about her career direction.
- There is a discrepancy between the participant's self-evaluations in chemistry and her actual performance in chemistry-related tasks.
- The participant's explanation for her results does not seem convincing or alternative explanations are possible.
- The participant shows interest in certain topics.
- The participant expresses an explicit interest in chemistry-related careers.

In the following, an example is provided to show how the three sections can be used for guiding vocational orientation coachings for young women in chemistry. The section represents one particular case in which the participant did not trust in her chemistry abilities despite her good performance in the chemistry-related tasks of the coaching. The case combines aspects that appeared in several coachings that can be subsumed under a lack of confidence in one's abilities.

- (I) *Preconditions of the participant.* The participant shows low (a) *career aspirations* and a weak (b) *self-concept* in science but performs well in chemistry-related exercises and improved in these tasks during the coaching. Further, the participant shows only limited (c) *interest* in chemistry.
- (II) *Strategies of the coach.* The coach reacted to this by addressing the discrepancy between the participant's evaluation of her abilities and her actual performance. One important strategy was (a) *asking for reasons*. The coach asked the participant to explain her thoughts, feelings, and experiences, seeking to identify aspects where change might be conceivable and to challenge the participant's self-descriptions. The coach asked: "What do you think of the results? What goes through your mind? Are you surprised?". In this coaching conversation, the participant was surprised by her positive results since she had not expected to perform well. She justified her low self-confidence because she had never done this kind of task before and that her grades in science and chemistry are generally not good. In response to this, the coach used the strategy of (f) *giving emotional feedback* by highlighting concrete results. Together with the participant, the coach went through the practical exercises' results, highlighting her improvement, praising her results, and her way of working on the tasks. This raised awareness of positive results. The participant finally stated that the practical laboratory skills task was not as difficult as she previously thought and that the tasks were fun.

- (III) *Connecting element*. The connecting element the coach used in this conversation was the discrepancy between the participant's self-evaluations in chemistry and her actual performance in the chemistry-related tasks in the first part of the coaching. The coach tried to point towards this discrepancy to engage in questioning the participant's negative self-concept. This seemed to be fruitful since the participant also reported that she tends to expect negative results in chemistry and science lessons and exams. She did not trust her abilities in science.

At this point, the coach used further *(II) strategies of the coaches*, such as, for instance, *(d) encouraging*: the coach called for more confidence in her performance and tried to use the strategy of *(e) presenting oneself as a role model*.

Discussion and conclusions

This study presented a scheme with strategies for coaching young women in vocational orientation in chemistry which were developed as part of the vocational orientation project “*DiversitySensitive Support: vocational orientation in STEM for female adolescents with a migration background in cooperation with parents (DiSenSu)*”. The goal of the coachings was to create a greater awareness of chemistry-related careers, especially among young women of non-dominant ethnicity, and to support their development of cultural chemistry capital (Archer et al., 2014; Rüschpöhler & Markic, 2020a). Particular attention was paid to self-concept and career aspirations in science and chemistry. The strategies developed in this study are based on the analysis of 11 coaching conversations conducted by four trained coaches. The strategies have the potential to support girls and young women in acquiring chemistry capital. In particular, cultural chemistry capital can be acquired, namely a positive attitude towards chemistry, a science identity, and openness to vocational orientation in chemistry.

How to use these results in practice

The coaching strategies and the scheme for diversity-sensitive coachings for vocational orientation in chemistry (Figure 1) can be used by chemistry educators. In order to be diversity-sensitive, coachings need to be based on the *(I) preconditions of the participants* which were established in the first part of the coaching, including data on self-concept, career aspirations, and performance in certain chemistry-related tasks. The tool for conducting the first part of the coaching is described in (Markic et al., 2018). Using this tool, quantitative information on the young women's self-concepts and career aspirations can be obtained. Based on these data, coaching conversations can be conducted, structured by the elements defined in the present study. The coaches used the information from the tool to select appropriate *(II) strategies of the coaches* and to determine potential *(III) connecting elements* that might engage both the coach and the participant in an authentic reflection on different perspectives on careers in chemistry-related fields, in particular, on chemistry identities, aspirations, and self-concept.

Out-of-school activities in the sense of *Science in Public* appear to be particularly promising contexts for diversity-sensitive coachings for vocational orientation in chemistry. These settings allow to step back from school experiences and thereby provide a space in which new developments are possible. During the project, positive experiences were made especially at career fairs. Here, the young women were particularly interested in reflecting on their career aspirations because they visit these events with the specific purpose of getting to know different types of occupations.

The coaches in the present study had received special training preparing them for their work. This training enabled the coaches to focus on aspects relevant to the diversity sensitivity of the coachings, such as typical structures in self-concept and career aspirations in science and chemistry. Prior training thus seems to be an important condition for providing diversity-sensitive coachings in vocational orientation in science and

chemistry. Professionals in vocational orientation and chemistry educators in out-of-school settings could prepare for vocational orientation based on the three main categories described in this article (Figure 1). After conducting the first coachings, chemistry educators and vocational orientation professionals could try to step back from their work in order to reflect their coachings. This could be done using the scheme established in this study. This self-reflection could inspire further coachings. Feedback from colleagues could also be helpful for reflecting on the diversity sensitivity of the coachings. Educators could thereby professionalize in vocational orientation for young women in chemistry-related professions.

The strategies presented are of course bound to their particular context and might not be directly transferable to other fields. Adaptations to concrete local structures providing vocational orientation in chemistry could be fruitful. Moreover, it is challenging to estimate the impact the coaching strategies had on the participants' long-term thinking and to determine whether they end up in such occupational fields. This would require a long-term intervention study. However, as part of another study, some participants were interviewed a few weeks after the intervention to determine the general effects of the coaching. This revealed a positive impact of the coaching, such as stimulating conversations between girls and friends about careers in chemistry-related fields or reflecting on their own attitudes (Hönig, Küsel, Rüschenpöhler, & Markic, in preparation).

The list of the preconditions of the participants, the strategies of the coaches, and the connecting elements (Figure 1) is of course not exhaustive. Since this study's results are based on the analysis of 11 coaching conversations, there may be other fruitful strategies that could be used in vocational orientation conversations in chemistry with young women. However, in our study those are the ones that were extracted and repeatedly used by the coaches. The strategies presented in this article thus seem to form a solid basis for this type of diversity-sensitive coaching. The coaches did not mention any additional coaching strategies. Their feedback confirmed that the strategies developed in this study might represent the most important aspects.

Since the vocational orientation is obligatory in secondary schools following the different curricula, the named strategies can also be used by teachers, especially during out-of-classroom activities. It is recommended that the coaching strategies should be a part of pre- and in-service chemistry teacher education.

Author contributions: All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

Research funding: The project “DiversitySensitive Support: vocational orientation in STEM for female adolescents with migration background in cooperation with parents (DiSenSu)” is funded by the Federal Ministry of Education and Research (BMBF) under the funding codes 01FP1725 and 01FP1726.

Conflict of interest statement: The authors declare no conflicts of interest regarding this article.

References

- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2010). “Doing” science versus “being” a scientist: Examining 10/11-year-old schoolchildren's constructions of science through the lens of identity. *Science Education*, 94(4), 617–639.
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). “Balancing acts”: Elementary school girls' negotiations of femininity, achievement, and science. *Science Education*, 96(6), 967–989.
- Archer, L., DeWitt, J., & Willis, B. (2014). Adolescent boys' science aspirations: Masculinity, capital, and power. *Journal of Research in Science Teaching*, 51(1), 1–30.
- Carlone, H. B. (2004). The cultural production of science in reform-based physics: girls' access, participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392–414.
- Carlone, H. B., Webb, A. W., Archer, L., & Taylor, M. (2015). What kind of boy does science? A critical perspective on the science trajectories of four scientifically talented boys. *Science Education*, 99(3), 438–64.
- DeWitt, J., Archer, L., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2011). High aspirations but low progression: The science aspirations-careers paradox amongst minority ethnic students. *International Journal of Science and Mathematics Education*, 9(2), 243–71.
- Hönig, M., Küsel, J., Rüschenpöhler, L., & Markic, S. (in preparation). *Nachhaltigkeit Und Auswirkung Der DiSenSu-Berufsorientierungscoachings*.

- Hönig, M., Rüschenpöhler, L., Küsel, J., & Markic, S. (2020). Förderung von Science capital im Berufsorientierungsprojekt DiSenSu. In S. Habig (Ed.), *Naturwissenschaftliche Kompetenzen in der Gesellschaft von morgen*. Vol. 40 (pp. 780–883). Wien: Gesellschaft für Didaktik der Chemie und Physik.
- Jayaratne, T. E., Thomas, N. G., & Trautmann, M. (2003). Intervention program to keep girls in the science pipeline: Outcome differences by ethnic status. *Journal of Research in Science Teaching*, 40(4), 393–414.
- Koul, R., Lerdpornkulrat, T., & Poondej, C. (2016). Gender compatibility, math-gender stereotypes, and self-concepts in math and physics. *Physical Review Physics Education Research*, 12(2), 020115. <https://doi.org/10.1103/PhysRevPhysEducRes.12.020115>.
- Kultusministerkonferenz. (2017). *Empfehlung zur beruflichen Orientierung an Schulen (Beschluss der Kultusministerkonferenz vom 07.12.2017)*. Berlin, Sekretariat der Ständigen Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland.
- Markic, S., Prechtel, M., Hönig, M., Küsel, J., Rüschenpöhler, L., & Stubbe, U. (2018). DiSenSu: diversity sensitive support for girls with migration background for STEM careers. In I. Eilks, S. Markic, & B. Ralle (Eds.), *Building bridges across disciplines for transformative education and a sustainable future* (pp. 215–218). Aachen, Shaker Verlag.
- Mayring, P. (2010). *Qualitative Inhaltsanalyse: Grundlagen und Techniken*. 11., aktualisierte und überarb. Aufl, Weinheim, Beltz.
- Ministerium für Kultus, Jugend und Sport. (2016). *Gemeinsamer Bildungsplan für die Sekundarstufe I. Bildungsplan 2016: Chemie*. Vol. 2/2016. Villingen-Schwenningen: Neckar-Verlag.
- OECD. (2009). *PISA 2006 technical report*, Paris: OECD Publishing.
- Rüschenpöhler, L., & Markic, S. (2019). A mixed methods approach to culture-sensitive academic self-concept research. *Education Sciences*, 9(3), 240–256.
- Rüschenpöhler, L., & Markic, S. (2020a). Secondary school students' acquisition of science capital in the field of chemistry. *Chemistry Education Research and Practice*, 21(1), 220–236.
- Rüschenpöhler, L., & Markic, S. (2020b). Secondary school students' chemistry self-concepts: Gender and culture, and the impact of chemistry self-concept on learning behaviour. *Chemistry Education Research and Practice*, 21(1), 209–219.
- Rüschenpöhler, L., Hönig, M., Küsel, J., & Markic, S. (2020a). The role of gender and culture in vocational orientation in science. *Education Sciences*, 10(9), 240.
- Rüschenpöhler, L., Hönig, M., Küsel, J., & Markic, S. (in preparation). *Die Bildung von Coaches für eine diversitätsensible Berufsorientierung in den Naturwissenschaften*.
- Rüschenpöhler, L., Küsel, J., Hönig, M., & Markic, S. (2020b). Gesprächsführung in Der Berufsorientierung: Strategien Zur Förderung Naturwissenschaftlicher Identitäten Nach Dem Science-Capital-Ansatz. *CHEMKON*. <https://doi.org/10.1002/ckon.202000056>.
- Thomas, J. A., & Strunk, K. K. (2017). Expectancy-value and children's science achievement: Parents matter. *Journal of Research in Science Teaching*, 54(6), 693–712.