DECEMBER 2024 NO. 7

BAVARIAN JOURNAL OF APPLIED SCIENCES®

www.jas.bayern

BAVARIAN JOURNAL OF APPLIED SCIENCES®

ISSN: 2366-3952
The Bavarian Journal of Applied Sciences is published annually.

CONTACT US

Bavarian Journal of Applied Sciences
Technische Hochschule Deggendorf
Dieter-Görlitz-Platz 1
94469 Deggendorf, Germany
Phone: ++49 (0) 991 3615-0
Fax: ++49 (0) 991 3615-297
E-Mail: info@jas.bayern
Web: https://jas.bayern

CONTENT

INHALT

FOREWORD

We are pleased to present the seventh issue of the Bavarian Journal of Applied Sciences (BJAS), which features three insightful contributions that delve into the realms of educational training and human resource management. This issue brings together a diverse range of perspectives and research findings that highlight the evolving nature of these fields.

The first contribution is a comprehensive literature review authored by Manuela Krawaga-Nöbauer. In this review, Krawaga-Nöbauer explores the necessity of adapting STEAM (Science, Technology, Engineering, Arts, and Mathematics) training methods to align with the dynamic societal frameworks and the shifting needs and expectations of adolescents looking to explore the STEM fields. The author emphasizes the importance of incorporating intercultural aspects to foster an early interest in the cultural and social dimensions of STEM subjects. Drawing from an extensive body of literature, Krawagna-Nöbauer argues for the development of a novel training method that seamlessly integrates these interdisciplinary fields, thereby enhancing the educational experience and engagement of young learners.

The second contribution by Bernadette Busler presents the findings of a survey conducted on future skills required in rural regions. This study underscores the parallel between the changing societal needs highlighted in the STEM training article and the necessity for developing target group-specific skills training. The survey reveals that future skills must extend beyond technical competencies to include social and entrepreneurial skills, addressing the holistic development of individuals in rural areas. This comprehensive approach aims to equip the rural workforce with the diverse skill set needed to thrive in an ever-evolving job market.

The third contribution, authored by Tobias Nickel, Gerhard Dipplinger, Natalie Straub, Sarina Feicht and Silvio Angelillo, addresses the innovative possibilities and inherent challenges of utilizing virtual reality (VR) in human resource management. Their research focuses on the application of eye-tracking technology to correlate job candidates' personalities with the Big Five personality traits, a model widely recognized in applied psychology. This pioneering approach offers a cutting-edge method for assessing personality traits through advanced technological solutions, potentially revolutionizing the recruitment and selection processes within organizations.

We extend our heartfelt gratitude to all reviewers for their invaluable contributions, which have significantly enhanced the quality of this journal issue. We also wish to acknowledge Simone Lindlbauer for her exceptional organizational management, Esther Kinateder for her meticulous proofreading and editorial work, and Diana Karl for her expert typesetting of this issue. Their collective efforts have been instrumental in bringing this publication to fruition.

Michelle Cummings-Koether & Kristin Seffer

Wir freuen uns, Ihnen die siebte Ausgabe des Bavarian Journal of Applied Sciences (BJAS) mit drei sehr aufschlussreichen Beiträgen zu den Themen Bildung/Weiterbildung und Human Resource Management präsentieren zu können. Die Ausgabe vereint eine Vielzahl von Perspektiven und Forschungsergebnissen, die Schlaglichter auf den Wandel werfen, der sich in diesen Bereichen aktuell vollzieht.

Der erste Beitrag ist eine umfassende Literaturübersicht, erstellt von Manuela Krawagna-Nöbauer. Darin untersucht die Autorin die Notwendigkeit einer Anpassung von STEAM-Methoden (Naturwissenschaften, Technologie, Ingenieurwesen, Künste und Mathematik) an die dynamischen gesellschaftlichen Rahmenbedingungen und die sich verändernden Bedürfnisse und Erwartungen von Jugendlichen, die MINT-Bereiche erkunden wollen. Die Autorin betont, wie wichtig es ist, interkulturelle Aspekte einzubeziehen, um ein frühes Interesse an den kulturellen und sozialen Dimensionen der MINT-Fächer zu fördern. Auf der Grundlage einer umfangreichen Literaturrecherche plädiert Krawaga-Nöbauer für die Entwicklung einer neuartigen Ausbildungsmethode, die diese interdisziplinären Bereiche nahtlos integriert und so die Bildungserfahrung und das Engagement junger Lernender verbessert.

Der zweite Beitrag von Bernadette Busler stellt die Ergebnisse einer Umfrage zum Bedarf an Future Skills in ländlichen Regionen vor. Diese Studie unterstreicht die Parallele zwischen den sich wandelnden gesellschaftlichen Bedürfnissen, die im vorangehenden Artikel über die STEAM-Trainingsprogramme hervorgehoben wurden, und der Notwendigkeit, eine zielgruppenspezifische Qualifizierung zu entwickeln. Aus der Umfrage geht hervor, dass künftige Qualifikationen über technische Kompetenzen hinausgehen und auch soziale und unternehmerische Fähigkeiten umfassen müssen, um die ganzheitliche Entwicklung der Menschen in ländlichen Gebieten zu fördern. Dieser umfassende Ansatz zielt darauf ab, die Arbeitskräfte im ländlichen Raum mit den vielfältigen Fähigkeiten auszustatten, die sie benötigen, um auf einem sich ständig weiterentwickelnden Arbeitsmarkt erfolgreich zu sein.

Der dritte Beitrag, verfasst von Tobias Nickel, Gerhard Dipplinger, Natalie Straub, Sarina Feicht und Silvio Angelillo, befasst sich mit den innovativen Möglichkeiten des Einsatzes von Virtual Reality (VR) im Personalmanagement und den damit verbundenen Herausforderungen. Ihre Forschung konzentriert sich auf die Anwendung der Eye-Tracking-Technologie, um die Persönlichkeit von Bewerberinnen und Bewerbern mit den Big-Five-Persönlichkeitsmerkmalen zu korrelieren, einem in der angewandten Psychologie weit verbreiteten Modell. Dieser bahnbrechende Ansatz bietet eine hochmoderne Methode zur Bewertung von Persönlichkeitsmerkmalen durch fortschrittliche technologische Lösungen und könnte die Einstellungs- und Auswahlprozesse in Unternehmen revolutionieren.

Wir danken allen Gutachterinnen und Gutachtern herzlich für ihre wertvollen Beiträge, die die Qualität dieses Hefts signifikant gesteigert haben. Wir danken außerdem Simone Lindlbauer für ihr außerordentliches Engagement als Redaktionsleitung, Esther Kinateder für ihre sorgfältigen Korrekturen und die redaktionelle Unterstützung sowie Diana Karl für die tolle Arbeit beim Satz dieser Ausgabe. Das vereinte Engagement aller Beteiligten hat wesentlich dazu beigetragen, dass diese Veröffentlichung zustande gekommen ist.

Michelle Cummings-Koether & Kristin Seffer

BAVARIAN JOURNAL OF APPLIED SCIENCES®

Intercultural STEAM Trainings: Training the Workforce of the Future

Manuela Krawagna-Nöbauer*

https://doi.org/10.25929/1rjp-d197

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.

*Stabsstelle Asienprojekte & Servicezentrum Studium/MINT, Technische Hochschule Deggendorf (THD)

KEYWORDS

Intercultural communication, STEM, STEAM, Generation Z, future skills

Interkulturelle Kommunikation, MINT, MINKT, Generation Z, Future Skills

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 Kultusminster 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 suggests 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-pluennecke-mint-bildung-staerken-potenziale-von-frauen-aelteren-und-zuwandernden-heben.html

Arbeitsmarkt (2023, March 15). *IWD.* https://www.iwd.de/artikel/auslaendische-beschaeftigte-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_Aspekte_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-teilzeit-erwerbstaetigen-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

Körber Stiftung, acatech – Deutsche Akademie der Technikwissenschaften (Ed.). (2021). *MINT Nachwuchsbarometer 2021.* file:///C:/Users/mkrawagna-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. 1. (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/

Manuela Krawagna-Nöbauer

Manuela Krawagna-Nöbauer studied sinology and political science at the University of Vienna in Austria and at Shandong Normal University in the People's Republic of China. In 2021, she completed her training as an intercultural trainer at the University of Jena. At the DIT, she manages the Asia Projects Unit, works in STEM youth development and teaches intercultural communication.

Manuela Krawagna-Nöbauer studierte Sinologie und Politikwissenschaft an der Universität Wien und an der Shandong Normal University in der VR China. 2021 absolvierte sie eine Ausbildung zur interkulturellen Trainerin an der Universität Jena. An der THD leitet sie die Stabsstelle Asienprojekte, arbeitet im Bereich MINT-Nachwuchsförderung und wirkt als Dozentin im Bereich interkulturelle Kommunikation.

Kontakt / *Contact*
✉ **manuela.krawagna-noebauer@th-deg.de**

BAVARIAN JOURNAL OF APPLIED SCIENCES®

Virtual Reality in der Personalauswahl: Stand der Forschung und Potenziale

Tobias Nickel[1] **Natalie Staub**[2] **Silvio Angelillo**[4]

Gerhard Dippinger[2] **Sarina Feicht**[3]

https://doi.org/10.25929/set0-3x55

ABSTRACT

Die Digitalisierung des Personalmanagements schreitet in der Forschung und in der betrieblichen Praxis voran. Dieser Artikel beleuchtet die bisherigen Einsatzgebiete und Erkenntnisse empirischer Forschung über Virtual Reality (VR) im Bereich Personalmanagement. In der Personalgewinnung wird das Instrument VR bislang vor allem im Bereich Employer Branding und bei Leistungstests eingesetzt. Dieser Artikel zeigt auf, dass in der Persönlichkeitsdiagnostik weitere, noch weitgehend ungenutzte Potenziale für den Einsatz von VR liegen. Ein erstes Virtual-Reality-Persönlichkeitsdiagnostik-Projekt wird vorgestellt. Die Evaluation des Tools zeigt Chancen und Grenzen auf. Aufgrund dessen wird ein neuer Forschungsweg mit VR-Augenbewegungserfassung aufgezeigt. Hierzu wird der aktuelle Forschungsstand zu Eyetracking in der VR-Umgebung zur Erfassung von Big-5-Persönlichkeitseigenschaften im Projekt VRPA B5 dargestellt. Neben Implikationen für das Personalmanagement wird abschließend ein Ausblick zu dem Thema gegeben.

The digitalization of human resources management is progressing both in research and in operational practice. This article sheds light on the current areas of application and findings of empirical research on virtual reality (VR) in the field of HR management. In recruitment, VR has so far been used primarily in employer branding and performance tests. This article shows that there is further, still largely untapped potential for the use of VR in personality diagnostics. A first VR personality diagnostics project is presented. The evaluation of the tool shows both opportunities and limitations. Based on this, a new research path with VR eye movement recording is shown. The current state of research on eye tracking in the VR environment for recording the Big Five personality traits in the VRPA B5 project is presented. In addition to implications for HR management, the paper concludes with an outlook on the topic.

KEYWORDS

Personalauswahl, Virtuelle Realität, VR, Persönlichkeitsdiagnostik, Eye-Tracking, digitale Personalauswahl, Immersion

Personnel selection, virtual reality, VR, personality diagnostics, eye tracking, digital assessment center, immersive testing

[1]Fakultät Angewandte Wirtschaftswissenschaften (School of Management), Technische Hochschule Deggendorf (THD)
[2]PwC Österreich
[3]Master-Studierende an der DIPLOMA Hochschule
[4]Technologie Campus Parsberg/Lupburg, Technische Hochschule Deggendorf (THD) & Ostbayerische Technische Hochschule (OTH) Regensburg

Limitationen klassischer Instrumente der Personaldiagnostik

Zweck der Personalauswahl ist es, die Passung der Kandidaten mit der künftigen Aufgabe zu bestimmen und eine Rangreihe der Kandidaten zu erstellen. Um diese Herausforderung zu meistern, hat die Psychologie eine Reihe von Methoden entwickelt. Heute ist sich die Wissenschaft einig, dass es zwei Hauptbereiche gibt, die die Wahrscheinlichkeit für beruflichen Erfolg vorhersagen können: Zum einen die Kompetenzen (Intelligenz und Fachwissen), zum anderen die Persönlichkeit (Schuler, 2014).

Vermeidung von sozial erwünschtem Antwortverhalten

Leistungstests, wie der klassische Intelligenztest, sind heute wissenschaftlich anerkannt und erfüllen alle psychologischen Gütekriterien. Damit können sie als gute bis sehr gute Prädiktoren für beruflichen Erfolg herangezogen werden. Bei den Persönlichkeitstests gibt es von Laien wie von Expertinnen immer wieder Zweifel an der uneingeschränkten Gültigkeit der Ergebnisse, die sich zum Teil in sozial erwünschten Antworttendenzen zeigen. So geht Herzberg (2011, S. 121) sogar noch einen Schritt weiter und überschreibt ein Kapitel in der Enzyklopädie der Psychologie mit: “Selbstdarstellung in Persönlichkeitsfragebögen: Das Phänomen der sozialen Erwünschtheit“. Demnach entwickeln Getestete während des Tests subjektive Annahmen, welche Antwortalternativen den Anforderungen der Aufgabe am besten entsprechen. Über ihr Antwortverhalten generieren sie also ein erwünschtes Selbstbild. Die Persönlichkeitstests unterliegen in der Regel keinen zeitlichen Vorgaben. Deshalb bietet sich ausreichend Gelegenheit, um sich mit der Entwicklung von individuellen Hypothesen und geeigneten Antwortalternativen zur Bestärkung des gewünschten Selbstbildes zu beschäftigen.

Beispiel: Heute wird Extraversion beispielsweise mit Items wie diesem gemessen:

> Gehen Sie bei einer Party gern auf Menschen zu?
>
> trifft voll zu | trifft zu | trifft weniger zu | trifft gar nicht zu

Wird dem Bewerbenden für eine Vertriebsposition diese Frage gestellt, wird die Antwort im Sinne einer sozial erwünschten Antworttendenz eher in Richtung „trifft voll zu“ verzerrt werden. Da die Distanz zu der Situation eher groß ist und es zu keiner emotionalen Involviertheit kommt, kann die Testperson entsprechend der Hypothese: „von Vertriebsmitarbeitenden wird wohl erwartet werden, dass sie auf Menschen zugehen“ antworten. Aus diesem Sachverhalt erwuchs bereits vor Jahrzehnten die Forschungsfrage (vgl. Barton, 1958; Viswesvaran et al., 1999), wie die soziale Erwünschtheit bei der Messung von Persönlichkeitseigenschaften reduziert werden kann.

Assessment Center: Von der Abfrage zum beobachtbaren Verhalten

Die Diagnostikforschung hat das Assessment Center als eine Antwort auf die Vermeidung von sozialer Erwünschtheit bei der Personalauswahl entwickelt. Damit werden Validität, Reliabilität und Objektivität der Persönlichkeitsdiagnostik erhöht. Statt Reize in Form von Fragestellungen mit einer Antwortalternative zu präsentieren, werden beim Assessment Center gewünschte Persönlichkeitsmerkmale durch die Operationalisierung von Aufgabenanforderungen beobachtbar gemacht. Von Vertriebsmitarbeitenden wird ein hohes Maß an Extraversion erwartet. In einem Assessment Center für die Auswahl zukünftiger Vertriebsmitarbeitenden wird daher beispielsweise die realitätsnahe Situation einer Kaltakquise simuliert. In diesem Setting, in dem es verteilte Rollen für potenzielle Kunden und Vertriebsmitarbeitende gibt, wird dann das vom Bewerbenden gezeigte Verhalten von Beobachtenden bewertet. Hierdurch wird die Selbstauskunft durch eine Verhaltensbeobachtung ersetzt. Ein guter Schritt, um soziale Erwünschtheit zu reduzieren, allerdings bleiben unbefriedigende Rahmenbedingungen beim Thema Objektivität bestehen. Jedes Assessment Center läuft etwas anders ab, die Interaktionen zwischen dem potenziellen Kunden und dem Vertriebsmitarbeitenden sind wenig standardisiert und können nicht repliziert werden. Die Aufgabe besteht also darin, eine immer wieder replizierbare Umgebung zu schaffen, in der die Interaktionen objektiv beobachtbar und messbar sind. Ein Assessment

Center verursacht zudem hohe Kosten für Raumbedarf, Führungskräfte als Beobachtende, Infrastruktur und Essen für die Teilnehmenden.

A similar modulation of the amplitude can be achieved by superimposing two closely spaced electromagnetic waves of same amplitude often referred to as a beat signal. Mathematically, a beat signal can be described by:

Virtual Reality als objektivierte Umgebung

Eine objektivere Alternative könnte Virtual Reality (VR) bieten. Während klassische Testverfahren Texte, projektive Verfahren und Bilder als Stimulus nutzen, können mit Hilfe von VR immersive Umgebungen als Stimulus genutzt werden. Bei der Auswahl von Piloten sind Simulationen schon seit längerer Zeit im Einsatz. Dabei werden komplexe reproduzierbare Szenarien genutzt, um die Reaktionen der Kandidatinnen und Kandidaten zu testen. Der Aufwand und die Kosten einer solchen Flugsimulator-Nutzung bewegen sich in Millionenhöhe, und sind somit sehr hoch. Allerdings ist die körperliche Immersion in eine dreidimensionale Bewegung in den meisten Berufsbildern nicht notwendig.

Statt wie beim Flugsimulator eine echte Umwelt zu bauen, werden bei VR alle Elemente der Umwelt in der Virtual-Reality-Brille umgesetzt.

Stand der Forschung zu Virtual Reality in der Personalauswahl

Die Technologie der Virtual Reality wird immer günstiger und verbreitet sich sehr schnell. Der Umsatz mit Virtual Reality im Jahr 2021 belief sich auf rund 4,8 Milliarden US-Dollar und soll im Jahr 2024 auf rund 12,2 Milliarden US-Dollar anwachsen (Tenzer, 2021).

Auch für die Personalauswahl kann VR Vorteile bieten: Neben klassischen Assessment-Center-Situationen, in einem Hotel oder der Unternehmenszentrale, ergibt sich die Möglichkeit, auch unsichere, teure oder virtuelle Umfelder zu generieren, die dem künftigen Arbeitsumfeld entsprechen (Roberts et al., 2019).

Eine Voraussetzung für die Reduktion der sozial erwünschten Antworttendenz ist, dass die Testpersonen die Virtual Reality so real wahrnehmen, dass sie echte Reaktionen zeigen, da sie sich der Immersion nicht entziehen können (s. Abb. 1). Diese Rahmenbedingungen werden schon seit einiger Zeit von Psychologinnen und Psychologen im therapeutischen Umfeld genutzt (Glotzbach et al., 2013). Dort werden beispielsweise Desensibilisierungen für unterschiedliche Ängste durchgeführt. Hierzu stellen verschiedene Anbieter Szenen für Höhenangst, Angst vor Dunkelheit, Spinnenangst, Angst vor öffentlichen Auftritten, etc. zur Verfügung. Dabei ist die Reizstärke der angstinduzierenden Stimuli variierbar.

Im therapeutischen Umfeld hat sich gezeigt, dass die immersive Qualität der virtuellen Realität mit einer entsprechenden Brille und Simulation so hoch ist, dass sie die Testpersonen emotional voll fordert (Serra-Pla et al., 2017). Dieses „Vor-Ort-Gefühl“ (Jäger 2018, S. 51) kann demnach auch genutzt werden, um einen starken Stimulus bei für die Personalauswahl relevanten Persönlichkeitseigenschaften zu setzen.

Abbildung 1: VR-Szenario aus der Phobien-Therapieanwendung für Menschen mit Angst vor öffentlichen Auftritten (Quelle: https://virtuallybetter.com/).

Das Thema Personalauswahl mithilfe von Virtual Reality ist bis dato nur vereinzelt in wissenschaftlichen Publikationen aufgetaucht. So beschreibt Jäger (2021, S. 53) mögliche Einsatzgebiete: Messen, Trainings, Assessment, Compliance, Previsualisierungen von Gebäuden und Arbeitsplätzen, ohne aber auf das Thema Assessment weiter einzugehen.

Virtuelle Realität in der Persönlichkeitsdiagnostik

Mithilfe der VR-Brille ergeben sich verschiedene weitere Möglichkeiten der Datengenerierung. So sind zum einen Verhaltenseinschätzungen im Sinne einer Assessment-Center-Beobachtung mithilfe von Verhaltensankern möglich. Dabei ist der Vorteil gegenüber dem klassischen Assessment Center, dass die Situation objektivierbar ist. Daraus wiederum ergibt sich die Möglichkeit, eine Reihe von Kandidatinnen und Kandidaten mit derselben Situation zu konfrontieren und ihre Reaktionen vergleichbar zu beobachten. Und dies nicht nur zeitgebunden von allen Teilnehmenden zum gleichen Zeitpunkt am gleichen Ort, wie beispielsweise einem Tagungshotel, sondern zeitlich und räumlich komplett unabhängig. Dabei werden nicht nur Kosten und Aufwand für die organisierende Recruiting-Abteilung und die als Beobachtende eingesetzten Führungskräfte eingespart. Auch die Quote der Teilnehmenden wird erhöht, da es keine zeitlichen Einschränkungen und Reiseaufwände gibt. So können beispielsweise VR-Brillen versendet werden. Sind die Kosten hierfür zu hoch, können auch einfache, als Google Cardboard bekannte VR-Brillen zum Einsatz kommen, die mithilfe eines Wellpappe-Kastens mit zwei Linsen in Kombination mit dem eigenen Handy des Bewerbenden genutzt werden.

Aktueller Stand der Forschung

PwC Österreich hat mit KOIA ein prototypisches VR-Werkzeug zur Persönlichkeitsbeurteilung entwickelt. Traditionelle und gut validierte psychometrische Tests werden in VR-Minispiele mit einer vordefinierten Storyline umgewandelt. So kann überprüft werden, inwieweit die Persönlichkeit zur Unternehmenskultur passt (Dipplinger et al., 2021).

Grundlegend besteht die VR-Applikation KOIA aus vier Phasen, welche darauf abzielen, die Handlungen und Entscheidungen von Nutzerinnen und Nutzern bestimmten Persönlichkeitsmerkmalen aus dem HEXACO-Modell zuzuordnen.

In der ersten Phase der Anwendung müssen Teilnehmende einen virtuellen Raum namens „Greenfield“ in der Marketingagentur KOIA mit Möbeln ausstatten. Die Möbel entstammen 16 verschiedenen Kategorien, beinhalten bis zu vier verschiedene Modelle (s. Abb. 2) und

verfügen jeweils über drei unterschiedliche Farbtöne. Durch die Möbelauswahl soll ein Rückschluss auf die Persönlichkeitseigenschaft Offenheit für Erfahrungen möglich sein. Die wählbaren Möbelstücke differenzieren sich in den Bereichen Kreativität, Konventionalität und ästhetische Wertschätzung (PwC Österreich 2021, S. 11). Beispielsweise verfügt man über die Möglichkeit, eine Stehlampe in Giraffenform gegenüber einer konventionellen Stehlampe auszuwählen. Im HEXACO-Fragebogen ist Kreativität eine Unterkategorie von Offenheit. Die Präferenz der ausgefalleneren Giraffen-Stehlampe indiziert, dass eine Person unkonventionell handelt und aufgrund ihrer Auswahl als offen für Erfahrungen eingestuft werden kann.

In der zweiten Phase des Assessments kann man sich in einem Forum mit Mitarbeitenden austauschen und mit vorgefertigten Texten oder Emojis auf Nachrichten antworten (s. Abb. 3). In der dritten Phase wird die Einrichtung von „Greenfield“ von virtuellen Mitarbeitenden evaluiert. Dieses Feedback beabsichtigt es, bestimmte Emotionen der Nutzerinnen und Nutzer zu triggern, um die Bindung zu den VR-Mitarbeitenden zu beeinflussen. Beispielsweise erhält man von einem Kollegen Feedback, dass Greenfield nicht ansprechend genug eingerichtet ist. Im letzten Teil des Assessments (Phase 4) soll als Abschluss des Projektes für alle Teammitglieder ein Essen bestellt werden. Bei allen Mitarbeitenden wird als bevorzugtes Schärfe-Level „mild“ angegeben. Somit wird den Testpersonen die Möglichkeit gegeben, dass bei ungewünschtem Feedback durch Mitarbeitende (Phase 3) das Essen zu scharf bestellt wird, um sich aufgrund negativen Feedbacks an ihnen zu rächen (PwC Österreich

Abbildung 2: Möbelauswahl für den Raum „Greenfield“ in Virtual Reality Personality Assessment (VRPA) KOIA (PwC, 2022).

Abbildung 3: Szene aus dem KOIA VR-Personality-Assessment. (Quelle: PwC 2022)

Methodisches Vorgehen

Im Rahmen einer an der Technischen Hochschule Deggendorf (THD) durchgeführten Validierungsstudie wurde eine statistische Überprüfung und Bewertung der vom Unternehmen zur Verfügung gestellten Erhebungen und Daten vorgenommen.

Ergebnisse aus der ersten Validierung des Prototypen

Cronbachs Alpha

Eine Voraussetzung für eine hohe Validität ist eine hohe Reliabilität eines Tests. Hierfür ist es möglich, mittels Cronbachs Alpha zu testen, ob die Items eines Tests Messgenauigkeit aufweisen und dieser somit eine interne Konsistenz (Inter-Item-Reliabilität) besitzt. Werte ab $\alpha = .6$ zählen als akzeptabel. Korrelationen zwischen $\alpha = .7$ und $\alpha = .8$ gelten als gut und bei Werten zwischen $\alpha = .8$ und $\alpha = .9$ wird von sehr guten Reliabilitätskoeffizienten ausgegangen. Werte über $\alpha = .9$ sollten kritisch betrachtet werden, da Redundanzen möglich sein können (Streiner, 2003).

Die beiden Persönlichkeitsdimensionen Verträglichkeit ($\alpha = .750$) und Offenheit für Erfahrungen ($\alpha = .733$), die in der Validierungsstudie hauptsächlich untersucht wurden, sind als gut einzuschätzen.

Trennschärfe

Die Trennschärfe ermittelt, ob sich Unterscheidungen in der Ausprägung eines Items zwischen Personen mit hohem oder niedrigem Wert ergeben. Hierfür wird die Differenzierung der Merkmale der einzelnen Items in korrelativen Zusammenhang mit der

Differenzierung aller Items gesetzt. Als gut trennscharf werden Items bezeichnet, wenn sie Werte im Bereich zwischen r = .4 bis r = .7 erreichen (Moosbrugger & Kelava, 2020a, S. 153–157). Hier sind Werte zwischen -0,383 (negative Polung), 0,24 (keine Trennung möglich) und 0,969 (sehr trennscharfes Item) für verschiedene Items vorhanden, weshalb hier eine Überarbeitung der Skala oder das Streichen schlecht trennender Items in Betracht gezogen werden sollte.

Aus den Erkenntnissen der Validierungsstudie wurde eine neue Ausrichtung der Forschung abgeleitet, beginnend bei einer Verbesserung der Operationalisierung und Überarbeitung des Konstrukts. Hierzu wurden alternative Szenarien entwickelt. Zudem wäre eine Steigerung der Interaktion zwischen den Charakteren und dem Teilnehmenden sinnvoll, um ein Gefühl von Präsenz zu erzeugen. Eine Erhöhung des Grades an Immersion wäre sehr von Vorteil und anstrebenswert. 360-Grad-Videos ermöglichen die Nutzung von realistischen Aufnahmen, abgespielt aus einer bestimmten Position der Kamera. Hierbei ist ein Rundumblick mit der VR-Brille möglich, hierbei wird ein Forschungsgegenstand die Interaktion bei gleichzeitiger Immersion sein. Diese Form der Darbietung vermittelt ein starkes Gefühl, sich an einem anderen, realistischen Ort zu befinden. Der Grad an Immersion ist sehr hoch (Jäger, 2018).

Konvergente Validität

Die konvergente Validität misst, ob das richtige Merkmal durch einen Test gemessen wird. Zur Überprüfung kann verglichen werden, ob ein Test, der dasselbe oder ein ähnliches Merkmal misst, hohe Korrelationen aufweist (Moosbrugger & Kelava, 2008, S. 17). Die Analyse des VR-Tools KOIA und der mit den Testpersonen durchgeführten Interviews zeigt lediglich eine nennenswerte Korrelation ($r = .347$, $p = .048$) für Offenheit für Erfahrungen, die auf dem Signifikanzniveau von $\alpha = .05$ einen laut Cohen (1988) moderat signifikanten Zusammenhang aufweist.

Zusammenfassend konnte durch die Validierungsstudie festgestellt werden, dass mit der aktuellen Anwendung noch keine den psychologischen Gütekriterien genügenden Ergebnisse erzielt werden konnten. Dies ist zum Teil auch auf die Limitationen der Studie, wie beispielsweise eine zu geringe Teilnehmeranzahl (n = 33) oder noch nicht optimierte Szenarien zurückzuführen.

Neuer Forschungsansatz: Persönlichkeitsdiagnostik durch Eye-Tracking

Die Ergebnisse der Validierungsstudie haben die Eignung von Virtual Reality als Persönlichkeitsdiagnostikwerkzeug grundsätzlich bestätigt. Die Szenarien haben aber teilweise die Erwartungen an die Prädiktion von Persönlichkeitsmerkmalen nicht erfüllt. Deshalb wird zusätzlich zu der VR-Technik eine neue Forschungsrichtung eingeschlagen. Hierdurch sollen die psychologischen Gütekriterien besser erfüllt werden. Hierbei werden die Persönlichkeitsmerkmale der Nutzerinnen und Nutzer auf Basis von unbewusster Bewegung der Augen (Okulomotorik) zugeordnet.

Zusammenhang Fünf-Faktoren-Modell und Okulomotorik

Das strukturelle und deskriptive Fünf-Faktoren-Modell der Persönlichkeit „Big Five“ ist eine weit anerkannte integrative Taxonomie der menschlichen individuellen Unterschiede (Costa & Mccrae, 1992; John & Srivastava, 1999; zitiert nach Rauthmann et al., 2012, S. 148). Bei den Persönlichkeitsmerkmalen Neurotizismus, Extraversion und Offenheit ist der Zusammenhang mit den Augenbewegungen beschrieben (Rauthmann et al., 2012, S. 147).

Neurotizismus zeichnet sich an einer höheren Verweildauer auf einem bestimmten Fixationspunkt einhergehend mit einer geringeren Anzahl an Fixationen ab. Dies könnte damit zusammenhängen, dass eine längere Verarbeitungsdauer benötigt wird, um Stimuli einen tendenziell negativeren Wert zuzuordnen (Rauthmann et al., 2012, S. 152).

Extraversion kann anhand der Performance bei „Anti-Sakkaden-Tests“ (Hn et al. 2008) sowie über spontane Augenbewegungen wie der Lidschlagfrequenz festgestellt werden. Bei Sakkaden handelt es sich um rasche Augenbewegungen, bei denen ein Objekt fokussiert wird. Anti-Sakkaden hingegen beschreiben eine absichtlich ausgeführte Unterdrückung dieser reflexiven Augenbewegung, da eine zielgerichtete Sakkade in die gegensätzliche Richtung des ursprünglichen Stimulus durchgeführt wird

(Guitton et al., 1985, S. 455). Extraversion korreliert zusätzlich mit einer höheren Anzahl von verschiedenen Fixationspunkten, einhergehend mit einer kürzeren Verweildauer auf den jeweiligen Fixationspunkten (Costa & Mccrae, 1992 zitiert nach Rauthmann et al., 2012, S. 152).

Offenheit wird beispielsweise mit Fixationspunkten verbunden, da Menschen mit stärkerer Tendenz zu Offenheit ihren Blick öfter und länger auf bestimmte Punkte fixieren, um Informationen darüber aufzunehmen (Matsumoto et al., 2010, S. 299).

Die Virtual-Reality-Persönlichkeitsdiagnostik VRPA B5 folgt dem nachstehenden generischen Konzept nach Berkovsky et al. (2019 (s. Abb. 4)), welches nicht auf Selbsteinschätzung beruht: (i) Externer Stimulus, (ii) Feststellungsmethodik (Infrarot-Sensor), (iii) Datenverarbeitung, (iv) Psychologische Auswertung. Nach weiterer Entwicklung könnten Machine-Learning-Algorithmen zukünftig Datensätze automatisch einem bestimmten Persönlichkeitsmerkmal zuordnen.

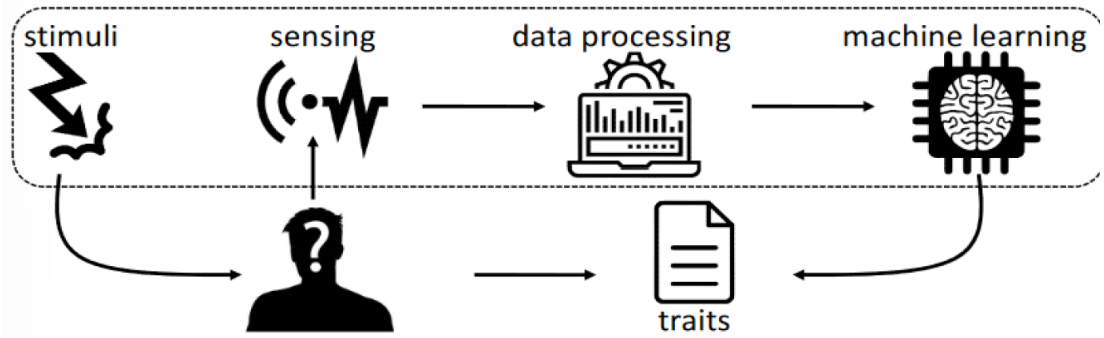

Abbildung. 4: Konzept zur Persönlichkeitserfassung (Berkovsky et al., 2019, S. 3)

Technik des Eye-Tracking im Bereich Virtual Reality

Eye-Tracking wird generell als Verfolgung der Blickrichtung im menschlichen Auge definiert. Dieses Verfahren wird zur Datenerhebung und Analyse des Blickverlaufs bei Personen angewendet und kann wörtlich mit Blickregistrierung übersetzt werden (Grimm et al., 2019, S. 149).

Hierbei wird ein nicht-invasives Verfahren präferiert, bei dem die Blickrichtung von Personen berührungslos erhoben werden kann (Grimm et al., 2019, S. 149). Ferner wird nicht-invasives Tracking, welches videobasiert arbeitet, in passive und aktive Augenbestrahlung unterteilt. Eine aktive Bestrahlung der Augenszene durch eine Infrarotquelle ist die präzisere Methode, welche zudem eine klare Merkmalidentifikation zwischen Iris und Pupille ermöglicht (Abb. 1) (Grimm et al., 2019, S. 149).

Bei passiven Verfahren wird Umgebungslicht zur Bestrahlung der Augenszene verwendet, was besonders bei undefinierten Lichtverhältnissen hohe Anforderungen für eine akkurate Merkmalsidentifikation der Augenbestandteile darstellt (Grimm et al., 2019, S. 149).

Technischer Stand von VRPA B5

Der Technology Readiness Level (TRL) ist ein Messsystem, um den Reifegrad einer Technologie zu bestimmen. Der Fortschritt von Technologieprojekten wird anhand dieses Modells in neun unterschiedliche Stufen unterteilt (Technology Readiness Levels – NASA 2023). TRL 9 repräsentiert den höchsten technologischen Reifegrad und bestätigt den erfolgreichen Einsatz eines qualifizierten Systems. TRL 1 spiegelt hingegen den niedrigsten Technologie-Level und stellt den Übergang von Forschung zu angewandter Forschung durch Technologiestudien dar (Vlăduţ et al., 2018).

Im Folgenden wird der TRL von VRPA B5 eruiert. Aufgrund der bereits vorliegenden Studienlage zur Korrelation der Blickrichtungsregistrierung

und den Big Five ist zu vermerken, dass bereits angewandte Forschung in diesem Bereich durchgeführt wurde. Auf Basis dieser Forschungsergebnisse gilt die Hypothese „Die Big-Five--Persönlichkeitsmerkmale können anhand von Augenmotilität festgestellt werden“ für dieses Technologieprojekt als bestätigt. Der Reifegrad der Anwendung übersteigt TRL 2 (Grundlagenforschung).

Die Machbarkeit oder Funktionstüchtigkeit durch die verwendete Hardware (Meta Quest Pro) gilt zudem als bestätigt, da die VR-Brille mit Infrarot-Sensoren zur Blickrichtungsregistrierung ausgestattet ist. Die eigens entwickelte Software in Unity Engine ermöglicht es, zu diesem Zeitpunkt eine Blickrichtungsregistrierung durchzuführen und die erhobenen Daten in einer Datenbank zu speichern. Die notwendigen Komponenten zur Datenanalyse und deren weiteren Auswertung sind bereits in VRPA B5 integriert (TRL 3).

Der Status Quo der Applikation VRPA B5 lässt sich unter „Technologienentwicklung“ (TRL 4) eingliedern. Genauer ist das Ziel zu diesem Zeitpunkt, das Eye-Tracking System bezüglich des Persönlichkeitsmerkmals Offenheit für Erfahrung in der Laborumgebung mit eigens hierzu entwickelten Szenarien zu testen und zu validieren (funktionale Verifikation). Im nächsten Schritt wird TRL 5 erreicht. Aktuell wird das System mit Probanden unter Laborbedingungen in seiner späteren Einsatzumgebung getestet und evaluiert.

Die Innovation von VRPA B5 liegt in der Bestimmung von Persönlichkeitsmerkmalen durch Blickregistrierung mittels eines Head-Mounted Device (HMD). Eine wesentliche Projektanforderung ist, dass die virtuelle Umgebung möglichst realitätsnah, interaktiv und intuitiv für die Testpersonen gestaltet wird. Genauer wird in den Projektzielen spezifiziert, dass dies nötig ist, um möglichst akkurate Datensätze zu erhalten.

VRPA B5 wird in der Creation Engine „Unity“ entwickelt. Unity ermöglicht die Erstellung von VR-Applikationen durch das Hinzufügen von 3D-Modellierungen sowie Programmier-Codes. Das Gerüst der Applikation besteht aus fünf separaten Szenen für die jeweiligen Persönlichkeitsmerkmale.

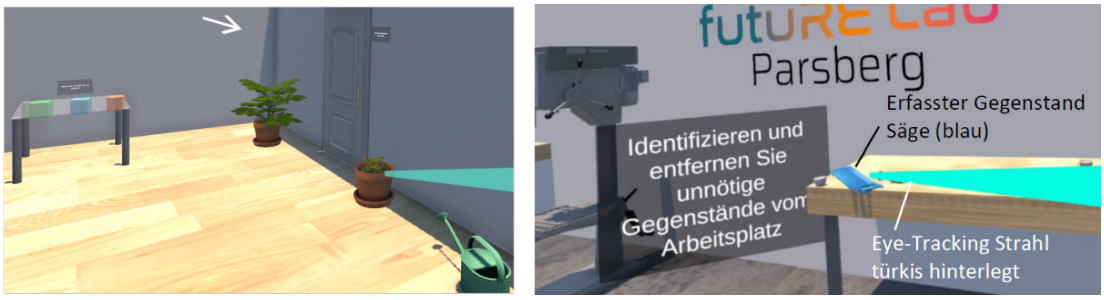

Abbildung 5a und b: Blickregistrierung mittels Strahl-VRPA-B5.

Abbildung 5 zeigt die Funktionsweise der Blickrichtungsregistrierung. Im Moment der Objekterfassung werden nähere Informationen zur Verweildauer an den jeweiligen Fixationspunkten gespeichert. In der finalisierten Umgebung ist dieser Strahl unsichtbar, um eine Irritierung der Testteilnehmenden zu vermeiden.

Letztlich kann das Unity-Plugin „Cognitive-3D“ installiert werden, um die Blickregistrierung mittels Heat-Maps für eine spätere Analyse vereinfacht zu visualisieren (s. Abb. 6).

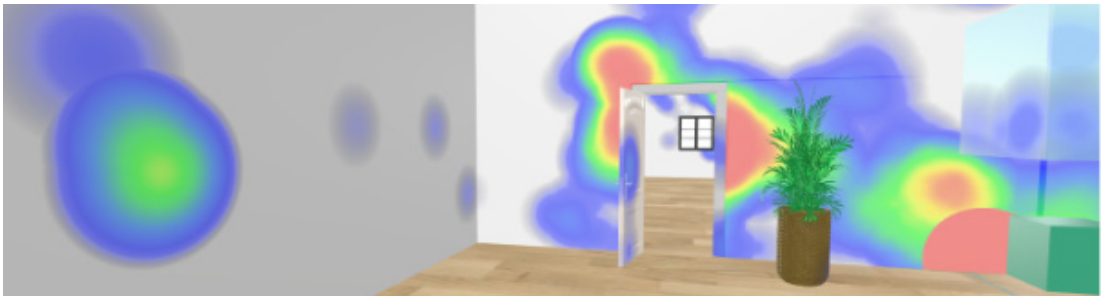

Abbildung 6: Heat-Maps zur Blickrichtungsregistierung(Cognitive3D, 2023).

Ausblick

Eine neue Technologie hat seit der Corona-Pandemie an Bedeutung gewonnen. Der Trend zu mehr virtuellen Meetings mit Avataren führte dazu, dass neue Sensoren auf den Markt kamen. So ist nun auch ein Mimik-Sensor erhältlich, der unterhalb der VR-Brille angebracht wird, und dort die Mimik der unteren Gesichtshälfte erfasst. Dies dient dazu, Mundbewegungen in Spielen und Meetings sprechsynchron auf den Avatar zu projizieren. Im Kontext der Diagnostik kann diese Sensorik aber auch genutzt werden, um Gesichtsbewegungen zu den jeweiligen Situationen in der Simulation aufzuzeichnen und zu analysieren.

Des Weiteren kann das System mit einem Multiplayer-Modus sowie Chat-GPT-gesteuerten Avataren ausgestattet werden, sodass soziale Interaktionen in die Anwendung aufgenommen werden können. So könnten die Nutzerinnen und Nutzer beim Persönlichkeitsmerkmal Extraversion beispielsweise mit sozialen Reizen durch Meta-Avatare konfrontiert werden. Diese könnten mit natürlichsprachlichen Dialogen, welche durch Chat GPT ermöglicht werden, in eine sehr echte Interaktion gehen.

Die Apple VR-Brille VisionPro (Apple, 2023) eröffnet neue Möglichkeiten, die die Immersion noch weiter steigern. Beispielsweise können Inhalte im Sinne einer Mixed Reality in den realen Raum integriert werden. Außerdem kann die VisionPro ohne Controller mit Hilfe von Handgesten gesteuert werden, was die Natürlichkeit der Interaktion erhöht. Ein ultrapräzises Eye-Tracking wird weitere Datenanalysen ermöglichen.

Wenn eine Reihe von VR-Anwendungen für die Personaldiagnostik erstellt und validiert worden sind, können diese im Sinne eines Methodenmix (Kanning, 2018) zu einem Virtual Reality Assessment Center kombiniert werden. Dies würde enorme Vorteile hinsichtlich der Kosten, der Ortsunabhängigkeit und der Geschwindigkeit der Umsetzung bringen, was gerade in Zeiten eines Arbeitnehmermarktes wichtig ist.

Der disruptive Charakter von VRPA B5 ebnet somit den Weg für eine Neuausrichtung von Recruiting-Szenarien in Assessment Centern. In Zukunft bietet sich die Gelegenheit, potenzielle Talente für eine Job-Position einfacher zu identifizieren, insbesondere wenn klar definierte Persönlichkeitseigenschaften eine signifikante Rolle spielen.

Deshalb sollte die Forschung versuchen, möglichst viele Persönlichkeitseigenschaften so zu operationalisieren, dass sie als VR-Verhaltensbeobachtungsszenario genutzt werden können. Über Validierungsstudien ist jedoch die Alltagstauglichkeit für die Persönlichkeitsdiagnostik zu prüfen. Die Vorzeichen stehen gut, denn die Qualitäten, die die VR schon in den therapeutischen Anwendungen gezeigt hat, legen nahe, dass Menschen sich der immersiven Wirkung von VR nicht entziehen können. Damit ist die Basis gelegt für die Diagnostik von Persönlichkeitseigenschaften bei maximal reduzierten Effekten der sozialen Erwünschtheit.

Wenn dies möglich wird, ist es ein erster Schritt für ganz neue Formen der Messung von menschlichen Eigenschaften im Kontext der Personalauswahl.

References

Apple (2023). *Apple Vision Pro.* https://www.apple.com/apple-vision-pro/?&cid=wwa-de-kwgo-VisionPro-slid---productid---Avalanche-Announce-&mnid=s-dc_mtid_20925oze42631_pcrid_663403275004_pgrid_149272522054_pexid__&mtid=20925oze42631&aosid=p238

Barton, A. (1958). Asking the Embarrassing Question. *Public Opinion Quarterly*, 22(1), 67–68. https://doi.org/10.1086/266761

Berkovsky, S., Taib, R., Koprinska, I., Wang, E., Zeng, Y., Li, J., & Kleitman, S. (2019). *Detecting Personality Traits Using Eye-Tracking Data.* CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. Paper No.: 221, 1–12. https://doi.org/10.1145/3290605.3300451

Cognitive3D. (21. Dezember 2023). Spatial Analytics for the Unity Engine. https://cognitive3d.com/product/unity/ (Abgerufen am 31.10.2024)

Cohen, J. (1988). Statistical *power analysis for the behavioral sciences* (2nd ed.). Erlbaum. http://www.loc.gov/catdir/enhancements/fy0731/88012110-d.html

Costa, P., & Mccrae, R. (1992). Neo PI-R professional manual. *Psychological Assessment Resources,* 396.

Dahl, A. (08. März 2017). *Virtual Reality – coming to your assessment centre soon?, University of Bath.* https://blogs.bath.ac.uk/careers/2017/03/08/virtual-reality-coming-to-your-assessment-centre-soon/

Dipplinger, G., Tome, G., Straub, N.C. J.A. (2021). Virtual Reality Personality Assessment. Mit Einsatz immersiver Technologien zur Bereicherung von Rekrutierungsprozessen. https://www.pwc.at/de/dienstleistungen/steuerberatung/steuerfunktion-der-zukunft/augmented-und-virtual-reality/vr-personality-assessment.html

Glotzbach-Schoon, E; Andreatta, M; Mühlberger, A; Pauli, P (2013). Context conditioning in virtual reality as a model for pathological anxiety. *e-Neuroforum* 2013, 4(3), 63–70. https://doi.org/10.1007/s13295-013-0047-z

Grimm, P., Dörner, R., Broll, W., & Jung, B. (Eds.). (2019). Virtual und Augmented Reality (VR/AR): *Grundlagen und Methoden der Virtuellen und Augmentierten Realität.* Springer. https://doi.org/10.1007/978-3-662-58861-1

Guitton, D., Buchtel, H., & Douglas, R. (1985). Frontal Lobe Lesions in Man Cause Difficulties in Suppressing Reflexive Glances and in Generating Goal-Directed Saccades. Experimental Brain Research. *Experimentelle Hirnforschung. Expérimentation Cérébrale,* 58(3), 455–472. https://doi.org/10.1007/BF00235863

Hn, N., Jb, M., & La, A. (2008). Extraversion degrades performance on the antisaccade task. *Brain Research,* 1231, 81–85. https://doi.org/10.1016/j.brainres.2008.07.054

Jäger, W. (2018). Potenziale von Virtual, Augmented und Mixed Reality für HR. In T. Petry & W. Jäger (Hrsg.), *Digital HR. Smarte und agile Systeme, Prozesse und Strukturen im Personalmanagement.* Haufe: Freiburg

John, O. P., & Srivastava, S. (1999). The Big Five *Trait taxonomy: History, measurement, and theoretical perspectives.* In L. A. Pervin & O. P. John (Eds.), Handbook of personality: Theory and research (2nd ed., pp. 102–138). Guilford Press

Kanning, U. P. (2018). *Diagnostik für Führungspositionen.* Hogrefe: Göttingen

Matsumoto, K., Shibata, S., Shimosato, S., Mori, C., & Shioe, K. (2010). Factors influencing the processing of visual information from non-verbal communications. *Psychiatry and Clinical Neurosciences,* 64, 299–308. https://doi.org/10.1111/j.1440-1819.2010.02077.x

Moosbrugger, H. (2011). *Testtheorie und Fragebogenkonstruktion.* Springer: Berlin Heidelberg

National Aeronautics and Space Administration (NASA). (27. September 2023). Technology Readiness Levels. https://www.nasa.gov/directorates/somd/space-communications-navigation-program/technology-readiness-levels/

Petry, T., & Jäger, W. (Eds.). (2018). Digital HR: *smarte und agile Systeme, Prozesse und Strukturen im Personalmanagement* (Vol. 14054). Haufe-Lexware.

PwC Österreich. (2021). Virtual Reality Personality Assessment: Using immersive technologies to facilitate recruitment processes. *PwC Österreich.* https://publikationen.pwc.at/download/2021_06_koia-report_de.pdf?standalone=false&category=aufsichtsrat

Rauthmann, J. F., Seubert, C. T., Sachse, P., & Furtner, M. R. (2012). Eyes as windows to the soul: Gazing behavior is related to personality. *Journal of Research in Personality,* 46(2), 147–156. https://doi.org/10.1016/j.jrp.2011.12.010

Roberts, A. C., Yeap, Y. W., Seah, H. S., Chan, E., Soh, C.-K., & Christopoulos, G. I. (2019). Assessing the suitability of virtual reality for psychological testing. *Psychological Assessment,* 31(3). 318–328. http://doi.org/10.1037/pas0000663

Schuler, Heinz (2014). Psychologische Personalauswahl. *Eignungsdiagnostik für Personalentscheidungen und Berufsberatung.* Hogrefe: Göttingen

Serra-Pla, J. F., Pozuelo, M., Richarte, V., Corrales, M., Ibanez, P., Bellina, M., Ramos-Quiroga, J. A. (2017). Treatment of attention deficit hyperactivity disorder in adults using virtual reality through a mindfulness programme. In: *Revista de Neurologia*, 64(s01), S117–S122

Streiner, D. L. (2003). Starting at the beginning: an introduction to coefficient alpha and internal consistency. *Journal of Personality Assessment,* 80(1), 99–103. https://doi.org/10.1207/S15327752JPA8001_18

Tenzer, F. (2021). Prognose zum Umsatz mit Virtual Reality weltweit in den Jahren 2021 bis 2026. Dossier Virtual Reality. *Statista.* https://de.statista.com/statistik/daten/studie/318536/umfrage/prognose-zum-umsatz-mit-virtual-reality-weltweit/

Viswesvaran, C. & Ones, D. S. (1999). Meta-Analyses of Fakability Estimates: Implications for Personality Measurement. Educational and Psychological Measurement, 59(2), 197-210. https://doi.org/10.1177/00131649921969802

Vlăduţ, G., Tănase, N. M., Caramihai, M., & Purcărea, A. A. (2018). *Innovation Audit for business excellence.* Proceedings of the International Conference on Business Excellence, 12(1), 1026–1037. https://doi.org/10.2478/picbe-2018-0092

Tobias Nickel

Tobias Nickel ist seit 2021 Professor im Bereich Wirtschaftspsychologie an der Technischen Hochschule Deggendorf. Zuvor war er in leitenden Positionen bei der Dräxlmaier Group und der BMW Group tätig, u.a. als Leiter globale Rekrutierung. Er studierte Psychologie an der Universität Regensburg, wo er auch promovierte. Seine Forschungsschwerpunkte liegen in Virtual-Reality-Personaldiagnostik und Organisationsentwicklung.

Tobias Nickel has been a professor of business psychology at the Deggendorf Institute of Technology since 2021. Previously, he held leadership positions at the Dräxlmaier Group and the BMW Group, including Head of Global Recruitment. He studied psychology at the University of Regensburg, where he also earned his doctorate. His research focuses on VR-based personnel diagnostics and organizational development.

Kontakt / *Contact*
✉ **tobias.nickel@th-deg.de**

Gerald Dipplinger

Gerald Dipplinger ist seit über 20 Jahren bei PwC Österreich im Rechts- und Steuerbereich tätig. Sein Schwerpunkt liegt dabei auf Innovation und Digitalisierung, insbesondere in den Bereichen Künstliche Intelligenz und Emerging Technologies. Er hat das Studium der Rechtswissenschaften am Juridicum Wien sowie das Studium der Betriebswirtschaftslehre an der WU Wien abgeschlossen. Er ist auch als Fachvortragender, Autor und Lehrgangsleiter tätig.

Gerald Dipplinger has been working in the legal and tax department at PwC Austria for over 20 years. His focus is on innovation and digitalization, particularly in artificial intelligence and emerging technologies. He graduated in law from the Juridicum Vienna and in business administration from WU Vienna. He is also a lecturer, author, and course director.

Kontakt / *Contact*
✉ **gerald.dipplinger@pwc.com**

Natalie Straub

Natalie Straub ist Psychologin, Psychotherapeutin i.A.u.S., Betriebswirtin und Managerin bei PwC, wo sie den Bereich Leadership und Development verantwortet. Seit über 10 Jahren berät sie zu Persönlichkeits- und Organisationsentwicklung. Sie studierte Betriebswirtschaftslehre an der DHBW Mannheim, Psychologie an der Uni Wien sowie Personal- & Organisationsentwicklung an der FH WKW. Zudem ist sie Dozentin, Fachvortragende, Autorin und führt eine freie Praxis.

Natalie Straub is a psychologist, psychotherapist i.t.a.s., business economist, and manager at PwC, where she is responsible for the Leadership and Development sector. For over 10 years, she has been advising on personality and organizational development. She graduated in Business Administration from DHBW Mannheim, in Psychology from the University of Vienna, and in Human Resources & Organizational Development from FH WKW. Additionally, she is a lecturer, author, and runs a private practice.

Kontakt / *Contact*
✉ **natalie.straub@pwc.com**

Sarina Feicht

Sarina Feicht hat 2022 das Studium der Wirtschaftspsychologie (B.Sc.) an der Technischen Hochschule Deggendorf (THD) absolviert. Im Rahmen des Studiums war sie als studentische Hilfskraft Teil des Forschungsprojekts und überprüfte darüber hinaus die statistische Gültigkeit des KOIA VR-Personality-Assessments anhand einer Validierungsstudie in ihrer Bachelorarbeit. Seit 2023 studiert sie Klinische Psychologie und Psychologisches Empowerment (M.Sc.) an der Diploma Hochschule.

Sarina Feicht completed her degree in Business Psychology (B.Sc.) at the Deggendorf Institute of Technology (DIT) in 2022. As part of her academic education, she collaborated in the research project as a student assistant and additionally examined the statistical validity of the KOIA VR-Personality-Assessment using a validation study in her Bachelor's thesis. Since 2023 she has been studying Clinical Psychology and Psychological Empowerment (M.Sc.) at the Diploma Hochschule.

Silvio Angelillo

Silvio Angelillo ist seit 2023 Projektansprechpartner im EFRE-geförderten Forschungsprojekt FutuRE-Lab, einem Demonstrationszentrum für Virtual und Mixed Reality. Neben seiner Tätigkeit studiert er berufsbegleitend im Master „Digital Business Engineering“. Das Projekt wird am Technologie Campus Parsberg/Lupburg, einem Forschungsstandort der THD und der OTH Regensburg, durchgeführt.

Silvio Angelillo has been the project lead in the ERDF-funded research initiative FutuRE-Lab, a demonstration center for virtual and mixed reality since 2023. Alongside his work, he is pursuing a part-time Master's degree in Digital Business Engineering. The project is implemented at the Technology Campus Parsberg/Lupburg, a joint research facility of Deggendorf Institute of Technology and OTH Regensburg.

Kontakt / *Contact*
✉ **silvio.angelillo@th-deg.de**

BAVARIAN JOURNAL OF APPLIED SCIENCES®

Continuing Education Measures for the Development of Future Skills at Universities: A Summary of the Empirical Analysis for East Bavaria in the Context of the Changing World of Work

Bernadette Busler*

https://doi.org/10.25929/ercv-q897

ABSTRACT

The dynamic work environment increasingly necessitates the development of future skills, pivotal competencies attainable through part-time continuing education at universities. In East Bavaria, a rural region marked by diverse challenges, providers of continuing education should devise measures to impart future skills, with innovative didactic methods playing a crucial role. This study analyzes the needs of professionals in the region, deriving concepts for academic training. A quantitative online survey involving 396 East Bavarian participants identifies key future skills, providing initial guidelines for continuing education. Survey results are condensed and expanded through a mixed methods approach, incorporating qualitative insights from interviews with five experts. Resilience, dialogue and conflict competency, problem-solving ability, and digital literacy emerge as central future skills. The development of training for these competences should take into account the different needs of the target groups. Short, three-month blended learning formats without prerequisites or with relevant professional experience are recommended. Didactic approaches should emphasize practical relevance, transferability, and action orientation. Problem- and project-based methods, promoting exchange, are suitable, and a methodological mix can support future skills development. The role of educators is evolving towards mentors and coaches. This work substantiates existing theories and empirical evidence on target group orientation and didactic methods, providing insights for further research and practical applications. It is recommended that universities expand future skills training offerings and facilitate a combination of formal and informal programs for increased flexibility.

Die dynamische Arbeitswelt erfordert zunehmend die Entwicklung von Future Skills, die durch berufsbegleitende Weiterbildung an Hochschulen erworben werden können. In Ostbayern, einer ländlich geprägten Region mit vielfältigen Herausforderungen, sind Weiterbildungsanbieter aufgefordert, Maßnahmen zur Vermittlung von Future Skills zu konzipieren, wobei innovative didaktische Methoden eine entscheidende Rolle spielen. Die vorliegende Studie analysiert den Bedarf der Fachkräfte in der Region und leitet daraus Konzepte für die wissenschaftliche Weiterbildung ab. In einer quantitativen Online-Befragung mit 396 Teilnehmerinnen und Teilnehmern aus Ostbayern werden wesentliche Future Skills für die Zukunft identifiziert und erste Ansätze zur Konzeption von Weiterbildungsmaßnahmen abgeleitet. Die Ergebnisse der Befragung werden im Sinne eines sequenziellen und integrativen Vorgehens im Mixed-Methods-Ansatz mit einer qualitativen Studie verdichtet und erweitert, wobei qualitative Erkenntnisse aus Interviews mit fünf Experten berücksichtigt werden. Als zentrale Future Skills kristallisieren sich Resilienz, Dialog- und Konfliktfähigkeit, Lösungsfähigkeit und Digital Literacy heraus.

* Service Centre Studies/E-Learning, Technische Hochschule Deggendorf (THD)

Bei der Entwicklung von Weiterbildungsmaßnahmen für diese Kompetenzen sollten vielfältige Bedürfnisse der Zielgruppe berücksichtigt werden. Empfehlenswert sind kurze, maximal dreimonatige Blended-Learning-Formate ohne Vorkenntnisse oder mit einschlägiger Berufserfahrung. Bei den didaktischen Ansätzen sollten Praxisbezug und -transfer sowie Handlungsorientierung zentral sein. Problem- und projektorientierte Methoden, die den Austausch fördern, sind geeignet, und ein Methodenmix kann die zukünftige Kompetenzentwicklung unterstützen. Die Rolle der Lehrenden entwickelt sich hin zu Lernbegleitern und Coaches. Die vorliegende Arbeit untermauert bereits existierende Theorien und empirische Belege zur Zielgruppenorientierung sowie zu didaktischen Methoden und liefert Erkenntnisse für die weitere Forschung und die praktische Anwendung. Es wird empfohlen, dass die Hochschulen ihr Angebot an wissenschaftlicher Weiterbildung erweitern und eine Kombination aus formellen und informellen Programmen anbieten, um die Flexibilität zu steigern.

KEYWORDS

Future skills, part-time continuing education at universities, innovative didactic methods, East Bavaria, development of future skills

Future Skills, berufsbegleitende Weiterbildung an Hochschulen, innovative didaktische Methoden, Ostbayern, Entwicklung von Future Skills

1. Introduction

The world of work has changed significantly in recent years, driven by a number of megatrends that are influencing business models, job profiles and working practices (Schermuly, 2021, pp. 29, 43; Wippermann, 2020, p. 46). Companies and employees are facing substantial challenges in a VUCA world characterized by volatile, uncertain, complex, and ambiguous events that need to be adequately managed (Blum & Gabathuler, 2019, pp. 75–76; Wippermann, 2020, pp. 55–56). Alongside the challenges posed by the changing work environment, companies are grappling with a skill gap, as often the required competencies are lacking to navigate through changes (Kienbaum & StepStone, 2021, pp. 19–21; Mayer, 2021, p. 1). Companies can address the skill gap by hiring new professionals or by upskilling existing personnel (Europäische Kommission, 2021; Kienbaum & StepStone, 2021, p. 22). However, recruiting is hindered by the shortage of skilled workers, and the skill gap is expected to widen further (Kienbaum & StepStone, 2021, p. 19). Consequently, it is imperative for companies to emphasize the continued education of their employees (Bräutigam & Schindler, 2021, p. 137). In rural regions such as East Bavaria, the challenges of the skill gap and the shortage of skilled workers are increased by ongoing urbanization and the appeal of metropolitan areas to young professionals (Ruscheinski, 2023, pp. 11-12). Therefore, it is particularly crucial to focus on these regions and strive for the further qualification of existing professionals to reduce the skill gap (Schermuly, 2023, p. 26). One chance to promote future skills is through part-time continuing education at universities (Stifterverband, 2022, pp. 27–28). In the context of lifelong learning, skills can be developed and extended alongside work or other commitments (Bräutigam & Schindler, 2021, p. 137; Schiefner-Rohs, 2020, p. 409). Traditional education concepts with rigid curricula are likely to be less effective in developing future skills, highlighting the need for innovative didactic methods (Bräutigam & Schindler, 2021, pp. 137–138; Edelkraut & Sauter, 2023, p. 72–73; Ehlers, 2020, p. 4).

The present study aims to develop measures for a concept promoting future skills within the framework of part-time continuing education at universities, particularly in rural regions such as East Bavaria. The empirical findings could contribute to strengthening the region by enabling universities to develop demand-oriented offerings for continuing education or to adjust existing measures.

2 Background

2.1 Future Skills

To close the skill gap, the development of future skills is essential. The *Stifterverband* (2018, p. 4) describes future skills as competencies that will become increasingly important for professional development and/or active participation in social life across various sectors over the next five years. This definition explicitly indicates that competencies required only in specific fields, or those that are less important than others do not qualify as future skills. Edelkraut and Sauter (2023, pp. 71–72) particularly emphasize the constructivist and connectivist perspectives in the development of future skills, as both facilitate a self-directed learning process, with instructors acting as learning guides or coaches. It is also strongly emphasized that competencies cannot be effectively conveyed through seminars (Edelkraut & Sauter, 2023, p. 93).

In recent years, organizations and research groups have pursued the goal of identifying relevant future skills. Ehlers (2022, p. 21–22) underlines that not all studies are suitable for methodically describing future competencies. However, the *Stifterverband* study is methodologically well-suited and, due to its clear practical relevance, serves as the theoretical basis for the following. The Future Skills Framework, introduced by the *Stifterverband* in 2018, was expanded in 2021 and now includes 21 competencies in four categories. These categories are:

- **Technological competencies:** data analytics & ai, software development, user-centred design, it architecture, hardware/ robotics development and quantum computing
- **Digital key competencies:** digital literacy, digital ethics, digital collaboration, digital learning and agile working
- **Classic competencies:** problem-solving ability, creativity, entrepreneurship & initiative, intercultural communication, resilience
- **Transformative competencies:** judgment capability, innovation competence, mission orientation, change competence as well as dialogue and conflict competence

According to the *Stifterverband,* classic competencies are the most important for both 2021 and 2026. Transformative competencies rank second, followed by digital key competencies and technological competencies. The identified future skills are not equally important for all employees, with technological competencies primarily relevant for specialists, according to the *Stifterverband*. Therefore, they are excluded from the present study.

2.2 Part-time continuing education at universities

This study focuses on continuing education at universities. The target group comprises adults with at least an initial professional or academic degree. Therefore, continuing education at universities is a form of adult education (Reich-Claassen, 2020, p. 280). More agile than traditional university formats, it acts as a seismograph for changes in the economy and society (Faulstich & Zeuner, 2008, p. 234; Lehmann, 2020, pp. 83–88). Opening up universities to non-traditional target groups is one of the tasks of university continuing education. The role of academic continuing education in the development of the regional environment is little researched, but offers opportunities. Offer formats range from shorter certificate courses to master's programs. The *Deutsche Gesellschaft für Wissenschaftliche Weiterbildung und Fernstudium (DGWF)* recommends categorization levels, with programs requiring at least 180 ECTS for bachelor's degrees and approximately 60 to 120 ECTS for master's degrees (Deutsche Gesellschaft für Wissenschaftliche Weiterbildung und Fernstudium (DGWF), 2010, p. 3). Certificate courses can accrue between twelve and 60 credit points. It can be conducted through various event formats such as face-to-face, online, or blended learning. There is a multitude of terms for different formats, including microcredentials and microdegrees.

2.3 Designing continuing education to develop future skills

The integration of future skills into German degree programs and continuing education offerings at universities is gaining significance (Stifterverband, 2022, pp. 27– 28). Since 2016, 13 studies on this topic have been conducted, with initial developments in technological competencies becoming apparent. However,

there are few systematic comparative studies due to the complexity of measuring future skills. It is assumed that universities have been insufficiently focused on promoting future skills so far (Ehlers, 2022, pp. 9–10). Traditional educational programs at universities may not be beneficial to develop future skills (Ehlers, 2020, p. 4). Innovative teaching and learning methods such as agile learning could replace conventional course-based offerings. Continuous updating and adaptation of continuing education measures are necessary as future skills evolve. Lifelong learning is gaining importance, and universities must adjust their structures and content to provide future-oriented offerings (Schäfer, 2021, pp. 29–32). In addition, offers should be geared towards the current requirements and needs of the target group. The heterogeneity of participants requires individualization of learning formats, taking into account different learning preferences and prerequisites. Innovative didactic concepts are necessary to meet the demands of adults who value practical relevance, flexibility, and the compatibility of work and continuing education (Rump & Eilers, 2022, p. 107).

2.4 Special needs in East Bavaria

The structure of East Bavaria is predominantly rural (Bundesamt für Bauwesen und Raumordnung (BBSR), 2020). Rural areas are increasingly facing challenges compared to urban areas. As a result of ongoing urbanization and migration from rural areas, the sparsely populated areas are becoming more and more depopulated. This is increasingly weakening them and causing them to lag behind urban centers in terms of economic performance, among other things (Ruscheinski, 2023, pp. 11–12). Rural regions also face challenges in the area of education. For example, due to the low density of universities or continuing education institutions, attending such institutions is associated with longer travel times (Bundesministerium für Ernährung und Landwirtschaft (BMEL), 2023, pp. 23–26).

Furthermore, there is a decline in participation in continuing education programs in East Bavaria. For Bavaria as a whole, the decline from 2019 to 2021 is -6.2 %. For the two East Bavarian administrative districts, the decline is even more pronounced: -8.03 % for the Upper Palatinate and -8.74 % for Lower Bavaria (Bertelsmann Stiftung, 2021).

2.5 Research questions

The background clearly indicates the need for action there is in the field of continuing education for universities in East Bavaria. However, to be able to develop specific offerings, it is essential to align the content and formats with the requirements of the professionals in the region. Furthermore, the formats and methods of continuing education should be pedagogically suitable for the development of future skills.
From these requirements, the following four research questions arise, which are intended to be answered within the scope of this work:

1. What three future skills are significant for aspiring and existing professionals in East Bavaria?

2. Through which continuing education measures can the most important three future skills be developed by aspiring and existing professionals in East Bavaria?

3. With which didactic methods can the most important three future skills be developed by aspiring and existing professionals in East Bavaria?

4. What is the difference between the didactic methods to be used for the acquisition of future competences according to the future competence in question?

3 Methodology

As an empirical research method, a mixed methods approach was chosen. It involves a sequential process, consisting of two phases, with a deepening design where a quantitative study is followed by a qualitative study. In this approach, the qualitative study was prioritized, and the results of the first study were intended to be extended by the second (Kuckartz, 2014, pp. 77–78; Schreier & Odağ, 2020, p. 170). This mixed methods approach allows a comprehensive insight into the field of research. Practical implications can be derived as the findings of both methods complement each other (Schreier & Odağ, 2020, p. 168).

3.1 Study I: Quantitative online survey

Based on the theoretical foundations, a standardized quantitative online survey was

conducted as a first study. The Future Skills Framework from 2021 (cf. 2.1) served as a basis, including the categorization and description of skills to operationalize the variables.

To operationalize the construct of 'continuing education', the needs and interests of the target audience were contrasted with offerings of scientific continuing education. The target group for the survey was defined as employees and students who live, work or study in Lower Bavaria or the Upper Palatinate. From May 2nd to May 19th, 2023, an ad-hoc sample of participants was able to complete a standardized quantitative online survey. The data from the online survey was analyzed using descriptive statistics, including frequency distributions and means. The survey resulted in a sample of N = 396, of which 154 were male and 235 female. Seven persons did not provide information. Respondents ranged in age from 17 to 69 years with a mean of 36.54 years. The distribution by occupation, higher education institution, place of residence of students and employees and place of work is shown in Figures 1–5. Participants (N = 396) had to evaluate15 future skills by rating the perceived importance of each skill. In order to consolidate this result, additional variables on interest in further training for future skills and participation in further training for a specific future skill were analyzed. These, along with the following variables, are based on a subsample (n = 284), as a filter question was used to inquire about general interest in

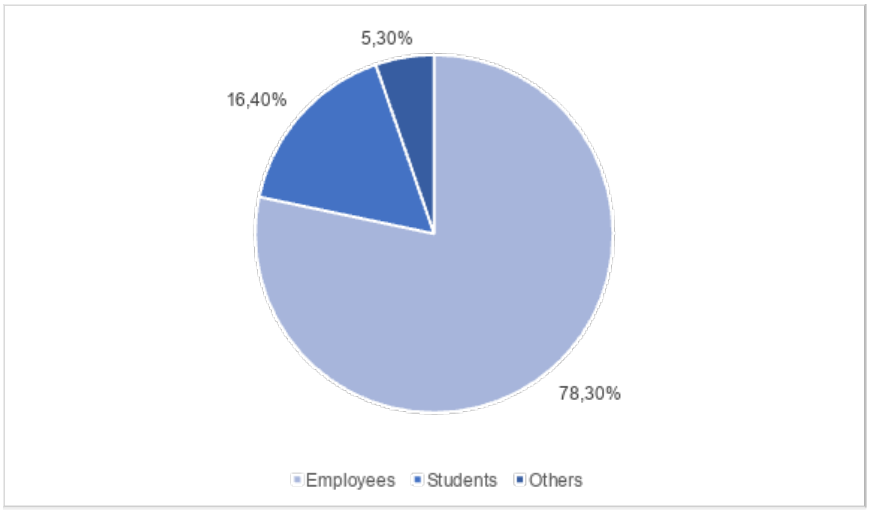

Figure 1: Occupation of respondents (N = 396).

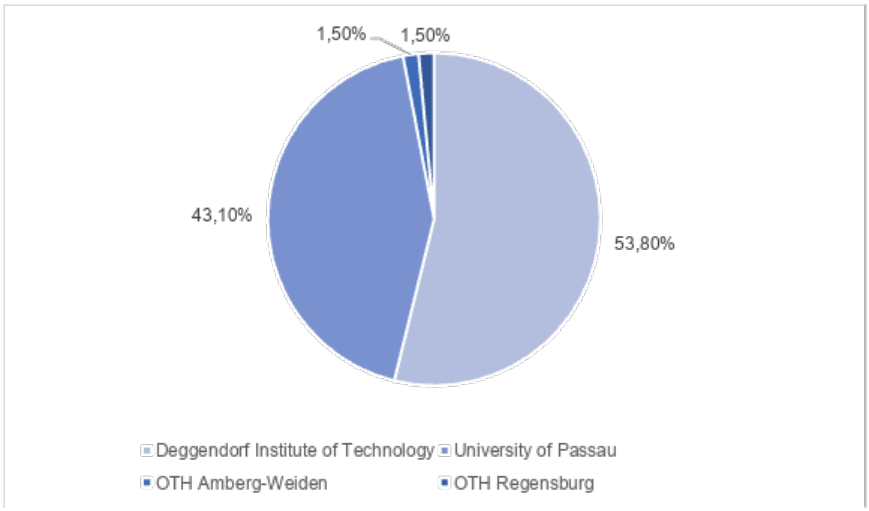

Figure 2: Distribution by university (n = 65).

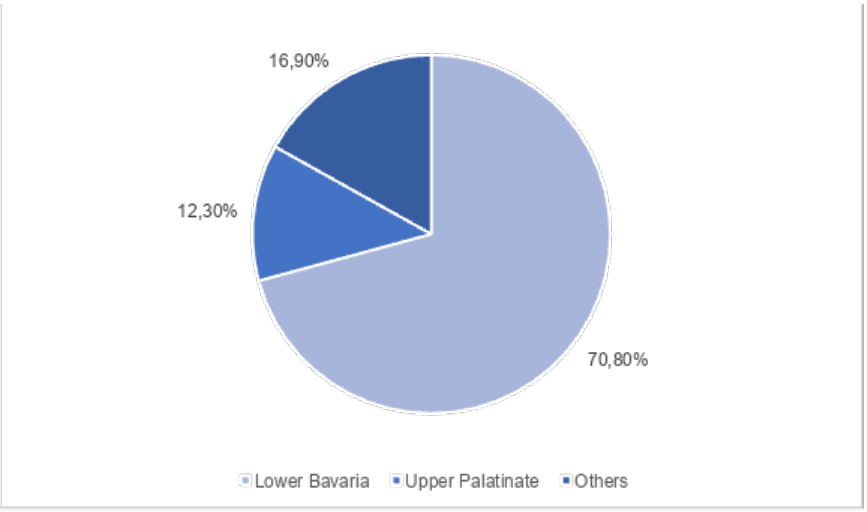

Figure 3: Distribution with regard to students' place of residence (n = 65).

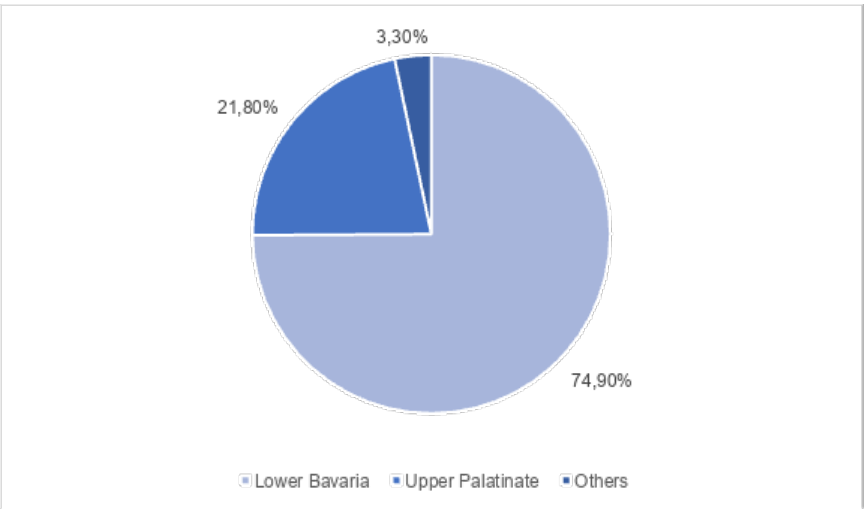

Figure 4: Distribution in terms of employees' places of employment (n = 310).

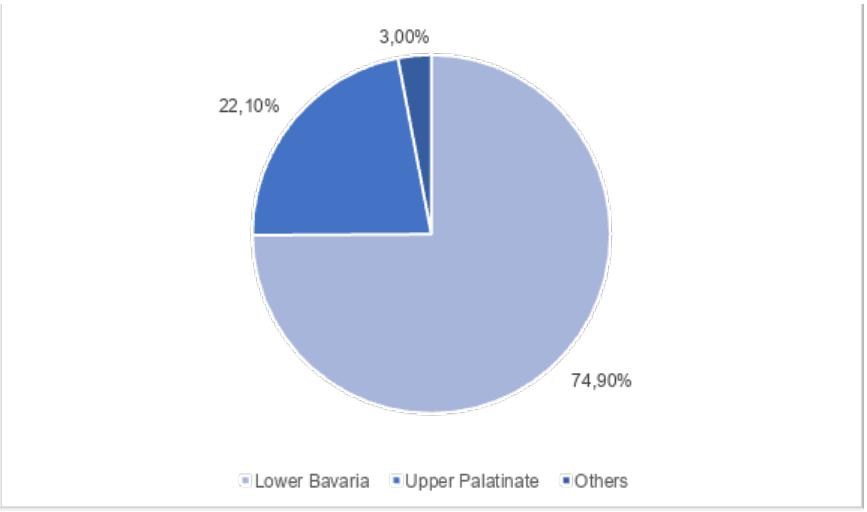

Figure 5: Distribution in terms of employees' places of residence (n = 310).

continuing education.

Results: ranking of future skills on various dimensions

Fifteen future skills were rated by participants on a total of three dimensions: (a) *importance* (cf. table 1, column 5), (b) *interest* in continuing education (cf. table 1, column 6), and (c) *participation* in continuing education (cf. table 1, column 7). These ratings were then aggregated into a summarized score (cf. table 1, columns 1 and 2).

Regarding the *importance* of future skills, participants identified the following future competencies as most significant: (1) problem-solving ability, (2) digital literacy, and (3) resilience. Considering which three future skills are of interest for continuing education, (1) resilience and (2) dialogue and conflict competence take the first two places. Due to the same number of mentions, (3) problem-solving ability and (3) innovation competence are tied for third place. As to *participation* in continuing education, the ranking was as follows: (1) resilience, (2) dialogue and conflict competence, along with equal frequency, (3) change competence, and (3) digital learning. The summary of the rankings regarding importance, interest, and specific participation in continuing education related to each future skill is presented in Table 1 (columns 5–7). Table 1 also includes a ranking based on the average position (columns 1–2) and the frequency of placements in the top five rankings (column 3). To identify the top three future skills, frequencies of placement in top five and an overall average placement ranking were calculated. It is noteworthy that resilience, with an average ranking of 1.67 and 100 % placement in the top five rankings, occupies the top position regarding *interest* and *participation* in continuing education. Dialogue and conflict competence, with an average overall placement ranking of 2.67 and also 100 % in the top five rankings, holds the second position. Third in the average placement ranking is problem-solving ability, with a score of 3.67, even though it appears in the top five rankings with only 66.67 % frequency. Regarding average positions, there is a smaller gap between third and fourth versus fourth and fifth place. In addition, the future skill digital literacy (fourth place) is included in the top five rankings at 100 %. In contrast, only 66.67 % of the third-placed skill problem-solving ability is included. For this reason, research questions (1) to (3) are adapted to the most important **four** future skills and the subsequent study was based on the

Ranking by position Ø	Position Ø	Frequency in top 5 rankings	Future skill	Position: Importance of future skill	Position: Interest in continuing education	Position: Participation in continuing education
1	**1,67**	3/3	**Resilience**	3	1	1
2	**2,67**	3/3	**Dialogue and conflict competence**	4	2	2
3	**3,67**	2/3	**Problem-solving ability**	1	3	7
4	**4,00**	**3/3**	**Digital literacy**	2	5	5
5	6,00	1/3	Change competence	9	6	3
6	6,33	1/3	Digital learning	7	9	3
7	6,67	1/3	Digital collaboration	4	8	8
8	7,67	1/3	Innovation competence	14	3	6
9	8,00	-	Entrepreneurship & initiative	6	7	11
10	9,00	-	Agile working	8	10	9
11	10,33	-	Intercultural communication	12	10	9
12	10,67	-	Creativity	10	10	12
13	12,00	-	Digital ethics	11	13	12
14	13,67	-	Judgment capability	13	14	14
15	15,00	-	Mission orientation	15	15	15

Table 1: Ranking of 15 Future Skills

most important four future skills.

Revised research questions were accordingly modified to:

1. What **four** future skills are significant for aspiring and existing professionals in East Bavaria?

2. Through which continuing education measures can the most important **four** future skills be developed by aspiring and existing professionals in East Bavaria?

3. With which didactic methods can the most important **four** future skills be developed by aspiring and existing professionals in East Bavaria?

4. What is the difference between the didactic methods to be used for the acquisition of future competences according to the future competence in question?

Continuing education measures for the development of future skills

With regard to the type of continuing education in terms of the offered programs, 22.5 % of respondents prefer individual workshops or seminars without ECTS credits. Free lecture series receive approval from 18 %, and certificate courses (ranging from five to 15 ECTS) garner 13.4 % agreement among participants. As the preferred format for continuing education, half of the respondents opt for a blend of on-site and online components, known as blended learning. A part-time continuing education format is favored by 60.2 % of respondents, maintaining a significant lead over other formats. In terms of the duration, shorter formats dominate. 33.5 % of respondents can envision a duration between one and three months, and less than one month is considered by 23.2 %. When asked about the admission requirements for attending continuing education to acquire the selected future skill, 38.4 % of respondents indicate no specific requirements, while 32.7 % mention relevant professional experience.

3.2 Study II: Qualitative expert interviews

The results obtained in the first study were consolidated and supplemented with additional aspects in the second one through structured expert interviews. The interviewed experts play a special role due to their socially ascribed status (Bogner et al., 2014, p. 11; Helfferich, 2019, p. 681). Expert status is defined by characteristics such as education and professional activities, especially in the fields of adult and higher education, key competencies, future skills, and innovative teaching and learning methods. Typically, individuals in key positions in continuing education or in teaching and research areas, such as professors and researchers, possess the required expertise (Helfferich, 2019, pp. 680–681). The qualitative sample consists of five experts with extensive academic and professional backgrounds in relevant areas. Three of the respondents are professors with a focus on e-learning, innovative teaching formats, and continuing education. One person is a research associate in the field of future skills, and another one is the head of a center for key competencies. Four of the respondents work at universities of applied sciences, and one works at a university. Three work in Germany, and two work in Austria. The experts were interviewed outside of East Bavaria to avoid bias. The interviews were conducted via Microsoft Teams between July 24th and August 11th, 2023, and audio recordings were made to produce the transcripts.

The second study used a qualitative content analysis to interpret data from the interviews. An exploratory, predominantly inductive approach to category formation was pursued to explore novel research areas, such as the acquisition of future skills through scientific continuing education in the context of changing work environments. Data was analyzed using content-structuring qualitative content analysis, an analytical procedure that reduces data complexity based on categories and rule-guided to enable interpretation of the texts (Kuckartz & Rädiker, 2022, pp. 110–111). This methodological approach forms the framework for interpreting the conducted interviews. The main categories were initially developed deductively, then expanded inductively, and further differentiated with the help of inductively formed subcategories, allowing for various analyses of the material to be conducted subsequently.

4. Results

4.1 Research question (1)

What four future skills are significant for aspiring and existing professionals in East Bavaria?

The preliminary results of the first study reveal four future skills that are significant for both prospective and existing professionals in the region. These are (1) resilience, (2) dialogue and conflict competence, (3) problem-solving ability, and (4) digital literacy. Four out of the five experts agree with and confirm the ranking of the top 4 future skills. Therefore, the interviewed persons validated the results obtained from the quantitative survey. However, one expert noted that the ranking of the most important future skills depends heavily on the activities of the professionals, leading to a lack of clear agreement. Given the highly differentiated consideration of the choice between problem-solving ability and digital literacy, it is clear that adjusting the research question to a top 4 ranking was a logical decision.

4.2 Research question (2)

Through which continuing education measures can the most important four future skills be developed by aspiring and existing professionals in East Bavaria?

It becomes evident that the design of continuing education measures to develop future skills is essential and dependent on the target group. Therefore, it is sensible to start with a needs analysis, as conducted in study 1. Half of the respondents prefer individual workshops without ECTS, free lecture series or courses up to a maximum of 15 ECTS. The formats should be part-time, use a blended learning approach and last a maximum of three months. In addition, about half of the respondents from Study 1 prefer programs with no admission requirements or where only relevant work experience is required. With the help of the expert statements from Study 2, the requirements of the target group were examined with regard to a didactically, institutionally and organizationally sensible concept. In this context, the statements of the experts confirm the methodological approach of the present work.

Differences in the target group, including professional activities, competency levels, and experience with academic education or online teaching, significantly influence the design. Consequently, a continuing education measure could take place within a shorter timeframe if potential participants have already completed academic education or have experience in specific learning environments.

In general, it is crucial for continuing education measures aimed at developing future skills to offer participants a high degree of flexibility. In this context, it is advisable to design the measures with a modular structure, following a modular principle. This allows participants to select individual elements according to their interests and combine them, ultimately achieving a larger formal qualification. As the interviews show, this can work through the completion of small continuing education elements with at least 1 ECTS point. However, the experts interviewed identified an organizational challenge in ensuring the accreditation or recognition of achievements. Additionally, it must be ensured that the combination of modules follows a meaningful structure. Regarding the temporal scope, various possibilities are generally conceivable for developing future skills. If a specific future competence is to be developed, the implementation of Communities of Practice (CoPs) or the use of Massive Open Online Courses (MOOCs) and Microcredentials could be considered as short- to medium-term offerings. However, the challenge arises again, particularly with informal offerings, as to whether and how these can be credited. Furthermore, experts suggest that short- or medium-duration formats are likely to be more appropriate for individuals with an academic background. Whether future skills can be developed equally well with short- or medium-term offerings as with longer continuing education measures is assessed differently by the experts. Besides the scientific focus, as seen in master's programs, longer formats offer additional advantages. Various future skills can be developed and deepened sustainably, sometimes subconsciously, during longer-term continuing education. Additionally, longer formats allow for better variation in terms of the applied didactic methods and the instructors. This mix can positively impact competence development. As an additional incentive, formal certificates can be motivational for participants. Generally, it should be ensured during the conception phase that the formats are

interdisciplinary and enable a heterogeneous participant group. Regarding the event format of continuing education measures, the design depends significantly on the respective competency. For example, digital literacy can be developed entirely online.

To improve problem-solving ability, a high online component is possible, but on-site phases would also be beneficial. However, the development of resilience and dialogue and conflict competence requires on-site phases that enable participants to interact locally.

The future skills relevant to the target group can be developed through various approaches in continuing education. In addition to specific target group and needs analyses, which are essential for the conception, general aspects should be considered. For this work, study 1 represents a corresponding analysis of requirements and needs. Therefore, as the answer to research question (2), shorter formats without or up to a maximum of 15 ECTS in blended learning format, which can be completed part-time and without admission restrictions, are recommended.

4.3 Research question (3)

With which didactic methods can the most important four future skills be developed by aspiring and existing professionals in East Bavaria?

Didactic methods for developing resilience

To strengthen the future skill of resilience, didactic methods are needed that facilitate participant interaction and exchange during on-site events. Additionally, the selected instruments should enable a connection to individual problems or challenges in participants' everyday work. Concrete case studies can support the development of resilience. Participants in the training should learn practical methods that can be transferred to their personal lives, thus allowing for the sustainable development of resilience. Moreover, reflective elements are required, guiding or accompanying participants in conducting reflections. It is advisable to have an additional person act as a learning guide or coach, providing support parallel to the content-focused lecturer with a focus on feedback and assistance. Alternatively, one lecturer can be responsible for both content and methodological and accompanying elements, necessitating a role shift for the lecturer to become a learning guide.

Didactic methods for developing dialogue and conflict competence

This future skill is best developed through didactic methods that encourage exchange, conducted in on-site events with other participants. Project- or problem-based methods are particularly suitable, requiring teams to solve or address tasks, problems, and concrete use cases. Through practical exercises, participants can observe and reflect on conflict conversations of others, engage in their own, and reflect on them. The exchange and feedback within the group facilitate the development of dialogue and conflict competence.

Didactic methods for developing problem-solving ability

Using action-oriented methods, the future skill of problem-solving ability can be developed both online and on-site. Practical exercises, as well as real projects, problems, and tasks that participants work on and solve collaboratively with others, are effective. It is important to ensure that groups are as interdisciplinary as possible to obtain diverse perspectives on the problem or task, contributing to the development of problem-solving ability. Additionally, participants should be guided with feedback during the learning or problem-solving process. Since improving problem-solving ability often involves addressing problems and tasks with no predefined solution approach and, therefore, usually no completely right or wrong path, feedback by the lecturer is essential to guide participants through the learning process.

Didactic methods for developing digital literacy

For improving digital literacy, methods for imparting foundational knowledge are particularly effective. Online-based self-learning formats, completed asynchronously, as well as on-site events, can be utilized for this purpose. In addition to knowledge transfer, exercises or practical applications are necessary to apply and practice what has been learned. In the context of integrative courses, it is sensible to begin with knowledge transfer elements and then proceed to practice this knowledge.

Building on this, further or more in-depth knowledge can be conveyed, which should be applied and practiced again. Suitable hardware and software for the respective content can support the application of knowledge in real-world scenarios.

4.4 Research question (4)

What is the difference between the didactic methods to be used for the acquisition of future competences according to the future competence in question?

According to experts, there are both overlaps and differences in the appropriate didactic methods for developing the four future skills of resilience, dialogue and conflict competence, problem-solving ability, and digital literacy. Differences become apparent, primarily related to whether knowledge transfer, coaching, reflection, or exchange are necessary or helpful for fostering each respective future skill. As stated by the interviewed specialists, methods for knowledge transfer, for example, are not necessarily required for the development of resilience, dialogue and conflict competence, and problem-solving ability. Coaching, on the other hand, is not necessary for fostering dialogue and conflict competence, problem-solving ability, and digital literacy. Furthermore, there is no need to use reflection-oriented methods to foster problem-solving ability or digital literacy. Additionally, the experts assume, that the improvement of digital literacy requires the use of appropriate hardware and software, but not necessarily methods that encourage exchange among participants. Another difference lies in whether the development of future skills is possible purely online. The experts' statements show that this is only the case for problem-solving ability and digital literacy.

5 Discussion

5.1 Identification of the most important future skills

The quantitative survey results revealed resilience, dialogue and conflict competence, problem-solving ability, and digital literacy as key future skills.

Overlaps are observed with the ranking from the Stifterverband, where problem-solving ability and dialogue and conflict competence emerge as the most important future skills for both 2021 and 2026. The top four future skills identified in study 1 were further validated through expert interviews, although there were differing views on the rankings of the third and fourth positions. It is also evident that the ranking of future skills based on their importance is dependent on the target audience. Since the sample in study 1 is not representative of the overall population of professionals in East Bavaria due to an ad hoc sampling, the results cannot be generalized to the entire population. Nevertheless, a trend can be inferred, and these four identified future competencies form the basis for answering the remaining three research questions. From the results of research question (1), the following hypothesis can be generated for further studies:

H1: There are differences in the importance of future skills depending on the target audience.

5.2 Continuing education measures concept to develop future skills

The results of the quantitative survey indicate that respondents prefer shorter formats with or without a formal degree, conducted in a blended learning format, and accessible without restrictions, or with professional experience as a prerequisite for admission. These results provided a basis for discussion in the qualitative interviews. The experts emphasized that the design of continuing education measures significantly depends on the target group and confirm the necessity of audience orientation as per theory. Furthermore, it is highlighted that continuing education formats for the development of future skills should be designed to be as flexible as possible. In this context, the best solution would be a modular principle. A mix of continuing education formats from different providers is also conceivable. However, this implies significant conceptual, organizational, and potentially legal effort for the institutions. Recognition of various formats must be ensured. In terms of timeframe, the prospects of shorter forms of continuing education for future skills development are questionable. Therefore, success tends to be achieved only with longer offerings. However, literature on adapting continuing education in the context of future skills suggests that universities must become more agile and flexible to keep up with the pace and changes in the working world. This also requires a flexible adjustment of offerings and content of continuing education measures, which

is often not feasible with rigid curricula of study programs. Additionally, literature recommends developing shorter formats to develop future skills and testing and evaluating them in line with the exploratory nature of continuing education at universities (Stifterverband, 2022, p. 28). Due to the discrepancy between the obtained results and the theoretical background presented in 2.3, this aspect should be explored in more in-depth studies. The following hypotheses can be derived from the results of the second research question, which need to be examined in subsequent research:

H2: Continuing education formats at universities with a duration of up to three months are suitable for developing a future skill.

H3: For target groups that differ in terms of educational level, an adapted concept of continuing education measures at universities in terms of duration is required.

H4: For target groups without academic background, continuing education measures at universities must be designed with a duration of more than six months to enable the development of a future skill.

5.3 Didactic methods for developing future skills

Depending on the respective future skills, different didactic methods can be conducive to competency development. For all four future skills, methods that enable practical relevance or transfer and are action-oriented are suitable. Additionally, problem- or project-based methods are very helpful in improving the four future skills. Furthermore, didactic tools that work especially well in face-to-face events are useful, as developing all four competencies in on-site events is suitable. It is evident that a mix of different methods can contribute to the development of future skills. Ideally, measures are meaningfully combined, allowing for the acquisition of knowledge, stimulating action, and reflecting on the developmental process. In this context, there is agreement with the theory that a meaningful combination of diverse didactic methods is required to achieve the best possible success. However, it is also important to reconsider the role of lecturers, as supporting the development of future skills, for example, in project-oriented methods, requires learning companions who provide coaching assistance in the developmental process. These findings can be encapsulated in the following hypotheses:

H5: With a mix of didactic methods, future skills in continuing education at universities can be developed most effectively.

H6: To develop future skills, there is a need for a change in the role of lecturers towards learning companions.

5.4 Differences in didactic methods for developing future skills

Besides didactic methods that can contribute to the development of all four future skills, there are also measures that are better suited for certain competencies than others. For this reason, the differences regarding the methods to be used are examined with research question (4). In this context, it becomes apparent that elements of knowledge transfer, as well as the use of appropriate hardware and software, are helpful primarily for developing digital literacy. Coaching methods, on the other hand, can contribute more to the improvement of resilience. Furthermore, differences emerge regarding exchange-based methods such as peer learning. These formats are helpful for the development of resilience, dialogue and conflict competence, as well as problem-solving ability. Regarding digital literacy, no benefit is expressed by the experts in this regard. According to the expert, reflection-oriented methods seem to be helpful for improving resilience as well as dialogue and conflict competence, but no benefits are mentioned for the development of problem-solving ability and digital literacy. From this, the following hypothesis can be derived:

H7: The suitable didactic methods for developing future skills differ in relation to the competency to be imparted on participants.

5.5 Limitations

This study had to be completed within 6 months. For this reason, it was only possible to deal with the subject of the research in a limited way in terms of time and content, but no in-depth analysis was possible. Additionally, the application of the Future Skills Framework is somewhat limited, as it strictly separates digital and technological competencies and assumes that technological future skills are only needed by a smaller group of specialists.

This aspect is critical, considering that it is often challenging to distinguish digital and technological competencies from each other. Despite the discourse around the framework, it forms the substantive basis of this work, as it incorporates requirements from the business and societal perspectives, has been methodically developed in a traceable manner, and places a particular focus on universities and continuing education. Another limitation of the work lies in the sample selection for the quantitative survey. Due to insufficient financial and personnel resources, no random, representative sample could be drawn. The analysis of the demographic variables of the quantitative survey shows that approximately 96 % of the surveyed students study in Lower Bavaria, and about 75 % live in Lower Bavaria. Similarly, about 75 % of the employed individuals work and live in Lower Bavaria. This reveals a distortion due to the arbitrary sample selection. Another aspect to be critically viewed is the lack of definition of the target group for which the continuing education measures are intended. This was only limited to aspiring and existing professionals in East Bavaria. However, it becomes clear that a more detailed examination beforehand or at least during the evaluation of the quantitative survey would have been required to design measures for a specific target group.

6 Conclusion

In general, it is recommended to expand the offerings of continuing education at universities, as it significantly contributes to lifelong learning and enables further qualification alongside work or private commitments. In this context, universities play a crucial role in counteracting the shortage of skilled workers and developing employees, companies, and the entire region. Furthermore, universities themselves benefit from a well-developed continuing education offering, as it opens up an additional financial resource for them. Through collaboration with providers of informal continuing education opportunities, the attractiveness of continuing education can be increased, and the offerings can be better tailored to the needs of the target group. As a next step, a comparison of the results of this work with the existing continuing education offerings of universities in East Bavaria should take place. This can identify overlaps and differences, allowing the offerings of respective institutions to be adjusted. In the conception of new measures and the adaptation of existing ones, it is advisable to further narrow down the target audience. This might encompass access restrictions or professional activities, as these factors can significantly influence further conception. The narrower the target group, the more precise and audience-oriented the conception, development, and implementation can be. However, care should be taken not to limit the target group too much, as this may lead to a loss of the benefits of heterogeneous groups, which significantly contribute to competence development due to their interdisciplinary and multiperspective nature. After implementing measures, they should be regularly evaluated and, if necessary, adapted.

In addition to the prospective development of continuing education at universities based on the results obtained from this research, it is advisable to expand the current study. This includes the analysis of existing data from both quantitative and qualitative studies. Possible quantitative analyses could identify differences between target groups regarding relevant future skills. This should be evaluated among students and employees, students of different disciplines, or employees from different industries. With the data material from the qualitative study, additional analyses can also be conducted, e.g. a comparison between German and Austrian universities. Future research could also expand the current study by enlarging the sample of expert interviews to allow for a comparison between universities and universities of applied sciences.

With this study, the research questions have been answered, and agreements between theoretical background from section 2 and the obtained results have been identified. A significant insight is that there is a need for a stronger focus on continuing education at universities to enable lifelong learning. Additionally, traditional offerings should be reconsidered and adapted to the requirements of the target audiences.

References

Bertelsmann Stiftung. (2018). *Deutscher Weiterbildungsatlas. Teilnahme und Angebot in Kreisen und kreisfreien Städten.* https://www.bertelsmann-stiftung.de/de/publikationen/publikation/did/deutscherweiterbildungsatlas-2

Blum, U. & Gabathuler, J. (2019). PE 4.0: Herausforderungen für Führungskräfte und Bildungsverantwortliche. In C. Negri (Eds.), *Führen in der Arbeitswelt 4.0* (p. 73–93). Berlin: Springer.

Bogner, A., Littig, B., & Menz, W. (2014). Interviews mit Experten: Eine praxisorientierte Einführung. Springer VS

Bräutigam, S. & Schindler, F. (2021). Zukunft des agilen Lernens in der wissenschaftlichen Weiterbildung. In J. Longmuß, G. Korge, A. Bauer & B. Höhne (Eds.), *Agiles Lernen im Unternehmen* (p. 137–143). Berlin: Springer Vieweg

Bundesamt für Bauwesen und Raumordnung (BBSR). (2020). *Raumbeobachtung – Laufende Raumbeobachtung – Raumabgrenzungen.* https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/Raumabgrenzungen/deutschland/kreise/siedlungsstrukturelle-kreistypen/kreistypen.html

Bundesministerium für Ernährung und Landwirtschaft (BMEL). (2023). *Ländliche Regionen im Fokus – Fakten und Hintergründe.* https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/laendliche-regionen-im-fokus.html

Deutsche Gesellschaft für Wissenschaftliche Weiterbildung und Fernstudium (DGWF). (2010). *DGWF-Empfehlungen zu Formaten wissenschaftlicher Weiterbildung.* https://dgwf.net/files/web/service/DGWF- empfehlungen_formate_12_2010.pdf

Edelkraut, F., & Sauter, W. (2023). *Future-Skills-Training: Zukunftsfähigkeit professionell erfassen und gezielt entwickeln.* Schäffer-Poeschel Verlag.

Ehlers, U.-D. (2020). Future Skills: *Lernen der Zukunft - Hochschule der Zukunft.* Springer VS

Ehlers, U.-D. (2022). *Future Skills im Vergleich: Zur Konstruktion eines allgemeinen Rahmenmodells für Zukunftskompetenzen in der akademischen Bildung.* https://nextskills.org/fs-metaanalyse/

Europäische Kommission. (2021). *Maßnahmen zur Verbesserung des lebenslangen Lernens und der Beschäftigungsfähigkeit*. https://ec.europa.eu/commission/presscorner/detail/de/ip_21_6476

Faulstich, P., & Zeuner, C. (2008). *Erwachsenenbildung: Eine handlungsorientierte Einführung in Theorie,* Didaktik und Adressaten (3rd ed.). Juventa

Helfferich, C. (2019). Leitfaden- und Experteninterviews. In N. Baur & J. Blasius (Eds.), *Handbuch Methoden der empirischen Sozialforschung* (2nd ed., pp. 669–686). Springer VS

Kienbaum & StepStone. (2021). *Future Skills – Future Learning. Eine Kooperationsstudie von Kienbaum mit StepStone.* https://www.kienbaum.com/de/publikationen/future-skills-future-learning/

Kuckartz, U. (2014). *Mixed Methods: Methodologie, Forschungsdesigns und Analyseverfahren.* Springer VS

Kuckartz, U., & Rädiker, S. (2022). *Qualitative Inhaltsanalyse – Methoden, Praxis, Computerunterstützung* (5th ed.). Beltz Juventa

Lehmann, B. (2020). Ziele und Aufgaben wissenschaftlicher Weiterbildung. In W. Jütte & M. Rohs (Eds.), *Handbuch Wissenschaftliche Weiterbildung* (pp. 79–98). Springer VS

Mayer, M. M. (Bertelsmann Stiftung, Eds.). (2021). *Fachkräfteengpässe und Zuwanderung aus Unternehmenssicht in Deutschland 2021: Stärkerer Anstieg als im Vorjahr angenommen.* https://www.bertelsmannstiftung.de/de/publikationen/publikation/did/fachkraefteengpaesse-undzuwanderung-aus-unternehmenssicht-in-deutschland-2021-staerkereranstieg-als-im-vorjahr-angenommen-all

Reich-Claassen, J. (2020). Angebotsentwicklung und Programmplanung in der wissenschaftlichen Weiterbildung. In W. Jütte & M. Rohs (Eds.), *Handbuch Wissenschaftliche Weiterbildung* (pp. 279–297). Springer VS

Rump, J., & Eilers, S. (2022). Heute für morgen: betriebliche Bildung zur Sicherung der Employability. In J. Rump, T. Sattelberger, & S. Eilers (Eds.), *Employability Management 5.0: Impulse für die Transformation von Wirtschaft, Bildung und Gesellschaft* (97–116). Schäffer-Poeschel

Ruscheinski, T. (2023). Herausforderungen ländlicher Räume – das Ziel gleichwertiger Lebensverhältnisse. In D. Ahrens (Eds.), *Smart Region: Angewandte digitale Lösungen für den ländlichen Raum. Best Practices aus den Modellprojekten "Digitales Dorf Bayern"* (9–23). Springer Gabler

Schäfer, E. (2021). Das Konzept des lebenslangen Lernens. In U. Blum, J. Gabathuler, & S. Bajus (Eds.), *Weiterbildungsmanagement in der Praxis: Psychologie des Lernens* (pp. 17–46). Springer

Schermuly, C. C. (2021). New Work – *Gute Arbeit gestalten. Psychologisches Empowerment von Mitarbeitern* (3rd ed.). Haufe

Schreier, M., & Odağ, Ö. (2020). Mixed Methods. In G. Mey & K. Mruck (Eds.), *Handbuch Qualitative Forschung in der Psychologie: Band 2: Designs und Verfahren* (2nd ed., pp. 159–184). Springer

Stifterverband. (2018). *Future Skills: Welche Kompetenzen in Deutschland fehlen.* https://www.future-skills.net/analysen/future-skills-welche- kompetenzen-in-deutschland-fehlen

Stifterverband. (2022). *Hochschulbildung in der Transformation: Hochschul- Bildungs-Report 2020 Abschlussbericht.* https://www.hochschulbildungsreport.de/

Wippermann, F. (2020). *Future Skills für Führung und Organisation. Wie Sie strukturiert und flexibel die digitale Transformation meistern.* Schäffer-Poeschel Verlag

Bernadette Busler

Bernadette Busler has been a member of staff at the Deggendorf Institute of Technology since 2017, and a lecturer since 2018. She specializes in e-learning, occupational psychology and continuing education. With a Bachelor's degree in Communication, Knowledge, Media (University of Applied Sciences Upper Austria, 2010) and a Master's degree in Business Psychology, Leadership and Management (SRH Fernhochschule, 2023), she combines her interests with expertise.

Bernadette Busler ist seit 2017 Mitarbeiterin an der Technischen Hochschule Deggendorf und seit 2018 Lehrbeauftragte. E-Learning, Arbeitspsychologie und Weiterbildung sind ihre Steckenpferde. Durch den Bachelor Kommunikation, Wissen, Medien (FH Oberösterreich, 2010) und den Master Wirtschaftspsychologie, Leadership und Management (SRH Fernhochschule, 2023) vereint sie ihre Interessen mit fachlicher Kompetenz.

Kontakt / *Contact*
✉ **bernadette.busler@th-deg.de**

CALL FOR GUEST EDITORS

BJAS Issue 8 (2025):

The Bavarian Journal of Applied Sciences is seeking proposals from Guest Editors for the next issue of the journal to be published in 2025 (No. 8).

Proposals should be submitted no later than 30 January 2025 to info@jas.bayern, and will be evaluated by the journal's Editorial Board for their relevance to the BJAS readership and their academic quality.

About BJAS

For further information about the BJAS, please see the BJAS website: https://jas.bayern.

For preliminary enquiries and submissions, contact Michelle Cummings-Koether and Kristin Seffer via info@jas.bayern.

Proposal format

The next issue of the BJAS can have a specific topic and address different disciplines or interdisciplinary approaches, or it can have a disciplinary focus. It shall have a strong focus on applied research but with a theoretical foundation. Collaborative proposals (2 or 3 guest editors) are particularly welcome.

Proposals should include information in the following sections:

- the proposed topic for the special issue,
- a draft Call for Papers including the chosen theme, and target readership (max. 2 pages),
- Guest Editor profiles: names, affiliations, contact details, short biographical information,
- a list of potential reviewers.

The role of Guest Editors

Guest editors will work in close collaboration with the Editors and journal administrators of the BJAS, whose role is to help with the editorial procedures (dissemination of the Call for Papers, refereeing process, communication with authors, preparation of manuscripts for publication, etc.).

Duties of Guest Editors include:

- writing a Call for Papers,
- assessing initial submissions, selecting and allocating reviewers for submitted and invited papers,
- selecting papers for the issue on the basis of the peer reviews; Guest Editors are in charge of acceptance/rejection/revision and resubmission decisions and liaise closely with the Editor on the process as a whole,
- helping authors respond to reviewers' and Guest Editors' comments to improve the quality of their paper,
- preparing the manuscripts of the issue in accordance with the published guidelines, so as to facilitate the publisher's work,
- checking the publisher's proofs, along with the authors.

Timeline

- 31 January 2025: Deadline for submission of proposals from Guest Editors
- 15 February 2025: Decision by the Editors advised by the Editorial Board
- 20 February 2025: Publication of the Call for Papers
- 31 July 2025: Deadline for submission of papers
- 30 November 2025: Deadline for finalizing complete manuscript
- 15 December 2025: Publication and print

Bavarian Journal of Applied Sciences
Engineering, Information Technology, Economics, Health Sciences
Vol. 7 (2024)

Publishers:
Prof. Waldemar Berg & Prof. Dr. Wolfgang Dorner.
Deggendorf Institute of Technology, 2024

BAVARIAN JOURNAL OF APPLIED SCIENCES®