

Intercultural STEAM Trainings: Training the Workforce of the Future

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ABSTRACT

Our world today is undergoing significant changes that are impacting society and business. Interdisciplinary skills are essential to manage this transformation constructively. Digital, technological, and intercultural skills are among the so-called future skills that have been defined as relevant in the newly evolving conditions. New training and educational formats are needed to meet these needs.

A new training method of Intercultural STEAM Training is currently under development because research shows that intercultural exposure, experience, and training in school have multiple benefits. Its goal is to create a symbiosis of STEM training with intercultural training based on the STEAM approach. It is designed to increase motivation to engage in STEM and to develop intercultural competences in students aged between 12 and 16, as an adjustment screw along the educational chain. The design of the method takes the learning expectations of young generations into account. It contributes to providing the first elements of future skills at school age.

The following literature review describes the societal framework that requires novel training methods. It presents the training concept and illustrates the need for and relevance of the new approach.

Gegenwärtig vollziehen sich tiefgreifende Veränderungen, die sich gleichermaßen auf Gesellschaft und Wirtschaft auswirken. Um diesem Wandel auf konstruktive Weise zu begegnen, sind interdisziplinäre Fähigkeiten unerlässlich. Digitale, technologische und interkulturelle Kompetenzen gehören zu den so genannten Future Skills, die vor dem Hintergrund der neu entstehenden Bedingungen als relevant definiert wurden. Um den Anforderungen gerecht zu werden, sind neue Trainings- und Bildungsformate vonnöten.

Das interkulturelle STEAM-Training ist eine neue Trainingsmethode, die derzeit entwickelt wird, zumal die Forschung zeigt, dass interkulturelle Erfahrungen und Trainings in der Schule einen vielfältigen Nutzen haben. Ihr Ziel ist es, auf der Grundlage des STEAM-Ansatzes eine Symbiose aus MINT-Training und interkulturellem Training zu schaffen. Als Stellschraube entlang der Bildungskette sollen die Motivation zur Beschäftigung mit MINT-Fächern (Mathematik, Informatik, Naturwissenschaft, Technik) steigern und interkulturelle Kompetenzen bei Schülerinnen und Schülern im Alter zwischen 12 und 16 Jahren entwickelt werden. Das Design der Methode berücksichtigt die Lernerwartungen der jungen Generationen. Sie sorgt dafür, dass bereits im Schulalter die ersten Elemente von Future Skills vermittelt werden.

Die folgende Literaturübersicht beschreibt den gesellschaftlichen Rahmen, der neuartige Methoden der Ausbildung erfordert. Sie stellt das Ausbildungskonzept vor und verdeutlicht die Notwendigkeit und Relevanz des neuen Ansatzes.

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1. Introduction

Novel skills are needed to meet new challenges.

In order to play a constructive role in the labor market of the future, graduates will need, in addition to professional competences, a wide range of complementary skills, which are currently only rudimentarily included in curricula, the so-called future skills. Developments such as decarbonization, deglobalization, digitalization and demographic change are defining a new framework for the labor market (Demary et al., 2021). Definitions for professional success differ from those of the past (Lamri, 2019). Employees and leaders therefore need to adapt and develop new abilities and skills in order to deal with a world shaped by volatility, uncertainty, complexity and ambiguity and need to develop the discipline to carefully analyze situations for what they are (Nathan & Lemoine, 2014). Therefore, expertise beyond subject-specific matters is necessary in order to be able to act and to make decisions in ambiguous environments.

The joint organization *Stifterverband für die Deutsche Wirtschaft e. V.* (Suessenbach et al., 2021) identified 21 skills that are essential for employees to handle new and emerging challenges within their professional environment. They are categorized as technological, transformative, classical or digital competencies. Many of them refer to the so-called STEM disciplines (Science, Technology, Engineering, Mathematics). Many industries and professions are in urgent need of experts in STEM subjects, including intercultural skills.

The term STEM is widely used in a variety of educational contexts. In addition, the term STEAM has also become more widely used. STEAM is a variation of STEM. The "A" in the term STEAM, according to the definition, stands for Arts or other practices that can be

applied to show STEM topics from a different perspective. The goal is to encourage creativity, broaden horizons and inspire new ways of thinking (Nationales MINT-Forum e. V., 2023).

2. Search for STEM experts

Within the German educational system stakeholders along the educational system like schools, associations or companies are offering trainings and workshops for high-school study and career orientation throughout the entire educational chain with the goal to inspire the youth and show the opportunities of STEM and to minimize the shortage of STEM experts. Workshops are offered by educational institutions, e.g. schools, colleges, and universities. Examples include the ZDI (*Zukunft durch Innovation*) network in North-Rhine Westphalia (zdi-portal, 2023) offers from universities of applied sciences such as the Deggendorf Institute of Technology (THD und Schule | THD, 2023) and associations such as *Technik für Kinder e. V.* In addition, there are numerous companies, associations, foundations, and other stakeholders dedicated to out-of-school STEM education. Due to the diversity of providers it is not possible to quantify the total amount. What is offered varies a great deal between different regions and between urban and rural areas. Initiatives like *MINT-Regionen* (MINT-Regionen, 2023) or *MINTVernetzt* (Willkommen | MINTvernetzt, 2023) try to bundle these offers and by doing so to make them more visible for their target group and to connect stakeholders.

Besides huge efforts on multiple levels the current situation is severe. As of October 2022, Germany had a shortage of 326,100 people in STEM fields, and this number will continue to increase (Institut der deutschen Wirtschaft [IW], 2022). The disruptive environment, the need for research and innovation will constantly rise, driven by new societal, political and economic conditions. This is amplified by the fact that the

number of first-year STEM students between the academic years 2015/2017 and 2021/2022 was declining (Anger & Plünnecke, 2022; IW, 2022). In 2021, for example, 6.5 % fewer students opted to study STEM subjects than in the previous year. The proportion of those opting for STEM subjects in their first semester is also falling: in 2021, it was 37.7%. In 2015, it was still 40.5% (Statistisches Bundesamt, 2023).

These alarming figures lead to the conclusion that no one with a talent or interest in STEM can be left behind (Anger et al., 2023). Being educated is a human right (United Nations, 2023), regardless of economic prospects alone. To implement this right, it is necessary to facilitate the participation of all social groups, irrespective of stereotypes and structural barriers, and to use the full range of educational opportunities in accordance with personal interests and aptitudes.

3. The growing need for intercultural competences

Due to the high degree of interconnectedness individuals today encounter cultural diversity on various levels. This presents an opportunity to profit from its advantages, but also bears the risk of conflict potential. Intercultural competence enables individuals to effectively interact and communicate with others who come from and operate within different cultural contexts. This skill is crucial for remaining constructive and adaptable in situations of uncertainty, particularly in our increasingly interconnected and interdependent world. The concept of culture transcends national borders and encompasses the extended life worlds of people (Bolten, 2018).

According to Bolten, intercultural competence is not an independent area of competence but is best understood in the sense of the Latin term of *competere*: "to bring together". It unites the ability to combine and to apply individual, social, professional, and strategic competences in the best possible way within intercultural contexts with the goal to act constructively within an unknown field of agency. Intercultural competence is therefore not a key qualification, but rather a cross-cutting task. Its success depends on the interaction of different key qualifications (Bolten, 2018). It includes various fields of competences:

- Professional competences like international professional experience, market knowledge.
- Social competences like team building, leadership, empathy.
- Strategic competences like knowledge management, problem-solving skills.
- Self-competences like problem-solving skills (Bolten, 2018).

“Culture is a fuzzy set of basic assumptions and values, orientations to life, beliefs, policies, procedures and behavioural conventions that are shared by a group of people, and that influence (but do not determine) each member’s behaviour and his/her interpretations of the ‘meaning’ of other people’s behaviour“ (Spencer-Oatey, 2008, p. 3).

For the acquisition of intercultural competence it is imperative to be in touch with unfamiliar fields of action, to hone different skills and to be aware that there are no final answers within the discipline of intercultural communication. Life-long learning is inevitable.

Research shows that the exposure of students to intercultural issues during their adolescence is highly effective and beneficial.

Cultivating intercultural competence in high school students is highly beneficial because during this stage of their development, young people are learning to think independently and to engage with global concepts such as culture, history and politics without difficulty and they are planning their future choices of career and university (Nelson & Luetz, 2021).

“Young people today must not only learn to participate in a more interconnected world but also appreciate and benefit from cultural differences. Developing a global and intercultural outlook is a process—a lifelong process—that education can shape” (OECD, 2018).

Incorporating cultural diversity into the curriculum and adopting inclusive pedagogical approaches not only enhances the educational experience of students, but also promotes fairness and social justice in the education system (Pérez-Jorge et al., 2023). In school, intercultural competence is an important element

for realizing inclusion (Yang et al., 20174).

4. Intercultural STEAM trainings

A new, interdisciplinary training method is currently under development with the aim of enhancing motivation for engaging with STEM subjects and intercultural communication. The target group are students aged 12–16. It combines intercultural training with STEM education in a mutually beneficial manner within the STEAM framework. For the new training method the definition by the EuroSteam Initiative is utilized: STEAM is described here as a transdisciplinary interaction between science, technology, engineering, mathematics, arts, humanities and ecological awareness (Haesen & van de Put, 2018). The STEAM approach focuses on problem-solving. It develops understanding and attitudes by tackling real-world problems. Students and teachers work together as co-researchers. The teacher acts as a guide throughout the process and needs to ensure that the topics chosen are of interest to the students and within their reach (Haesen & van de Put, 2018).

The primary objectives of the new training method are increasing motivation engaging and exploring intercultural communication and age-appropriate STEM topics:

- The aim of the trainings is to motivate students for STEM subjects and to develop interest for intercultural communication from an early stage in their education. Studies show that people in this age group have a high level of curiosity and open-mindedness to explore new subjects but are limited to explore their fields of interest by gender stereotypes (Stemmer, 2019).
- To present STEM subjects and their related professions in a more realistic setting, with the integration of intercultural aspects, potentially making it more appealing to their target audience. Contextualized STEM topics can strengthen the interests of both genders and have the potential to highlight the relevance of STEM for people and nature, for society, politics and the economy to the target group (Körber Stiftung, acatech – Deutsche Akademie der Technikwissenschaften, 2021). Especially for young women the content of career and study guidance should be designed taking

into account practical relevance, meaningful links with the school curriculum and creative, exploratory learning (Nationales MINT-Forum e. V., 2023).

- To broaden young people's understanding of normality and help them gain new insights. In order to make the method accessible to a large pool of trainers on a low-threshold basis, the training method is being developed in a modular way to make it accessible to STEM trainers without intercultural training and thus has the potential to reach many students not only in schools but in external education places.
- Intercultural training originated in the USA. The reasoning behind implementing the methodology has evolved in recent decades. In the previous two decades, the prevailing view was that social diversity was a competitive advantage and provided business benefits (Anand Rohini, 2008). Germany is still at an evolving stage. However, there is a growing awareness of the various possible applications in different contexts and areas such as diversity, racism, and intercultural coexistence (Mazziotta et al., 2016).
- There is currently no comparable interdisciplinary method available. The approach to combine methods will increase the scope of intercultural education. Not everyone will attend university, but everyone benefits from intercultural competence in an interconnected world. This approach provides essential skills for the future by integrating existing learning materials with intercultural competence.
- Created for the target group: The training method is designed to meet the educational expectations of current pupils.
- The intercultural part of the training method is based on a holistic definition of culture. It encompasses both narrower and broader concepts of culture but does not exclude their validity from each other. Both two-valued and multi-valued logics have their place within this definition. “Either” and “both” are not “contradictory” in this context. Defining this requires that the various interpretations remain undifferentiated (Bolten, 2018). It will

consider the different perspectives of students towards culture (Paras & Mitchell, 2017). The training method will take into account implicit and explicit intercultural learning strategies (Morris et al., 2014).

The STEM part will be developed using best practices from existing approaches. There exists no standard or unifying framework for the development of STEM workshops. This is due to the diverse and wide range of applications within the STEM disciplines and due to the differences in the framework conditions of the providers. What unifies all offerings is the common goal to increase motivation among their target group to engage with STEM subjects. In German schools, content is prescribed by the curricula of the federal states. Within the context of the *MINT-Qualitätsoffensive* standardized quality standards have been formulated for extracurricular content to enhance the effectiveness of the offerings within Germany (Pahnke & Staats, 2022). An international comparison has proven itself difficult due to divergent educational systems and framework conditions. Directly transferring offers may not always be appropriate.

A number of different approaches are being considered to combine the elements of STEM and intercultural communication. One of the methods currently under consideration is storytelling. By recounting shared human experiences or universal insights that transcend differences related to situated realities and identities, stories foster connections between people (Hoffmann & Mastellotto, 2023). This method may therefore be an effective approach to contextualizing certain aspects of the STEM occupational field and communicating them to students in an accessible manner, while also highlighting intercultural aspects. An alternative possible approach could be the model of *Global Fitness Development Cycle* by Helen Spencer-Oatey that consists of the following elements:

- Skills and Qualities
- Mastering the Development Kit
- Moulding the organizational context (Spencer-Oatey, 2022, p. 12).

Further research is needed to find the most appropriate approach or combination of approaches that will suit the uniqueness of

both learning modules and support the pupils in achieving the predefined learning objectives.

A workshop will consist of two sessions. Each unit will consist of 4 x 45-minute workshops, divided into 50% STEM and 50% intercultural communication. The method will get developed modularly so it can be adapted according to the needs of trainers. A one-day train-the-trainer workshop prepares STEM educators to use the method. Special emphasis is placed on the combination of theory and practice, as studies show that this can be an important criterion for teachers when choosing a training course (Foulidi et al., 2016). Further research is needed to select the most suitable topics and exercises from both areas that can be combined in a meaningful way for both disciplines.

At the present time, evaluation of the research is premature in view of its early theoretical stage; evaluation will have to take place at later stages. However, evaluation based on Self-Determination Theory might be considered as a suitable approach. It provides a comprehensive framework for understanding the factors that facilitate or undermine intrinsic motivation, autonomous extrinsic motivation, and psychological wellness, all of which are of direct relevance to educational settings (Ryan & Deci, 2020).

5. Relevance of the training method

The following references demonstrate the relevance of the method:

- The degree of internationalization within the STEM fields

In business environments, using English nowadays is seen as extending one's native language rather than using a foreign language (Wissenschaftsladen Bonn, 2023). That could be seen as a strong indicator of the degree of internationalization in the contemporary world. Working in STEM means working in international environments and generally involves interacting with people from different countries and to handle foreign languages, particularly in STEM fields. Therefore, intercultural literacy and competence are essential facets of education that are necessary for successful communication, interaction and problem-solving in various subject areas of the STEM fields. Research questions for

instance can often only be answered in a global context and usually through collaboration with international research teams. While the share of STEM graduates with an international background was 14.2 per cent in 2011, it increased to 20.5 per cent in 2020. The influx of international skilled workers is a key factor in maintaining Germany's workforce (Institut der deutschen Wirtschaft (IW), 2022).

Moreover, fields oriented towards global markets are particularly likely to employ STEM professionals (Mostovova & Hetze, 2013). This factor is even more important for Germany given its role as one of the world's leading exporters (Statista, 2023b).

Supply chains are another example: Effective communication with individuals from different cultural backgrounds is crucial in supply chain management. Clear communication is essential to ensure that goods are delivered on time and in accordance with quality standards. Therefore, taking the time to understand cultural differences and adapting communication styles accordingly can greatly enhance supply chain efficiency.

The majority of computer hardware manufacturers are based in Asia (IBISWorld, 2024). Engineers and scientists working with computer hardware provide another compelling example of the need for intercultural communication skills in STEM due to the level of internationalization within the discipline.

Even within the country, the discipline continues to become more internationalized. The number of employees in academic STEM professions increased by 34% among Germans from the end of 2012 to the end of 2021, but by 155% among all foreigners (Arbeitsmarkt, 2023).

- Showing STEM in a new perspective focusing on underrepresented groups

One population group that is still underrepresented in STEM fields are women. Besides huge efforts to increase the number of women in STEM there is still a big gender gap. Although the numbers are slightly increasing, there are large differences between disciplines. Energy and electrical engineering (10.8%) and metal processing (11.6%) have currently the lowest figures in female employment (Drescher

et al., 2020).

Already in primary school, boys have a slight advantage over girls in mathematics and the gap has been increasing over the last 10 years. Differences were noticed in interest and self-confidence. Gender differences are greater in motivation than in performance. Part of the explanation is that boys tend to overestimate and girls underestimate themselves in areas that do not fit with their traditional role identity (Stanat et al., 2022).

Role perception has a big influence on the career choices of girls (Stemmer, 2019). Evidently a traditional view of social roles is very strong in parts of the German population. Up to 25% of Germans surveyed in 2022 agreed with anti-feminist and sexist statements that correlate with traditional views of women's roles (Kalkstein et al., 2022). These numbers have increased in the last years (Höcker et al., 2018).

Another indicator is the rate of women working part-time. In 2023, 48.7% of all working women were employed part-time (Statista, 2023a). Statistics from 2019 show that there is a particularly high share among mothers. 66.7% of mothers work part-time, compared to 6.9% of fathers (Janson, 2023).

For young people the phase of professional orientation is a crucial time within their development. The period of vocational orientation coincides with the onset of adolescence. It is a time when young people carry out a thorough self-assessment and when they map out the course of their lives. Simultaneously they encounter the demands and limitations of the labor market. Gender stereotypes play a significant role in this scenario. This phase poses a particular challenge for young women who pursue male-dominated occupations, which creates a challenging situation for them to search for their own identity (Wentzel, 2007).

The *IQB Bildungstrend 2018* recorded two indicators of student motivation: subject-specific self-confidence and subject-specific interest. The study identified gender stereotypes in relation to both of these indicators (Stanat et al., 2019).

Young women tend to respond more sensitively

to the disparity between their expectations and experiences, as well as societal prejudice, compared to boys. Moreover, a significant number of female students and young women prioritize the societal impact and contributions of technology over personal interests when selecting a profession. Female students primarily choose engineering because they perceive it as an opportunity to enhance and modernize the world in which we live (acatech, 2009).

Socialization plays a role in shaping the interests and behavioral choices of girls in STEM fields. From birth, boys and girls undergo gender-specific socialization and obtain gender-targeted backing for their inclination towards scientific and technical tasks. However, girls are discouraged from cultivating a fascination with STEM fields. Students develop an identity based on the expectations of their teachers and parents as a consequence of educational socialization. Additionally, any deviation from gender-typical behavior during adolescence is negatively sanctioned by their peer groups (Stemmer, 2019). Studies show that measures addressing the interests and realities of girls in terms of content, methodology and didactics are particularly successful. Measures such as creative research-based learning and the free choice of a research topic in competitions are effective in increasing the motivation of girls (Nationales MINT-Forum e. V., 2022).

Another significant but disproportionately underrepresented group in STEM careers are children with a migration background. There is a research gap regarding their level of orientation, but it can be assumed that their self-perception is negatively affected. This in turn has impacted on their career choices (Institut der deutschen Wirtschaft (IW), 2022).

- Teaching future generations

Contemporary research in the social sciences underscores the significance of generational identity in differentiating between generations and birth cohorts. This perspective on the construct of generation is somewhat fluid, taking into account both historical and identity-related shifts (Campbell et al., 2017).

Alwin and McCammon describe three distinct concepts of “generation”, that converge within the life history of the individual

- generations as positions in family lineages
- generations as birth cohorts or historical locations
- generations as historical participation (Alwin & McCammon, 2007).

The "age-period-cohort" model of social change offers a useful framework for understanding the influence of key factors, including aging, time, and cohort membership, on social change processes (Mason & Fienberg, 1985).

Social science studies therefore suggest that the term "generation" is not a concept that can be applied to all members of a defined group or cohort. Nevertheless, as the findings above show, similarities can be observed in certain areas.

A 2017 study concentrates to bridge the gap between students' and teachers' expectations and provides recommendations (Cilliers, 2017):

- The incorporation of digital tools, hardware, and social media in the teaching process.
- Exploring the Internet as a communication tool within a collaborative decision-making process, striving for enhanced interconnectedness among group members rather than individual isolation.
- Creative classroom setups as part of the education process.
- Discussions and groupwork instead of PowerPoint.
- Learner-based learning including visual methods and creative teaching methods.
- Education should prioritize hands-on experiences in a safe learning environment that encourages risk-taking and failure, as this is more effective than simply transferring information.
- Furthermore, education should focus on helping students navigate and process an overwhelming amount of information. Transparency is key for effective teacher-student communication (Cpuddy, 2022).
- Interested in the stories of their peer

students, storytelling is a suitable way to approach them (Schwieger & Ladwig).

- Intercultural education in German schools

In German schools, intercultural education has been a goal defined by the *Kultusministerkonferenz* and has been adopted as an educational objective in 1996 (Ständige Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland, 2013). Since the implementation of the curricula, within the federalist German system, is carried out by the federal states, the content and degree of the educational topics is defined by the federal states (Bundesministerium für Bildung und Forschung – BMBF, 2023). Intercultural education is incorporated into the curricula of Bavarian schools with varying degrees depending on the type of institution. It is found within subjects like languages, communication, and vocational orientation. However, it is notably absent with the STEM courses (LehrplanPLUS – Suchergebnis, 2023).

Currently intercultural education is integrated into the curricula of both compulsory and higher education institutions in Bavaria. It aims to promote cross-cultural understanding by providing students with the necessary knowledge and skills to interact respectfully with individuals from different cultures (LehrplanPLUS – Interkulturelle Bildung, 2023). The federal state of Bavaria has developed numerous measures and funded projects in the past decade promoting intercultural school development (Kultusministerkonferenz, 2017). An example is WERTvoll MITEinander (Bayerischer Lehrer- und Lehrerinnenverband (BLLV) e.V., 2023). The project results suggest that educational policies need to strive for equity for all students. This can be achieved by providing equal educational opportunities, ensuring that teachers have equal access to hierarchical positions within a school, and granting all parents access to schools irrespective of their social backgrounds or language abilities (Wertebündnis Bayern, 2015).

- A question of age

Neurobiological studies prove that learning at a young age is a huge benefit (Braun & Stern, 2007). Within the discipline, it is widely accepted that all forms of education, whether at home or in school, elicit permanent structural

alterations in the developing brain of a child. These changes become apparent over time.

The great plasticity of the adolescent brain makes it possible for environmental influences to have a special formative effect on cortical circuits. This opens up opportunities for education and upbringing (Deutscher Ärzteverlag GmbH, Redaktion Deutsches Ärzteblatt, 2013).

Therefore, neuroscientific research demonstrates that gaining future skills such as intercultural competence, and STEM-related trainings provides an advantage during adolescence or even earlier.

According to these findings, training potentially has long-lasting impact on adolescents between the ages of 12 and 16. The questioning of stereotypes and role models as well as the acquisition of new perspectives are particularly sustainable during the adolescent years.

6. Conclusion

Changing global conditions place new demands on the workforce of the future. So-called future skills define those essential competences and abilities for being able to operate successfully within the changed framework conditions. Intercultural competence and STEM skills are among those future skills defined by the *Deutsche Stifterverband* (Suessenbach et al., 2021).

The analyzed figures and studies show that the shortage of skilled workers in the STEM sector in Germany is enormous and that the gap will continue to grow in the coming years. At the same time, in an increasingly interconnected world, the need for intercultural competence will continue to grow strongly. A new training method that combines STEM training with intercultural training attempts to motivate young people to engage with these topics.

There are valid arguments for the implementation of this approach:

- Intercultural competence is a crucial skill in an increasingly interdependent world. It expands beyond nation-state concepts and has the potential to facilitate people's ability to operate in unknown and unpredictable fields of agency.

- In the professional STEM environment, international collaboration is an inherent aspect irrespective of the task at hand. Therefore, it is advantageous to have early intercultural training and education.
- The new training method takes into account the underrepresentation of women and immigrant children in STEM subjects, following the recommendations of the *Nationales MINT Forum* (Nationales MINT-Forum e. V., 2023). To inspire sustainable interest in STEM professions, particularly among women, offers are needed across the entire education chain starting at an early age. Specially designed programs tailored to each education phase and age group are required. The reviewed literature suggests that cross-cultural STEAM instruction can serve as a significant component for the specified audience, particularly for females. The training method accounts for the recommendations of the *Nationales MINT-Forum* to encourage young women in STEM fields.
- Neuroscientific research supports the assertion that the selected age group can particularly benefit from the training effects of the method due to neuroplasticity.
- The new approach takes into account the favored learning techniques of current pupils and students, making it very likely to be widely accepted by the target audience.
- Intercultural education is included in the curricula of Bavarian schools, but it is not integrated with STEM subjects. In conclusion, the available research shows that the novel approach can help to create a more realistic and contextualized understanding of STEM career prospects even at the early stages of career orientation.

Further research is needed to determine if the desired increase in motivation can be achieved with this new method of training.

Conflict of interest statement

The author declares that there is no conflict of interest in connection with the present work.

References

- acatech, V. D. (Ed.). (2009). *Nachwuchsbarometer Technikwissenschaften: Ergebnisbericht*. <https://www.acatech.de/publikation/ergebnisbericht-nachwuchsbarometer-technikwissenschaften/download-pdf/?lang=de>
- Alwin, D. F., & McCammon, R. J. (2007). Rethinking Generations. *Research in Human Development*, 4(3–4), 219–237. <https://doi.org/10.1080/15427600701663072>
- Anand Rohini, W. M.-F. (2008). A retrospective view of corporate diversity training from 1964 to the present. *Academy of Management Learning & Education* (7), 356–372. <https://doi.org/10.5465/AMLE.2008.34251673>
- Anger, C., & Plünnecke, A. (2022). *MINT gewinnt. Hohe Löhne in den MINT-Berufen*. Kurzbericht (Nr. 106). Institut der deutschen Wirtschaft (IW)
- Anger C., Betz J., & Plünnecke A. (2023). MINT-Bildung stärken, Potenziale von Frauen, Älteren und Zuwandernden heben. *Anger Gutachten*. <https://www.iwkoeln.de/studien/christina-anger-julia-betz-axel-plunnecke-mint-bildung-staerken-potenziale-von-frauen-aelteren-und-zuwandernden-heben.html>
- Arbeitsmarkt (2023, March 15). *IWD*. <https://www.iwd.de/artikel/auslaendische-beschaefigte-viele-haben-gut-bezahlte-mint-jobs-577372/>
- Bayerischer Lehrer- und Lehrerinnenverband (BLLV) e.V. *Wertvoll miteinander*. (2023, October 27). <https://www.bllv.de/projekte/paedagogische-initiativen/wertvoll-miteinander>
- Bolten, J. (2018). *Einführung in die interkulturelle Wirtschaftskommunikation* (3., überarbeitete und erweiterte Auflage). UTB: 2922. *Wirtschaftswissenschaften, interkulturelle Kommunikation*. Vandenhoeck & Ruprecht

- Braun A., & Stern E. (2007). *Neurowissenschaftliche Aspekte der Erziehung, Bildung und Betreuung von Kleinkindern*. https://www.renate-hendricks.de/dl/Prof._Braun,_von_Guericke_und_Prof._Stern_-_Neurowissenschaftliche_Aspunkte_der_Erziehung,_Bildung_und_Betreuung_von_Kleinkindern.pdf
- Bundesministerium für Bildung und Forschung – BMBF. (2023, October 26). *Zusammenarbeit von Bund und Ländern*. https://www.bmbf.de/bmbf/de/bildung/zusammenarbeit-von-bund-und-laendern/zusammenarbeit-von-bund-und-laendern_node.html
- Campbell, S. M., Twenge, J. M., & Campbell, W. K. (2017). Fuzzy But Useful Constructs: Making Sense of the Differences Between Generations. *Work, Aging and Retirement*, 3(2), 130–139. <https://doi.org/10.1093/workar/wax001>
- Cilliers, E. J. (2017). The Challenge of Teaching Generation Z. *PEOPLE International Journal of Social Sciences*, 3(1), 188–198. <https://doi.org/10.20319/pijss.2017.31.188198>
- Cpuddy. (2022). *Generation Z – Learning and Teaching Hub*. <https://lth.engineering.asu.edu/2022/08/gen-z/>
- Demary, V., Matthes, J., Plünnecke, A., & Schaefer, T. (. (2021). *Gleichzeitig: Wie vier Disruptionen die deutsche Wirtschaft verändern. Herausforderungen und Lösungen*. IW Studie
- Deutscher Ärzteverlag GmbH, Redaktion Deutsches Ärzteblatt. (2013). *Hirnentwicklung in der Adoleszenz*. <https://www.aerzteblatt.de/archiv/141049/Hirnentwicklung-in-der-Adoleszenz>
- Drescher, K., Häckl, S., & Schmieder, J. (2020). MINT-Berufe: *Workshops mit Rollenvorbildern können Geschlechterstereotype abbauen*. https://doi.org/10.18723/DIW_WB:2020-13-1
- Foulidi, X., Papakitsos, E. C., Karakiozis, K., Papapanousi, C., Theologis, E., & Argyriou, A. (2016). Systemic methodology for developing teachers extracurricular training. *Journal of Educational Leadership and Policy*(1 (2)), 36–42. <http://www.aiscience.org/journal/allissues/jelp.html?issueId=70660102>
- Haesen S., & van de Put, E. (2018). STEAM Education in Europe: *A comparative analysis report*. www.eurosteamproject.eu
- Höcker C., & Pickel, G. & Decker, O. (2018). Antifeminismus - das Geschlecht im Autoritarismus? Die Messung von Antifeminismus und Sexismus in Deutschland auf der Einstellungsebene. In O. Decker & E. Brähler (Eds.), *Flucht ins Autoritäre: Rechtsextreme Dynamiken in der Mitte der Gesellschaft : die Leipziger Autoritarismus-Studie 2018* (Originalausgabe). Psychosozial-Verlag
- Hoffmann, J., & Mastellotto, L. (2023). Storytelling in multilingual and intercultural contexts – An Introduction. Advance online publication. (Zeitschrift für Interkulturellen Fremdsprachenunterricht Volume 28 Issue 1 2023). <https://doi.org/10.48694/zif.3615>
- IBISWorld. (2024). *Global Computer Hardware Manufacturing – Market Size, Industry Analysis, Trends and Forecasts (2023–2028)*. (Last updated: July 2024). <https://www.ibisworld.com/global/market-research-reports/global-computer-hardware-manufacturing-industry/#GeographicBreakdown>
- Institut der deutschen Wirtschaft (IW) (Ed.). (2022, November 23). *MINT-Herbstreport 2022: MINT sichert Zukunft*. Gutachten für BDA, Gesamtmetall und MINT Zukunft schaffen. https://www.nationalesmintforum.de/fileadmin/medienablage/content/themen/aktuelles/2022/MINT-Herbstreport_2022.pdf
- Janson, M. (2023, May 12). Teilzeitquote von Müttern in Deutschland besonders hoch. *Statista*. <https://de.statista.com/infografik/29986/anteil-der-teilzeiterwerbstaetigen-im-eu-vergleich/>
- Kalkstein F., Pickel G., Niendorf J. (2022). 8. Antifeminismus und Geschlechterdemokratie. In O. Decker, J. Kiess, A. Heller, & E. Brähler (Eds.), *Forschung psychosozial. Autoritäre Dynamiken in unsicheren Zeiten: Neue Herausforderungen - alte Reaktionen?* : Leipziger Autoritarismus Studie 2022 (Originalausgabe, pp. 245–270). Psychosozial-Verlag
- Körper Stiftung, acatech – Deutsche Akademie der Technikwissenschaften (Ed.). (2021). *MINT Nachwuchsbarometer 2021*. file:///C:/Users/mkrwagna-noebauer/Downloads/MINT-Nachwuchsbarometer-2021_ES.pdf
- Kultusministerkonferenz (Ed.). „*Interkulturelle Bildung und Erziehung in der Schule*“: *Berichte der Länder über die Umsetzung des Beschlusses*.
- Lamri, J. (2019). *The 21st century skills: How soft skills can make all the difference in the digital era*. Independently published

- LehrplanPLUS – *Interkulturelle Bildung*. (2023, October 26)
- LehrplanPLUS – *Suchergebnis*. (2023, October 26)
- Mason, W. M., & Fienberg, S. E. (Eds.). (1985). *Cohort analysis in social research: Beyond the identification problem*. Springer-Verlag
- Mazziotta, A., Piper, V., & Rohmann, A. (2016). *Interkulturelle Trainings: Ein wissenschaftlich fundierter und praxisrelevanter Überblick* (1. Auflage). *essentials*. Springer Fachmedien Wiesbaden GmbH. <https://link.springer.com/book/10.1007/978-3-658-12873-9>
- MINT-Regionen. (2023, September 8). *MINT-Regionen*. <https://mint-regionen.de/>
- Morris, M. W., Savani, K., Mor, S., & Cho, J. (2014). When in Rome: Intercultural learning and implications for training. *Research in Organizational Behavior*, 34, 189–215. <https://doi.org/10.1016/j.riob.2014.09.003>
- Mostovova, E., & Hetze, P. (2013). *Wie international ist MINT?* Edition Stifterverband
- Nathan B., & Lemoine, G. J. (2014). What VUCA really means for you. *Harvard Business Review*, 92(1/2). https://www.researchgate.net/publication/263926940_What_VUCA_really_means_for_you
- Nationales MINT-Forum e.V. (Ed.). (2022). *Frauen in MINT-Berufen: gewinnen und halten: Empfehlungen des nationalen MINT-Forums*. https://www.nationalesmintforum.de/fileadmin/medienablage/content/themen/arbeitsgruppen/03_mint-frauen_4-0/Empfehlungen_MINT-Frauen_LF__05-12-2022__Web.pdf
- Nationales MINT-Forum e.V. (2023). *STEAM! Neue Zielgruppen über kreative Verbindungen erreichen Ein Thesenpapier*. Nationales MINT-Forum e.V. file:///C:/Users/mkrawagna-noebauer/Downloads/NMF-Thesenpapier-AG-Hochschulen_WEB_FINAL-1.pdf
- Nelson, W., & Luetz, J. M. (2021). The Impact of Short-Term Cross-Cultural Experience on the Intercultural Competence of Participating Students: A Case Study of Australian High School Students. *Social Sciences*, 10(8), 313. <https://doi.org/10.3390/socsci10080313>
- OECD. (2018). 0. <https://www.oecd.org/education/Global-competency-for-an-inclusive-world.pdf>
- Pahnke J., & Staats M. (2022). *Orientierungsrahmen Wirkungsvolle Arbeit außerschulischer MINT-Initiativen: Ein praktischer Leitfaden zur Selbstanalyse*. Nationales MINT-Forum e.V.
- Paras, A., & Mitchell, L. (2017). Assessing Intercultural Competence in Experiential Learning Abroad: Lessons. In *Experiential Learning & Teaching in Higher Education* (1 (1), pp. 45–64). <https://nsuworks.nova.edu/elthe/vol1/iss1/8/>
- Pérez-Jorge, D., González-Herrera, A. I., González-Afonso, M., & Santos-Álvarez, A. G. (2023). Reality and Future of Interculturality in Today's Schools. *Education Sciences*, 13(5), 525. <https://doi.org/10.3390/educsci13050525>
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>
- Schwieger D., & Ladwig C. (2018). *Reaching and Retaining the Next Generation: Adapting to the Expectations of Gen Z in the Classroom*. Southeast Missouri State University, Department of Accounting. <https://files.eric.ed.gov/fulltext/EJ1179303.pdf>
- Spencer-Oatey, H. (Ed.). (2008). *Culturally speaking: Culture, communication and politeness theory* (Second edition). Continuum International Publishing Group
- Spencer-Oatey, H. I. (2022). *Global fitness for global people : How to manage and leverage cultural diversity at work*. Castledown Publishers
- Stanat, P., Schipolowski, S., Mahler, N., Weirich, S., Henschel, S., & Lorz, R. A. (Eds.). (2019). *IQB-Bildungstrend 2018: Mathematische und naturwissenschaftliche Kompetenzen am Ende der Sekundarstufe I im zweiten Ländervergleich*. Waxmann
- Stanat, P., Schipolowski, S., Schneider, R., Sachse, K. A., Weirich, S., & Henschel, S. (Eds.). (2022). *IQB-Bildungstrend 2021: Kompetenzen in den Fächern Deutsch und Mathematik am Ende der 4. Jahrgangsstufe im dritten Ländervergleich* (1st ed.). Waxmann Verlag. <https://directory.doabooks.org/handle/20.500.12854/94704>
- Ständige Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland (Ed.). *Kultusminister Ständige Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland Interkulturelle Bildung und Erziehung in der Schule: (Beschluss der Kultusministerkonferenz vom 25.10.1996 i. d. F. vom 05.12.2013)*.

- Statista. (2023a, September 14). *EU - Teilzeitquoten nach Geschlecht 2023* | Statista. <https://de.statista.com/statistik/daten/studie/1098738/umfrage/anteil-der-teilzeitbeschaeftigung-in-den-eu-laendern/>
- Statista. (2023b, September 25). *Rangliste der größten Exportländer weltweit 2022* | Statista. <https://de.statista.com/statistik/daten/studie/37013/umfrage/ranking-der-top-20-exportlaender-weltweit/>
- Statistisches Bundesamt. (2023, January 23). *6,5 % weniger Studienanfängerinnen und -anfänger in MINT-Fächern im Studienjahr 2021: Pressemitteilung Nr. N004 vom 23. Januar 2023* [Press release] https://www.destatis.de/DE/Presse/Pressemitteilungen/2023/01/PD23_N004_213.html
- Stemmer, L. (2019). *Frauen in MINT:: Ein systematischer Erklärungsansatz der Leaky Pipeline*. Dissertation zur Erlangung des Doktorgrades Dr. phil. <https://open.fau.de/items/7fe0828e-6ace-40c0-b71e-d5f4f950c03e>
- Suessenbach, F., Winde, M., & Klier, Julia, Kirchherr Julia. (2021). *Future Skills 2021: 21 Kompetenzen für eine Welt im Wandel*
- THD und Schule* | THD. (2023, October 27). <https://www.th-deg.de/schule>
- Über Technik für Kinder e. V.* (2023, October 27). <https://www.tfk-ev.de/ueber-technik-fuer-kinder-e-v>
- United Nations. (2023, October 5). *Universal Declaration of Human Rights* | United Nations. <https://www.un.org/en/about-us/universal-declaration-of-human-rights>
- Wentzel, W. (Ed.). (2007). *Schriftenreihe/Kompetenzzentrum Technik - Diversity - Chancengleichheit: H. 6. Ingenieurin statt Germanistin und Tischlerin statt Friseurin? Evaluationsergebnisse zum Girls' Day – Mädchen-Zukunftstag*. Kompetenzzentrum Technik-Diversity-Chancengleichheit e.V.
- Wertebündnis Bayern (Ed.). (2015). *WERTvoll MITEinander: Interkulturelle Bildung für gelingendes Zusammenleben*. Vielfalt als Chance gestalten-Interkulturelle Schulentwicklung in Bayern
- Willkommen* | MINTvernetzt. (2023, September 28). <https://mint-vernetzt.de/>
- Wissenschaftsladen Bonn. (2023, September 25). *„Englisch gilt als Erweiterung der Muttersprache“*. <https://www.wila-arbeitsmarkt.de/blog/2017/10/04/%E2%80%9Eenglisch-gilt-als-erweiterung-der-muttersprache%E2%80%9C/>
- Yang, Y., Guo, C., & Sun, L. (2017). Study on the Standardization and Individuation of Classroom Teaching in Higher Education. In *Proceedings of the 2017 3rd International Conference on Social Science and Higher Education*. Atlantis Press. <https://doi.org/10.2991/icsshe-17.2017.54>
- zdi-portal. (2023, September 5). *Startseite*. <https://zdi-portal.de/>

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