

EUROPEAN SCIENTIFIC JOURNAL FOR

VOL. 2 NUMBER 3 2026

DUAL HIGHER EDUCATION.

SPECIAL ISSUE

The socially relevant university –
How can science, practice and society
be successfully integrated?

New Learning Spaces, Practice Integration
and Social Responsibility



This journal is part of
EU4DUAL

IMPRINT

European Scientific Journal for Dual Higher Education (ESJ DHE)

ISSN (online): 3052-7015

Publisher: EU4Dual European University Alliance

Editor-in-Chief: Prof. Dr. phil. habil. Ulf-Daniel Ehlers (Baden-Wuerttemberg Cooperative State University (DHBW), Germany)

Managing Editors: Dr. Norberta Sági (John von Neumann University, Hungary) | Florian Schäfer (Baden-Wuerttemberg Cooperative State University (DHBW), Germany) | Dr. Szilvia Varga (John von Neumann University, Hungary)

Language and Copy Editing: Florian Schäfer (Baden-Wuerttemberg Cooperative State University (DHBW), Germany) | Dr. Szilvia Varga (John von Neumann University, Hungary)

Editorial Board Members: Dr. Tomislav Bukša (PAR University of Applied Sciences, Croatia) | Dr. Ainara Imaz Aguirre (Mondragon University, Spain) | Dr. Minna Kaarakainen (Finnish Institute for Health and Welfare (THL), Finland) | Dr. Rajeev Kanth (Savonia University of Applied Sciences, Finland) | Dr. Elmar Krainz (FH Joanneum University of Applied Sciences, Austria) | Dr. Maria Luojus (Savonia University of Applied Sciences, Finland) | Dr. habil. Christophe Merlo (École supérieure des technologies industrielles avancées (ESTIA), France) | Dr. Gordana Nikolić (PAR University of Applied Sciences, Rijeka, Croatia) | Dr. Fernando António Trindade Rebola (Portoalegre Polytechnic University, Portugal) | Dr. Alison Said (Malta College of Arts, Science and Technology (MCAST), Malta) | Dr. habil. Anita Tangl (John von Neumann University, Hungary) | Dr. Marko Turk (National Scientific Institute for Migration Research / PAR University of Applied Sciences, Croatia) | Dr. Katja Wengler (Baden-Wuerttemberg Cooperative State University (DHBW), Germany) | Dr. habil. Teresa Żółkowska (Koszalin University of Technology, Poland)

Contact: Florian Schäfer (florian.schaefer@dhbw.de)

Website: <https://ojs.eu4dualdevelopment.com/index.php/esjdhe>

Aims and Scope: The *European Scientific Journal for Dual Higher Education* is an open-access, peer-reviewed scholarly journal dedicated to research, theory, and practice in dual and work-integrated higher education. It serves as a European platform for interdisciplinary, evidence-based scholarship that connects academia and professional practice, promoting innovation, transformation, and future-skills development in higher education.

Editorial and Ethical Standards: The journal follows the ethical guidelines of the Committee on Publication Ethics (COPE). Authors, editors, and reviewers adhere to the highest standards of academic integrity, including policies on authorship, plagiarism, AI use disclosure, data transparency, and conflict of interest. Editorial independence is guaranteed; decisions are based solely on academic merit and relevance.

Copyright Notice: © 2026 European Scientific Journal for Dual Higher Education (ESJ DHE). Content may be shared and adapted under CC BY-NC 4.0 with proper attribution. Commercial use requires permission from the publisher.

Suggested Citation: Author(s) (2026). Article title. *European Scientific Journal for Dual Higher Education (ESJ DHE)*, 2 (3), XX-XX. <https://doi.org/10.82321/xxxxx>

Disclaimer: The views and opinions expressed in the articles are those of the authors and do not necessarily reflect the positions of the Editor-in-Chief, Editorial Board, or the publisher.

CONTENTS

Editorial — Reconfiguring Higher Education: New Learning Spaces, Practice Integration, and Social Responsibility	
<i>Ulf-Daniel Ehlers and Martin Lachmair</i>	i
Fostering Autonomy in STEM Education – The Use of Jupyter Notebooks in Higher Education	
<i>Christina Maiwald</i>	1
Bildung verNetz – Designing an Agile Learning Format for Employees at Educational Institutions	
<i>Miriam Geiß, Jennifer Majunke, Nicole Ondrusch, Veronica Quandt and Doris Ternes</i>	15
Win-Win-Win for Industry, Research and Individuals: Supervisors’ Insights from Tandem Programme at TH Köln	
<i>Anastasia Asiedu, Dagmar Linnartz and Hendrik Thesing</i>	29
The Third Learning Space in Dual Higher Education: A Systematic Review	
<i>Ulf-Daniel Ehlers, Gerhard Götz, Myriam Hamich, Martin Lachmair and Doris Ternes</i>	47
Caught Between Technical Expertise and Transdisciplinary Structure Formation: Opportunities and Prospects for (Institutionalised) Competence Building in Transfer-oriented Research Using the Case of the InNoWest Joint Research Project	
<i>Cornelia Kühn, Christine Hobelsberger, Antje Michel, Verena Graf, Pauline Hillenbrand and Gregor Schmidt</i>	67
Social Inequality in Academic Success	
<i>Luisa Junghänel</i>	81

EDITORIAL — RECONFIGURING HIGHER EDUCATION: NEW LEARNING SPACES, PRACTICE INTEGRATION, AND SOCIAL RESPONSIBILITY*

European Scientific Journal for Dual Higher Education (ESJ DHE), Vol. 2, No. 3 (2026)

Prof. Dr. Ulf-Daniel Ehlers¹ and Prof. Dr. Martin Lachmair²

*¹ Editor-in-Chief, European Scientific Journal for Dual Higher Education
EU4Dual European University Alliance*

Baden-Wuerttemberg Cooperative State University (DHBW), NextEducation

*² Conference Chair of the 2025 Annual Conference of the German Society for Higher Education Research
(Gesellschaft für Hochschulforschung - GfHf) and
Baden-Wuerttemberg Cooperative State University (DHBW)*

Dear readers,

This issue is the second of two companion issues emerging from the 2025 annual conference of the German Society for Higher Education Research (Gesellschaft für Hochschulforschung – GfHf) in Heilbronn. The first issue examined societal relevance, Future Skills, artificial intelligence, and institutional and curricular transformation. This second issue continues that conversation by turning to the spaces, relationships, and organisational arrangements through which transformation is enacted.

Publishing the collection in two parts makes visible an important distinction within a shared field of inquiry. Higher education must ask what purposes it serves and what competences it should foster; it must also ask where learning takes place, how academic and professional worlds are connected, and who is able to participate successfully. The six contributions gathered here address this second set of questions through digital learning environments, agile professional learning, industry–university partnerships, third learning spaces, transfer-oriented research, and educational inequality.

The issue opens with *Fostering Autonomy in STEM Education – The Use of Jupyter Notebooks in Higher Education*. Drawing on Self-Determination Theory, the contribution examines how digital infrastructures can support autonomy in higher education. Its focus is not technology for its own sake, but the design of accessible, interactive, and professionally relevant learning environments. The article thus reminds us that digital tools become educationally meaningful only when they expand learners' capacity to explore, act, and take responsibility for their learning.

Bildung verNetz – Designing an Agile Learning Format for Employees at Educational Institutions widens the perspective from student learning to professional learning within educational organisations. By focusing on an agile, practice-oriented, and network-based format, the contribution shows how continuing development can be organised as a collaborative process rather than a sequence of isolated training events. It highlights the importance of exchange, iteration, and sustained engagement when institutions seek to build capacity for change.

Win-Win-Win for Industry, Research and Individuals: Supervisors' Insights from Tandem Programme at TH Köln moves into the field of partnership-based research training. Through the perspectives of supervisors in academia and industry, the article explores the promise and complexity of integrated doctoral and postdoctoral qualification pathways. Such formats can create value for individuals, research, and industry, but they also require careful coordination, mutual recognition, and clarity about expectations. Practice integration, the contribution demonstrates, is not produced by proximity alone; it depends on durable relationships and supportive structures.

* To cite this editorial: Ehlers, U.-D. and Lachmair, M. (2026). Editorial — Reconfiguring Higher Education: New Learning Spaces, Practice Integration, and Social Responsibility. *European Scientific Journal for Dual Higher Education (ESJ DHE)*, 2 (3), i-ii. <https://doi.org/10.82321/07ma-34m68>

The Third Learning Space in Dual Higher Education: A Systematic Review provides a synthesising conceptual frame for many of these concerns. By mapping adjacent literatures on third spaces, boundary crossing, work-integrated learning, and learning-place cooperation, the review examines how theory and practice can be connected through intermediary, learner-centred spaces. The idea of a third learning space is powerful precisely because it does not reduce integration to the transfer of knowledge from one location to another. It draws attention to reflection, translation, and the creation of new knowledge across institutional boundaries.

Caught between Technical Expertise and Transdisciplinary Structure Formation: Opportunities and Prospects for (Institutionalised) Competence Building in Transfer-Oriented Research brings the question of mediation into the context of socially engaged research. It analyses the tensions that arise when higher education institutions seek to support transdisciplinary and co-creative work while remaining embedded in disciplinary structures, established career paths, and conventional definitions of expertise. The article makes clear that transfer-oriented competence cannot depend solely on individual commitment. If it is to endure, it requires institutional recognition and structure.

The issue closes with *Social Inequality of Academic Success*. This final contribution provides a necessary corrective to any account of innovation that focuses only on new tools, formats, or partnerships. Transformative opportunities are never distributed evenly, and educational success is shaped by social conditions that institutions must recognise rather than treat as external to teaching and learning. The article therefore places questions of participation and justice at the heart of the debate about the future of higher education.

Taken together, the contributions show that new learning spaces are not defined primarily by architecture or technology. They are relational arrangements in which boundaries are crossed, responsibilities are renegotiated, and different forms of knowledge encounter one another. A Jupyter environment, an agile learning journey, a tandem programme, a third learning space, or a transfer-oriented research structure becomes educationally significant when it enables autonomy, collaboration, reflection, and meaningful participation.

At the same time, the issue resists celebratory simplification. Hybrid arrangements can create new possibilities, but they also generate coordination demands and may reproduce existing inequalities. Partnerships can connect institutions with professional and social contexts, but only when roles, resources, and recognition are addressed. Innovation can widen access to learning, but it can also privilege those already best positioned to benefit. Social responsibility must therefore be treated not as a separate theme, but as a criterion by which educational transformation is judged.

Read alongside the first companion issue, this collection offers a differentiated account of higher education's present transformation. The first issue asked how societal relevance, competence, AI, and institutional identity are being redefined. This issue asks how those redefinitions take form in learning environments, partnerships, transfer structures, and patterns of participation. The two perspectives belong together. Meaningful transformation requires both compelling purposes and robust arrangements through which those purposes can be realised.

We hope that the two companion issues will stimulate further research and conversation across disciplines, institutions, and national contexts. We thank all authors, reviewers, and editors for making this publication possible and for contributing to a shared effort to understand higher education as a space of mediation between technology and pedagogy, theory and practice, institutional continuity and change, individual development and collective responsibility.

Prof. Dr. Ulf-Daniel Ehlers

Editor-in-Chief, European Scientific Journal for Dual Higher Education
EU4Dual European University Alliance
Baden-Wuerttemberg Cooperative State University (DHBW), NextEducation

Prof. Dr. Martin Lachmair

Conference Chair of the 2025 Annual Conference German Society for Higher Education Research (Gesellschaft für Hochschulforschung - GfHf)
Baden-Wuerttemberg Cooperative State University (DHBW)

FOSTERING AUTONOMY IN STEM EDUCATION – THE USE OF JUPYTER NOTEBOOKS IN HIGHER EDUCATION

Christina Maiwald  ^{1*}

¹ TU Dortmund University, Germany

Keywords:

Jupyter notebooks
Self-determination theory
STEM education
Autonomy-supportive teaching
Higher education
Large language models

Article history:

Received: 10 December 2025
Revised: 16 March 2026
Accepted: 14 April 2026

To cite this article:

Maiwald, C. (2026). Fostering Autonomy in STEM Education – The Use of Jupyter Notebooks in Higher Education. European Scientific Journal for Dual Higher Education (ESJ DHE), 2 (3), 1-13.
<https://doi.org/10.82321/07ma-34m69>

Abstract

This paper examines how higher education instructors perceive the role of Jupyter notebooks in supporting autonomy within the framework of Self-Determination Theory (SDT) in higher education in sciences. Drawing on a qualitative research design, interviews were conducted with ten higher education instructors who frequently use Jupyter notebooks in their teaching. The interview data were analysed using qualitative content analysis. The findings suggest that Jupyter notebooks, as a low-threshold and interactive instructional tool, may promote autonomy by addressing students' three basic psychological needs as defined by SDT. Interview participants also emphasised the practical relevance of the notebooks for preparing students for future professional environments. Furthermore, the results indicate a growing demand for computational competencies across disciplines, driven by evolving technological requirements. At the same time, students demonstrate varying levels of prior knowledge. In response, the implementation of innovative infrastructures, such as a centralised JupyterHub, is identified as a promising strategy for providing equitable access to digital learning tools. Finally, the study considers the emerging influence of large language models (LLMs) and outlines several potential pathways through which they may interact with the principles of SDT.

1 Introduction

Competencies in the fields of Science, Technology, Engineering, and Mathematics (STEM) have become indispensable in the digital world of the 21st century, not least for addressing technological developments (Köller et al., 2021). In light of Germany's comparatively cautious position as a technology hub, it is crucial to retain and motivate students in these fields (Wörner & Kunst, 2024). Higher education institutions are therefore advised to strengthen digital and computational competences in particular by expanding digital provision and sustainable infrastructure (Köller et al., 2021).

Jupyter notebook (JN) is a software tool that may improve education in STEM subjects (Barba et al., 2019; Granger & Perez, 2021). JNs are interactive documents that allow users to execute code, visualise results, and combine explanatory text and multimedia elements within a single, user-friendly environment (*Jupyter Documentation*, 2015). They offer potential to support flexible and active learning environments in higher education and to promote students' acquisition of

* Corresponding author

E-mail address: christina.maiwald@tu-dortmund.de

computational competences (Amoudi & Tbaishat, 2023). Higher education instructors also report that students can experience a form of creative knowledge production through the use of JNs, which aligns with the highest levels of Bloom's taxonomy (1956) (Barba et al., 2019).

From the perspective of Self-Determination Theory (SDT), a core element of effective teaching is the fulfilment of students' three basic psychological needs: autonomy, competence, and social relatedness (Ryan & Deci, 2017). In an autonomy-supportive teaching and learning environment, instructors can specifically foster these needs, thereby strengthening students' self-determined learning motivation (Reeve & Cheon, 2021). This, in turn, may have positive effects on students' engagement, well-being, and performance (Ryan & Deci, 2020). Although SDT has been extensively studied in various educational contexts over the past two decades (Wilkesmann, 2023; Wilkesmann & Lauer, 2020), it has received limited attention to date in connection with JNs or STEM education (Stiefenhofer & Zhang, 2023).

2 Background

2.1 SDT and the basic psychological needs

As an organismic macro-theory, SDT explores the conditions that give rise to different forms of motivation. Motivation is characterised by varying degrees of autonomy, from non-self-determined to self-determined behaviour, and is categorised into amotivation, extrinsic motivation, and intrinsic motivation (Ryan & Deci, 2000, 2017) (Figure 1).

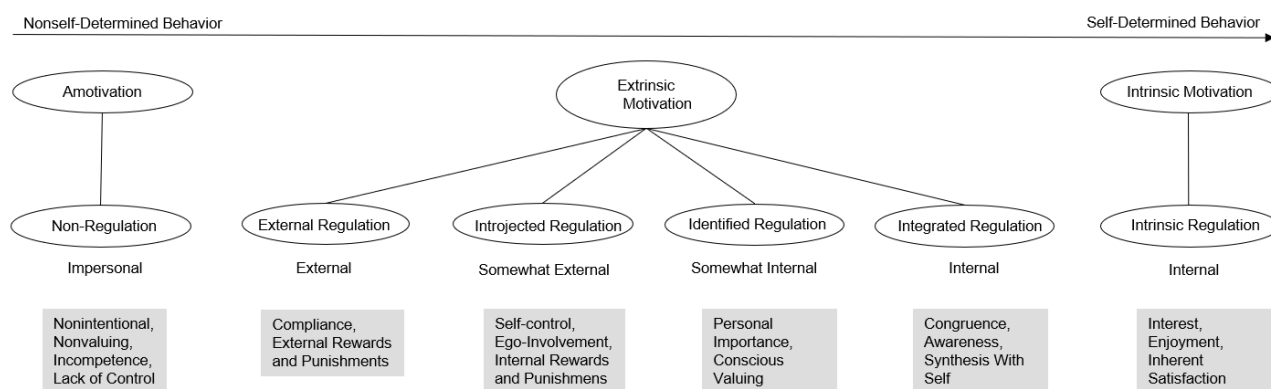


Figure 1. Self-Determination Theory (Ryan & Deci, 2000, p. 72) (own illustration)

Amotivation, the strongest form of non-self-determined behaviour, is defined as “the state of lacking the intention to act” (Ryan & Deci, 2000, p. 72), i.e. no action is taken at all or a movement sequence is imitated without any intent. In contrast, intrinsic motivation is seen as an innate tendency to engage in an activity for the enjoyment and inherent satisfaction it provides. Extrinsic motivation also involves a degree of self-determination and varies in its level of autonomy. The range includes external regulation, introjected regulation, identified regulation, and integrated regulation. Extrinsically motivated individuals aim to achieve specific outcomes, such as avoiding punishment or gaining rewards, in externally regulated forms of motivation. In the integrated form of regulation, individuals strive for congruence, which represents the stage closest to intrinsic motivation (Ryan & Deci, 2000).

Furthermore, Ryan and Deci (2009) include the terms autonomous motivation and controlled motivation within SDT. Autonomous motivation as a construct is often used in research and encompasses intrinsic, identified, and integrated forms of regulation, whereas controlled motivation encompasses external and introjected regulation (Guay, 2022; Ryan & Deci, 2009; Slemp et al., 2024) (Table 1).

Table 1. Controlled and autonomous motivation

Amotivation	Controlled motivation		Autonomous motivation		
	External	Introjected	Identified	Integrated	Intrinsic

In an educational context, students are autonomously motivated to learn when they learn out of interest and curiosity and perceive course content as meaningful (Vansteenkiste et al., 2012).

SDT also includes the continuum of internalisation within controlled and autonomous motivation. Internalisation is the process through which the underlying value of an action becomes part of an individual's value system, meaning that controlled, externally regulated behaviour is transformed into autonomously motivated behaviour (Ryan & Deci, 2002). SDT assumes that successful internalisation depends on the fulfilment of three needs – autonomy, competence, and relatedness – as described in Basic Psychological Needs Theory (BPNT), a sub-theory of SDT (Ryan & Deci, 2022). The three basic psychological needs are described as follows:

- Autonomy “refers to regulation by the self or to self-determination and authentic volition” (Legate & Ryan, 2020, p. 3), meaning that an individual's behaviour is entirely a matter of free choice (Ryan et al., 2021). Autonomy-driven actions involve taking initiative and responsibility for one's own behaviour and are supported by interest and value (Ryan & Deci, 2020). “When satisfied, students feel that they can be themselves and that they are the ‘owner’ of their thoughts, actions, and feelings” (Vansteenkiste et al., 2019, p. 55).
- Competence is the natural need to develop one's skills, referring to feelings of effectiveness (Ryan & Deci, 2017) and “a sense that one can succeed and grow” (Ryan & Deci, 2020, p. 1). Being recognised as competent is crucial when internalising external goals (Wilkesmann, 2023). “When satisfied, students feel confident and capable to execute a learning task and to exercise and extend their skills” (Vansteenkiste et al., 2019, p. 55).
- Relatedness is the need to belong to a social environment and to participate as a valued member in order to feel connected (Ryan & Deci, 2017). In higher education research settings, relatedness is often distinguished as relatedness to the instructor and relatedness to classmates, meaning that students have significant relationships with the instructor and with other students (Goldman et al., 2017; Loopers et al., 2024). “When satisfied, students feel strongly connected to and understood by significant others, while also displaying a reciprocal concern toward others” (Vansteenkiste et al., 2019, p. 55).

SDT posits that an autonomy-supportive environment supports autonomous motivation by initiating internalisation. Autonomy support in teaching means that instructors create opportunities for meaningful tasks and choices, allowing students to take ownership of their learning rather than creating a controlling environment that produces pressure (Ryan & Deci, 2020). According to Reeve and Cheon (2021, p. 55) “autonomy-supportive teaching emerges out of a student-focused attitude and an understanding interpersonal tone”. They identify seven autonomy-supportive instructional behaviours (ASIBs), which either foster intrinsic motivation or support internalisation (Reeve, 2016; Reeve & Cheon, 2021). The foundational ASIB is adopting the students' perspective, which supports both intrinsic motivation and internalisation by demonstrating empathy and awareness of the student experience (Reeve, 2016).

Two behaviours specifically promote intrinsic motivation: inviting students to pursue their interests and presenting learning activities in need-satisfying ways. These practices encourage curiosity and provide meaningful engagement through choice (Reeve & Cheon, 2021). Four additional ASIBs aim to support internalisation. First, providing explanatory rationales clarifies the value and purpose of tasks. Second, acknowledging and accepting students' negative emotions shows sensitivity to their experiences. Third, using invitational language - avoiding controlling expressions like “must” or “should” - helps reduce pressure. Finally, displaying patience allows students to progress at their own pace and in their own way, supporting deeper engagement and self-regulation (Reeve & Cheon, 2021).

As a result, people perform better and experience increased well-being (Reeve & Cheon, 2021; Ryan & Deci, 2020). An autonomy-supportive environment in educational settings, for both instructors and students, is key to the satisfaction of basic psychological needs (Goldman et al., 2017; Loopers et al., 2024; Wilkesmann & Schmid, 2014).

2.2 The Jupyter world

Julia, Python, and R – three well-known programming languages – form the acronym Jupyter (Barba et al., 2019). The Jupyter initiative, formerly known as iPython, was launched in 2014 with the aim of developing a unified set of open-source tools for scientific research, and enabling reproducible workflows, computational narratives, and data analysis (*Jupyter Documentation*, 2015).

A key component of this initiative is the browser-based JN, which supports multiple programming languages and provides pre-configured virtual workspaces. These environments offer a collaborative and iterative setting for data exploration, visualisation, and code prototyping (Granger & Perez, 2021). Users can access JNs through various means, including local installation on personal hardware, remote access via a server, or fully managed cloud services such as Google Colab.

The Jupyter server functions as a communication hub between the browser, the notebook file, and the kernel. The kernel executes the code contained in the notebook using the selected programming language and returns the results to the user (Figure 2).

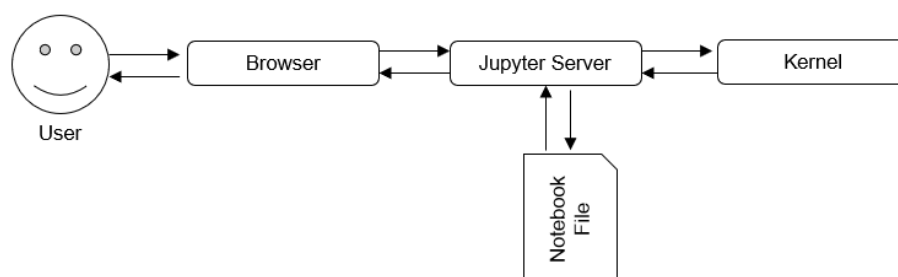


Figure 2. Jupyter notebook interface (*Jupyter Documentation*, 2015) (own illustration)

In educational contexts, Barba et al. (2019) reported various use cases for JNs. For example, educators highlighted the ease of switching programming languages in large courses, managing high student enrolments, and transferring course materials between instructors. Compared to traditional teaching approaches that rely on other software - or none at all - JNs reduce the administrative burden on instructors. They eliminate the need to secure sufficient university computers or allocate substantial lecture time to familiarising students with complex tools.

3 Literature review and research question

In relation to autonomy-supportive teaching practices, JNs appear promising. The active learning environment and extensive instructor-student and student-student interaction provided by JNs suggest that, when used appropriately in teaching, JNs may enable students to experience autonomy, relatedness to the instructor and other students (Amoudi & Tbaishat, 2023; Barba et al., 2019), and an increased sense of competence (Farah et al., 2020).

With regard to autonomy as a student need, the technical characteristics of JNs make self-determined learning possible because location, time, and students' hardware capabilities are not limiting factors (Granger & Perez, 2021). Students and instructors can access JNs anywhere, at any time, and on any hardware. They are not restricted to a single programming language. This personalisation allows instructors to design notebooks in such a way that multiple solutions are possible, enabling students to tailor their work to their own preferences (Barba et al., 2019).

Studies investigating the impact of JNs in teaching settings have found that they may also have the potential to develop students' essential skills, such as technical skills, problem-solving abilities, and critical thinking (Amoudi & Tbaishat, 2023; Farah et al., 2020; Johnson, 2020). Nonetheless, from an outcomes-oriented perspective, one study found that, in a computer science course for advanced programmers, students using JNs did not achieve significantly better learning outcomes than those in the control group (Al-Gahmi et al., 2022). Johnson (2020) also points out that poor coding practices could be reinforced. By contrast, studies focusing on courses that do not require programming skills found that JNs can indeed promote computational thinking (Farah et al., 2020). Moreover, Amoudi and Tbaishat (2023) have shown that students are encouraged to achieve higher-order learning objectives.

The collaborative environment provided by JNs (Amoudi & Tbaishat, 2023; Barba et al., 2019), indicates that the final construct of BPNT, relatedness, can also be supported. Collaborative learning "is a situation in which learners interact in a collaborative way" (Dillenbourg, 1999, p. 8). For instance, JNs have been shown to be effective in teaching through interactive lecture notes and the flipped classroom (Johnson, 2020). Also known as the inverted classroom, the flipped classroom concept involves collaborative group learning activities in the classroom and individual, computer-based instruction outside the classroom (Bishop & Verleger, 2013). Amoudi and Tbaishat (2023) point out that it is essential to use JNs within an experimental learning environment, such as the flipped classroom environment. As a result, students are encouraged during lectures and enjoy the sessions.

As generative artificial intelligence (AI) – particularly in the form of large language models (LLMs) – gains increasing significance and prevalence in higher education, not least due to the availability of open-source models such as OpenAI's ChatGPT (Lo, 2023), this topic is of particular relevance to this study. LLMs are powerful models for processing and generating natural language (Kelbert et al., 2023). Students are often able to solve programming tasks efficiently with the help of LLMs (Boguslawski et al., 2025; Jošt et al., 2024). Within the framework of SDT, LLMs may be conceptualised as potential mechanisms of action that influence motivational processes.

"What is clear is that no technology has an impact on learning in its own right; rather, its impact depends upon the way in which it is used" (Luckin et al., 2012, p. 9). In line with this statement, it is important to note that the use of JNs in higher education does not automatically result in an autonomy-supportive learning experience. The way in which instructors use JNs is critical to realising their full potential. It is therefore essential to investigate how instructors perceive and utilise JNs in their teaching practice.

Given the importance of autonomy support in STEM education, the limited attention to JNs in this area of research, and the disruptive influence of generative AI on how programming skills are taught and learned, addressing this research gap becomes increasingly urgent. Specifically, it is necessary to explore how JNs can be employed, through the lens of SDT, to help shape the future of STEM education. This leads to the following guiding research question:

How do higher education instructors perceive the influence of JNs on autonomy support within the framework of SDT in STEM education?

4 Methodology

4.1 Aim of the study and data collection

Since no comparative data were available, a qualitative research design was chosen to address the research question. Interviews were conducted with higher education instructors who frequently use JNs in their courses.

This was based, among other things, on the *JupyterHub.nrw* project, which provides instructors, researchers, and students in North Rhine-Westphalia with low-threshold access to JNs by embedding them into higher education institutions' infrastructure via a central JupyterHub. JupyterHub is a multi-user platform specifically designed to provide access to JNs via the web, hosted on centralised hardware; that is, a Jupyter server is launched for each user (Jupyter Documentation, 2015).

The *JupyterHub.nrw* project aims to enhance the quality of teaching at higher education institutions by offering low-threshold access to pre-configured virtual work environments. This allows students to use data analysis tools and common scripting languages regardless of their personal technical setup. The need to install digital tools locally on one's own device – previously identified as a significant challenge by Johnson (2020) – is thereby eliminated. At the same time, instructors are relieved from the burden of maintaining their own servers or directing students to third-party cloud services, as *JupyterHub.nrw* is fully integrated into the information technology infrastructure of participating higher education institutions.

The objective was to examine the use of JNs in higher education and to determine, from the instructors' perspective, the extent to which they contribute to the promotion of learner autonomy, in order to derive implications for both practice and research in STEM education at higher education institutions.

4.2 Participants and procedure

Ten higher education instructors who actively integrate JNs into their teaching were recruited as interview participants (IP). Recruitment was conducted via the *JupyterHub.nrw* project, through which eligible instructors were contacted. Inclusion criteria required frequent and active use of JNs in teaching contexts. The guiding principle was to interview all available and willing participants. The sample included five research associates, one postdoctoral researcher, and four professors, representing nine different departments across five higher education institutions in two German federal states (Table 2).

Table 2. Interview participants

	<i>Profession</i>	<i>Affiliation</i>
IP1	Professor	Department of Computer Science
IP2	Research associate	Chair for High Frequency Technology
IP3	Professor	Chair of Interconnected Automation Systems
IP4	Professor	Neural Data Science
IP5	Research associate	Department of Computer Science
IP6	Professor	Inorganic Chemistry
IP7	Postdoctoral researcher	Department of Physics
IP8	Research associate	Practical Computer Science
IP9	Research associate	Institute of Transport Logistics
IP10	Research associate	Data Literacy Education

A semi-structured interview guide was used, containing primarily open-ended questions regarding the use of JNs in educational contexts. The interviews were conducted using a video-conferencing tool, recorded with participants' consent, and subsequently transcribed and anonymised.

The data were analysed according to Mayring's (1991) recommended step model, which includes paraphrasing, reduction, and coding of the interview content. Certain analytical procedures were adapted to the specific context of this study in accordance with Mayring (1991). The analysis was carried out using MAXQDA software. Following the guidelines of Kuckartz and Rädiker (2024), particular attention was paid to the development of a clearly structured category system that is closely aligned with the research question.

Accordingly, a combination of deductive and inductive category development was employed. Deductive categories were derived from established theoretical frameworks, whereas inductive categories emerged from the material (Mayring, 1991). Given the study's alignment with SDT, the deductively defined main category was *autonomy support*, which encompassed the subcategories

autonomy, competence, and relatedness. In addition, the inductive subcategories *practical relevance* as a need and *use of AI* emerged within this head category. During the analysis, three further inductive categories were identified. Among them, the head category *perceived role and impact of JNs in teaching* was developed, comprising the subcategories *evaluation of JNs, integration into teaching, and instructional design*.

To approximate intercoder reliability, the procedure proposed by Kuckartz and Rädiker (2024) was applied. Two interviews were independently recoded by a second researcher using the existing category system. The aim of this process was not to generate a quantified reliability coefficient, but to ensure high coding quality by identifying and discussing the underlying causes of coding discrepancies. The resulting categorisations were subsequently compared and jointly reflected on.

5 Results

5.1 Perceived role and impact of JNs on teaching

Within the category of “evaluation of JNs”, the interviewees emphasised that the use of JNs offers a significant advantage for teaching, primarily because no local installation is required when a centralised JupyterHub is used. “Everyone has the same versions, the same conditions, and essentially a fully pre-configured tool”, as IP1 described the standardised starting point. This promotes equal opportunities, as students with less powerful hardware can also actively participate in courses. Several interviewees reported that some students attend programming courses using tablets or even smartphones.

Particularly, the cell-based execution and the combination of text and code within a single notebook allow instructors to present content in an accessible and illustrative manner. As IP10 put it, this enables a form of storytelling in teaching through the immediate visualisation of results. JNs offer instructors the opportunity to design interactive teaching formats that actively engage students and encourage participation: “[...] so that students can really concentrate and don’t have to take unnecessary notes, but can actually pay attention - even open it themselves, interact with things, try things out.” (IP1)

However, some respondents pointed out that JNs may have limitations when used for more complex purposes, such as software development. For students, JNs may become a comfort zone, potentially discouraging them from learning how to install and use more suitable software tools: “At the same time, I think it’s also important to eventually move away from these notebooks. I’ve found that many – for example, students writing their master’s theses – still prefer to work with notebooks, but at some point, that just reaches its limits.” (IP7).

The interviewees gave various reasons for integrating JNs into their teaching. In some cases, courses were newly taken over and materials had to be created from scratch. In others, the courses had already developed historically in the Jupyter format, and instructors received substantial support from their department: “We were lucky to have a professor who said: this Jupyter notebook, that’s the way to go.” (IP5). The flexibility of JNs was also highlighted. Since multiple virtual environments are supported, teaching can be quickly adapted depending on current trends in practice. This also addresses the heterogeneity of students’ prior knowledge.

The *JupyterHub.nrw* project also provided a good opportunity for introducing JNs, as its infrastructure enabled use without technical hurdles. As a result, JNs replaced traditional paper-based worksheets. A presentation plug-in in the notebook also allows “an interactive script to be created, which can also serve as the slides,” (IP1), meaning animations and videos can be integrated into the script.

“So, I didn’t prepare worksheets, but used JupyterHub in class as a simple setup system, so they didn’t have to install anything, and I just did small coding exercises with them.” (IP1). In some courses, a flipped classroom approach is also used: students work through JNs independently during self-study, while in-person sessions are reserved for discussions, clarification of open questions, and deeper engagement with the content. However, this offering is often only taken up to a limited extent, as only a small number of students attend in-person sessions: “There are always only a handful of students present.” (IP4), even though this format could also enhance social connectedness.

5.2 Autonomy support

On the topic of autonomy, several interviewees differentiated between Bachelor's and Master's students, as well as between mandatory and elective courses. As IP1 noted, “there is significantly less intrinsic motivation in mandatory courses than in elective ones.” IP1 described two distinct strategies: in Master's-level elective courses, students should be encouraged to install JNs locally “simply so that they learn independently: how do I help myself.” In Bachelor's mandatory courses, the approach should be the opposite: teaching should involve low-threshold tools, for which browser-based JNs are particularly suitable. “First show the students: what cool things can I actually do with this. I would say, first tease it. Instead of going through a long-suffering process, do it the other way around: ‘here, everything is already set up, you can use it’. So low-hanging fruit as an entry point.” (IP1)

In response to the request for independent programming in JNs, the interviewees also reported that students often initially reacted with uncertainty — not due to the tool itself, but due to the demand to actively engage. The autonomy associated with this was seen by instructors as a challenge, particularly for Bachelor's students. “Natural curiosity is largely trained out of students in the school context” (IP6). “When you start with it, of course there is a lot of groaning at first. Unfortunately, what is most comfortable is not always what is best for students, and at that point, they are challenged a bit because they have to work their way into a new tool themselves.” (IP1). However, over the course of the semester, this attitude reportedly changes to one of clear appreciation for JNs: “But by the middle of the semester, the realisation occurs: ‘oh wow, I can actually do a lot with this and, wow, it really helps me’.” (IP1).

Group work is generally encouraged by the interviewees. “But in fact, we don't force students to work alone; we explicitly encourage them to talk to their neighbours about the tasks and try to figure them out together. And that works very well. I have the impression that many students help each other and work through the tasks collaboratively.” (IP7)

Students are free to decide whether to work on JNs individually or in groups. In the context of group work, IP5 observed: “They really sit there like people used to do when playing games, in front of the same computer, and work through it together.” IP6 also observed playful interaction between students when working on JNs collaboratively: “And then you could tell that their play instinct was triggered, because then everyone started saying: ‘hey, did you see, when I do this, that happens’, and then they started talking to each other.”

The interviewees identified another relevant motivational factor: the practical relevance of the course content. The respondents agreed that “you can only motivate someone if they already bring a certain interest in the topic. And at that point, I have to pick them up.” (IP6). Some instructors refer to students' future professional environments and enrich their teaching with real company data and tasks, or integrate discussions on current societal and technological developments to highlight broader disciplinary contexts. IP5, for instance, uses entertaining datasets to make complex concepts more tangible: “Then I always try to find data that people are interested in. For example, I found Marvel scripts with the dialogues from the movies in them. At the beginning, we look at some statistics about the books, compare them: ‘how many words are actually in there? How many of those words are repeated?’ Then we make a few plots.” (IP5)

The motivation to use JNs in teaching also stems from a desire to ensure practical relevance and offer contemporary teaching. “Why did I change it? Well, because in practice, data science is already done using these tools, and in my view, students shouldn't learn statistics like mathematicians, but rather like computer scientists or data scientists. And of course, it helps to get to know the actual toolbox used in practice, like Jupyter notebooks, and to interact with it.” (IP1). Another important aspect is the interest in promoting active student participation, in order “to motivate students to think more for themselves and to participate more actively.” (IP3).

According to the interviewees, developing programming skills is becoming increasingly challenging due to the varying levels of prior knowledge: “And I often have students from different programmes. Most come from computer science, but I also have students from communication studies or completely different backgrounds. So sometimes the prior knowledge is different, and for that reason, I take more of an interactive approach. And notebooks are usually better suited for that.” (IP4).

For most of the respondents, however, programming is not the primary learning goal but a means of achieving a broader educational objective: “In my teaching, it’s often not about teaching students programming itself, but rather about using programming concepts or languages to analyze data or generate models.” (IP4).

Several interviewees stated that students should learn programming explicitly in other courses, but they also emphasised that the notebook format is accessible even for students who have not yet gained programming experience. Some instructors rely on cross-faculty or even higher education-wide courses, as programming skills taught in computer science are also needed, for example, in mechanical engineering. The interviewees agreed that interdisciplinary skills are becoming increasingly important, especially as computer science knowledge is no longer required exclusively in data science programmes.

“And people who still think that programming is only done by computer scientists, and that chemists are in the lab mixing chemicals - that may have been the case once, but it’s not like that anymore, and it never will be again. Nobody should be under that illusion.” (IP6).

Several interviewees also observed that students are increasingly using LLMs such as ChatGPT, especially for traditional programming tasks in the JN format. This becomes apparent in exams or assignments when students use Python libraries that were not covered in the course, or when they are unable to explain their code in oral exams. Instructors noted both reflective and unreflective uses of LLMs. IP5 commented: “Weaker students tend to use it as a shortcut or brain substitute, I would say.”

The potential threat this poses to the development of computer science competence was also discussed: “You’re outsourcing the competence, or you get the feeling that you don’t need to acquire it yourself, because there’s ChatGPT that can do it for you. The problem is, that’s not true. You can only use ChatGPT if you already have a certain level of competence.” (IP6). Other interviewees, who view programming only as a means to an end for broader learning objectives, were less critical of LLM use: “The focus is not on learning to program itself, but on using it, and in that context, ChatGPT is a good tool.” (IP4)

6 Discussion

The interviews suggest that the participating instructors perceive the use of JNs as having a positive impact on support for student autonomy. This begins with the absence of installation requirements, which enables active and equitable participation, and extends to the combination of code and text cells within a notebook, which allows for more accessible explanations of content. These findings align with results already reported in the literature, particularly due to the interactive nature of JNs (Amoudi & Tbaishat, 2023; Granger & Perez, 2021; Johnson, 2020). Given their diverse applications, Granger and Perez (2021, p. 6) argue that “Jupyter helps humans to think” by facilitating analysis, decision-making, creation, evaluation, and more.

The results also indicate that the autonomy-supportive nature of JNs, by enabling self-directed participation, may initially lead students to feel overwhelmed, especially in large, mandatory courses. However, the underlying causes of such reactions remain unclear. As this study does not include students’ perspectives, it cannot determine whether these responses are a direct result of autonomy-supportive tasks or potentially due to other factors. Given the limited research on this topic, no definitive conclusions can be drawn. In addition, focusing exclusively on autonomy support may not be sufficient to ensure comprehensive need satisfaction and successful internalisation. Recent findings by Eichhorn and Mergner (2025) also emphasise the importance of addressing students’ experiences of competence and social relatedness in teaching settings.

Nevertheless, participation remains accessible, as students can use JNs independently of time, location, or hardware. Stiefenhofer and Zhang (2023) also found that JN-based teaching enhances students’ autonomy in the learning process, as it supports individual learning paces and preferences. In this way, the challenges posed by heterogeneous prior knowledge and experience in digital tools and programming, especially in interdisciplinary contexts, as identified in this study, can be addressed. Similarly, a study by Al-Gahmi et al. (2022) reported that students in JN-based programming courses tended to achieve better performance outcomes. This finding suggests that

JNs may support autonomy, as improved performance is associated with the satisfaction of basic psychological needs (Ryan & Deci, 2020). However, it should be noted that these findings were not statistically significant due to the small sample size (Al-Gahmi et al., 2022). Despite this, the present study supports the findings of Stiefenhofer und Zhang (2023) and Al-Gahmi et al. (2022), indicating that, from the instructors' perspective, JNs provide favourable conditions for supporting student autonomy.

This study also highlights that voluntary group work can help students engage with content in a self-directed and playful manner. The immediate feedback provided by JNs on student input fosters joyful peer-to-peer interaction. Another approach to fostering social relatedness is collaborative problem-solving: confronting students with real-world challenges that they must address in group settings. According to Xu et al. (2023), this approach enhances critical thinking and learning progress, particularly in mathematics education, and represents an effective way to combine practical relevance and social embeddedness.

The practical relevance of course content can be interpreted as a need for meaning or perceived significance, which – like autonomy, competence, and relatedness – may contribute to the internalisation of learning goals. The findings indicate that respondents placed significant importance on this construct. This may apply both to preparing students more effectively for the demands of the professional world and to enhancing instructors' own teaching experience, given that instruction is perceived as more rewarding when students are engaged and actively participate. An experimental study by Johansen et al. (2023), which integrated this dimension into the framework of SDT, examined a group of STEM students who were given tasks considered relevant, while a control group received traditional assignments. The results showed that students in the experimental group reported significantly higher levels of autonomous motivation compared to the control group.

On the basis of the findings of this study, the development of programming-related competences may be either supported or hindered by the use of LLMs, depending on students' proficiency levels and the course learning objectives. Where programming is not the primary learning goal, LLMs can support autonomy by allowing students to reach results more quickly and avoid getting stuck on syntactic details (e.g., placement of parentheses in code). A recent study found that negative emotions that undermine perceived competence can be reduced through LLM use, as students are more willing to ask questions without hesitation (Boguslawski et al., 2025). However, when programming itself is the primary learning objective, LLMs are seen by respondents as a potential risk to the development of core competencies, depending on students' performance levels. A study by Jošt et al. (2024) showed that greater reliance on LLMs during programming tasks correlated with lower final grades.

Previous research has shown that instructors who work in autonomy-supportive environments are more likely to create autonomy-supportive learning conditions for their students (Wilkesmann, 2013; Wilkesmann & Schmid, 2014). The present study supports this relationship: instructors recognise that certain design features in teaching can influence student motivation and express interest in implementing them, as they themselves are autonomously motivated to teach. From their perspective, the use of JNs facilitates consideration of students' basic psychological needs in STEM education. Thus, a positive association between the use of JNs and autonomy support may be assumed from the instructors' perspective.

7 Conclusions, limitations, and future research

The study indicates that JNs offer favourable conditions for supporting autonomy in STEM education. Their structure and interactivity appear to facilitate the implementation of autonomy-supportive instructional practices by educators. In line with the research question, the findings indicate that higher education instructors report positive experiences with JNs, particularly when provided through an organisation-managed JupyterHub infrastructure. Access to such up-to-date technological tools is perceived as a catalyst for effective didactic implementation in STEM fields.

Projects such as *JupyterHub.nrw* may have resource-enhancing effects on higher education institutions and may therefore indirectly contribute to improved student learning outcomes. To support this assumption, further empirical research is required. The aim of future studies should be

to quantitatively assess the impact of teaching innovations such as JNs and to highlight their implications for higher education.

Practice-oriented study programmes may ease the transition into the labour market, resulting in macroeconomic efficiency gains. However, a key prerequisite for this is strong institutional support for teaching innovations on the part of academic departments, which is essential for their long-term integration into curricula (Wilkesmann & Lauer, 2020). In this context, it should also be systematically examined to what extent computer science-related competencies have gained significance across disciplines in the labour market – including also outside of the STEM fields – in order to provide well-founded recommendations for the implementation of accessible digital tools in higher education.

However, the interviews also reveal ambivalent perceptions regarding the use of LLMs. The limited literature available on this topic also points to mixed findings (Boguslawski et al., 2025; Jošt et al., 2024). Based on this interview study, it can be assumed that reflective use of AI may act as a moderating variable that strengthens the relationship between autonomy support and students' perceived autonomy as well as competence. Future research should aim to investigate these hypotheses using quantitative methods. It would also be valuable to explore whether this effect varies depending on students' performance levels. Furthermore, a fundamental question arises as to what extent programming competencies are still considered necessary in the era of increasingly powerful LLMs, particularly given that instructors in this study largely viewed programming as a means to an end.

Despite the broad range of expertise and disciplinary backgrounds of the interviewed higher education instructors, the generalisability of the findings is limited by the small sample size. It is also plausible that the study primarily attracted instructors who are already autonomously motivated, which further limits the generalisability of the findings. This is particularly relevant, as the integration of teaching innovations is considerably easier within an autonomy-supportive environment (Vansteenkiste et al., 2012; Wilkesmann & Schmid, 2014). Since this study captured only instructors' perspectives, future research should include students' views to gain a more comprehensive understanding of the mechanisms through which teaching innovations unfold their effects.

In conclusion, for higher education institutions, the integration of a JupyterHub infrastructure offers a scalable and inclusive approach to support autonomy, especially in STEM education, by reducing technical barriers and fostering flexible, student-centred learning. Instructors are encouraged to leverage JNs not only for their interactive features, but also as tools to promote autonomy-supportive teaching practices aligned with SDT. For students, JNs provide opportunities for self-paced, meaningful engagement and collaborative learning, which can enhance motivation and skill development. Ultimately, the study underscores the importance of aligning digital tools with pedagogical strategies that address the basic psychological needs to support internalisation.

Acknowledgement

I would like to express my sincere gratitude to Prof. Dr. Uwe Wilkesmann, Director of the Center for Higher Education and Chair of Organizational Research and Continuing Education Management at TU Dortmund University, whose academic expertise, critical feedback, and ongoing support were instrumental in developing the research question as well as in shaping the theoretical and methodological orientation of this study.

My thanks also go to Joana Eichhorn from the Center for Higher Education at TU Dortmund University for her valuable support in coding and discussing the interviews. Her expertise in higher education teaching methodology and her in-depth knowledge of Self-Determination Theory significantly contributed to the conceptual refinement of the results section.

References

- Al-Gahmi, A., Zhang, Y., & Valle, H. (2022). Jupyter in the Classroom: An Experience Report. *Proceedings of the 53rd ACM Technical Symposium on Computer Science Education*, 425–431. <https://doi.org/10.1145/3478431.3499379>
- Amoudi, G., & Tbaishat, D. (2023). Interactive notebooks for achieving learning outcomes in a graduate course: A pedagogical approach. *Education and Information Technologies*, 28(12), 16669–16704. <https://doi.org/10.1007/s10639-023-11854-x>

- Barba, L. A., Barker, L. J., Blank, D. S., Brown, J., Downey, A. B., George, T., Heagy, L. J., Mandli, K. T., Moore, J. K., Lippert, D., Niemeyer, K. E., Watkins, R. R., West, R. H., Willing, C., & Zingale, M. (2019). *Teaching and Learning with Jupyter* (pp. 1–77). <https://jupyter4edu.github.io/jupyter-edu-book>
- Bishop, J., & Verleger, M. (2013). The Flipped Classroom: A Survey of the Research. *2013 ASEE Annual Conference & Exposition Proceedings*, 23.1200.1–23.1200.18. <https://doi.org/10.18260/1-2--22585>
- Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals; Handbook 1 Cognitive domain*. David McKay.
- Boguslawski, S., Deer, R., & Dawson, M. G. (2025). Programming education and learner motivation in the age of generative AI: Student and educator perspectives. *Information and Learning Sciences*, 126(1/2), 91–109. <https://doi.org/10.1108/ILS-10-2023-0163>
- Dillenbourg, P. (1999). What do you mean by 'collaborative learning'? In P. Dillenbourg (Ed.), *Collaborative-learning: Cognitive and Computational Approaches* (pp. 1–19). Oxford: Elsevier.
- Eichhorn, J., & Mergner, J. (2025). Was motiviert Lehrende, E-Prüfungen zu nutzen? [What Motivates Instructors to Use E-Examinations?]. *Zeitschrift Für Hochschulentwicklung*, 20(1). <https://doi.org/10.21240/zfhe/20-1/11>
- Farah, J. C., Moro, A., Bergram, K., Kumar, A., Gillet, D., & Holzer, A. (2020). *Bringing Computational Thinking to non-STEM Undergraduates through an Integrated Notebook Application*.
- Goldman, Z. W., Goodboy, A. K., & Weber, K. (2017). College Students' Psychological Needs and Intrinsic Motivation to Learn: An Examination of Self-Determination Theory. *Communication Quarterly*, 65(2), 167–191. <https://doi.org/10.1080/01463373.2016.1215338>
- Granger, B. E., & Perez, F. (2021). Jupyter: Thinking and Storytelling With Code and Data. *Computing in Science & Engineering*, 23(2), 7–14. <https://doi.org/10.1109/MCSE.2021.3059263>
- Guay, F. (2022). Applying Self-Determination Theory to Education: Regulations Types, Psychological Needs, and Autonomy Supporting Behaviors. *Canadian Journal of School Psychology*, 37(1), 75–92. <https://doi.org/10.1177/08295735211055355>
- Johansen, M. O., Eliassen, S., & Jeno, L. M. (2023). "Why is this relevant for me?": Increasing content relevance enhances student motivation and vitality. *Frontiers in Psychology*, 14, 1184804. <https://doi.org/10.3389/fpsyg.2023.1184804>
- Johnson, J. W. (2020). Benefits and Pitfalls of Jupyter Notebooks in the Classroom. *Proceedings of the 21st Annual Conference on Information Technology Education*, 32–37. <https://doi.org/10.1145/3368308.3415397>
- Jošt, G., Taneski, V., & Karakatič, S. (2024). The Impact of Large Language Models on Programming Education and Student Learning Outcomes. *Applied Sciences*, 14(10), 4115. <https://doi.org/10.3390/app14104115>
- Jupyter Documentation. (2015). <https://docs.jupyter.org/en/latest/projects/architecture/content-architecture.html#the-jupyter-notebook-format>
- Kelbert, P., Siebert, J., & Jöckel, L. (2023, December 12). Was sind Large Language Models? Und was ist bei der Nutzung von KI-Sprachmodellen zu beachten? [What Are Large Language Models? And What Should Be Considered When Using AI Language Models?]. *Blog des Fraunhofer-Institut für Experimentelles Software Engineering*. <https://www.iese.fraunhofer.de/blog/large-language-models-ki-sprachmodelle/>
- Köller, O., Jungbauer-Gans, M., Artelt, C., & Powell, J. J. W. (2021). *Innovation und Wohlstand durch MINT-Bildung* [Innovation and Prosperity Through STEM Education]. (Bildungspotenziale Forum 2021 des Leibniz-Forschungsnetzwerks Bildungspotenziale (LERN), p. 8) [Positionspapier]. Leibniz-Forschungsnetzwerk Bildungspotenziale (LERN). https://www.leibniz-bildung.de/wp-content/uploads/2021/07/BPF21_Positionspapier.pdf
- Kuckartz, U., & Rädiker, S. (2024). *Fokussierte Interviewanalyse mit MAXQDA: Schritt für Schritt* [Focused Interview Analysis with MAXQDA: Step by Step]. Springer Fachmedien Wiesbaden. <https://doi.org/10.1007/978-3-658-40212-9>
- Legate, N., & Ryan, R. M. (2020). Individual Autonomy. In F. Maggino (Ed.), *Encyclopedia of Quality of Life and Well-Being Research* (pp. 1–4). Springer International Publishing. https://doi.org/10.1007/978-3-319-69909-7_140-2
- Lo, C. K. (2023). What Is the Impact of ChatGPT on Education? A Rapid Review of the Literature. *Education Sciences*, 13(4), 410. <https://doi.org/10.3390/educsci13040410>
- Loopers, J., Kupers, E., De Boer, A., & Minnaert, A. (2024). The relationship between basic psychological need satisfaction and intrinsic motivation: The role of individual differences and special educational needs. *European Journal of Psychology of Education*, 39(1), 341–360. <https://doi.org/10.1007/s10212-023-00683-8>
- Luckin, R., Bligh, B., Manches, A., Ainsworth, S., Crook, C., & Noss, R. (2012). *Decoding Learning: The Proof, Promise and Potential of Digital Education*. Nesta. <http://www.nesta.org.uk/publications/decoding-learning>
- Mayring, P. (1991). Qualitative Inhaltsanalyse [Qualitative Content Analysis]. In *Handbuch qualitative Forschung: Grundlagen, Konzepte, Methoden und Anwendungen* (pp. 209–213). Psychologie Verl. Union.
- Reeve, J. (2016). Autonomy-Supportive Teaching: What It Is, How to Do It. In W. C. Liu, J. C. K. Wang, & R. M. Ryan (Eds.), *Building Autonomous Learners* (pp. 129–152). Springer Singapore. https://doi.org/10.1007/978-981-287-630-0_7
- Reeve, J., & Cheon, S. H. (2021). Autonomy-supportive teaching: Its malleability, benefits, and potential to improve educational practice. *Educational Psychologist*, 56(1), 54–77. <https://doi.org/10.1080/00461520.2020.1862657>
- Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist*.
- Ryan, R. M., & Deci, E. L. (2002). Overview of Self-Determination Theory: An Organismic Dialectical Perspective. *Handbook of Self-Determination Research*, 2(3–33), 36.
- Ryan, R. M., & Deci, E. L. (2009). Promoting Self-Determined School Engagement: Motivation, Learning, and Well-Being. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 171–195). Routledge.

- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness* (Paperback edition). The Guilford Press.
- 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>
- Ryan, R. M., & Deci, E. L. (2022). Self-Determination Theory. In F. Maggino (Ed.), *Encyclopedia of Quality of Life and Well-Being Research* (pp. 1–7). Springer International Publishing. https://doi.org/10.1007/978-3-319-69909-7_2630-2
- Ryan, R. M., Deci, E. L., Vansteenkiste, M., & Soenens, B. (2021). Building a science of motivated persons: Self-determination theory's empirical approach to human experience and the regulation of behavior. *Motivation Science*, 7(2), 97–110. <https://doi.org/10.1037/mot0000194>
- Slemp, G. R., Field, J. G., Ryan, R. M., Forner, V. W., Van Den Broeck, A., & Lewis, K. J. (2024). Interpersonal supports for basic psychological needs and their relations with motivation, well-being, and performance: A meta-analysis. *Journal of Personality and Social Psychology*. <https://doi.org/10.1037/pspi0000459>
- Stiefenhofer, P., & Zhang, V. N. (2023). Attitudes towards student-centered learning with Jupyter notebooks in econometrics: A semantic analysis. *Journal of Innovative Technology and Education*, 10(1), 7–15. <https://doi.org/10.12988/jite.2023.1031>
- Vansteenkiste, M., Aelterman, N., Haerens, L., & Soenens, B. (2019). Seeking Stability in Stormy Educational Times: A Need-based Perspective on (De)motivating Teaching Grounded in Self-determination Theory. In E. N. Gonida & M. S. Lemos (Eds), *Advances in Motivation and Achievement* (Vol. 20, pp. 53–80). Emerald Publishing Limited. <https://doi.org/10.1108/S0749-742320190000020004>
- Vansteenkiste, M., Sierens, E., Goossens, L., Soenens, B., Dochy, F., Mouratidis, A., Aelterman, N., Haerens, L., & Beyers, W. (2012). Identifying configurations of perceived teacher autonomy support and structure: Associations with self-regulated learning, motivation and problem behavior. *Learning and Instruction*, 22(6), 431–439. <https://doi.org/10.1016/j.learninstruc.2012.04.002>
- Wilkesmann, U. (2013). Effects of Transactional and Transformational Governance on Academic Teaching: Empirical evidence from two types of higher education institutions. *Tertiary Education and Management*, 19(4), 281–300. <https://doi.org/10.1080/13583883.2013.802008>
- Wilkesmann, U. (2023). The organizational transformation of universities: Using motivation theories to explain the micro–macro link. In L. Leišytė, J. R. Dee, & B. J. R. Van Der Meulen (Eds), *Research Handbook on the Transformation of Higher Education* (pp. 317–330). Edward Elgar Publishing. <https://doi.org/10.4337/9781800378216>
- Wilkesmann, U., & Lauer, S. (2020). The influence of teaching motivation and New Public Management on academic teaching. *Studies in Higher Education*, 45(2), 434–451. <https://doi.org/10.1080/03075079.2018.1539960>
- Wilkesmann, U., & Schmid, C. (2014). Intrinsic and internalized modes of teaching motivation. *Evidence-Based HRM: A Global Forum for Empirical Scholarship*, 2(1), 6–27. <https://doi.org/10.1108/EBHRM-07-2013-0022>
- Wörner, J., & Kunst, S. (2024). *MINT Nachwuchsbarometer 2024* [STEM Talent Barometer 2024] (p. 17 pages) [Application/pdf]. Acatech. https://doi.org/10.48669/ACA_2024-8
- Xu, E., Wang, W., & Wang, Q. (2023). The effectiveness of collaborative problem solving in promoting students' critical thinking: A meta-analysis based on empirical literature. *Humanities and Social Sciences Communications*, 10(1), 16. <https://doi.org/10.1057/s41599-023-01508-1>

BILDUNG VERNETZT – DESIGNING AN AGILE LEARNING FORMAT FOR EMPLOYEES AT EDUCATIONAL INSTITUTIONS

Miriam Geiß ^{1*}, Jennifer Majunke ², Nicole Ondrusch ², Veronica Quandt ² and Doris Ternes ¹

¹ Centre for Higher Education Pedagogy and Lifelong Learning of the Baden-Wuerttemberg Cooperative State University (DHBW ZHL), Germany

² Heilbronn University of Applied Sciences, Germany

Keywords:

Agile learning
Personal development
Networking
Community of practice

Article history:

Received: 14 January 2026

Revised: 1 April 2026

Accepted: 14 April 2026

To cite this article:

Geiß, M., Majunke, J., Ondrusch, N., Quandt, V. & Ternes, D. (2026). Bildung verNetz – Designing an Agile Learning Format for Employees at Educational Institutions. European Scientific Journal for Dual Higher Education (ESJ DHE), 2 (3), 15-27.

<https://doi.org/10.82321/07ma-34m610>

Abstract

Educational institutions are undergoing profound changes driven by digitalisation, artificial intelligence and social change. These developments require new forms of cross-institutional collaboration and skills development. Flexible, practice-oriented approaches, self-directed learning and collegial networking are needed to respond to these dynamics. Bildung verNetz is an agile learning format designed specifically for employees in educational institutions to respond to these challenges. In ten-week inter-organisational learning journeys, participants work in heterogeneous small groups on self-selected, practice-relevant goals and build sustainable professional networks in the process. The format combines proven agile learning principles with the specific needs of the education sector. In the long term, it aims to build a permanent "community of practice" (CoP). Initial experiences in the Wissensstadt Heilbronn indicate promising effects at the individual and institutional levels and underscore the potential of agile learning formats for the education sector.

1 Introduction

Educational institutions operate in an environment characterised by rapid and profound change that is becoming increasingly complex as a result of digitalisation, artificial intelligence (AI) and social change (García-Morales et al., 2021; Rheinhardt, 2020). This complexity places new demands on administration, teaching and research, which require innovative forms of learning and collaboration (Rost & Hafer, 2020). These include, in particular, the continuous development of employees' skills and cross-institutional exchange. Ideally, such measures are work-integrated, flexible enough to fit into everyday routines, and designed to foster active learner participation (Muzam et al., 2023; Noe et al., 2014).

* Corresponding author

E-mail address: miriam.geiss@cas.dhbw.de

Communities of practice (CoP), that is, groups of individuals with shared areas of interest (in this case, education), are an effective way of promoting these conditions (Wenger, 2011; Foelsing & Schmitz, 2021; Rost & Hafer, 2020). They rely on trust-based relationships within the group and enable mutual support and collaborative learning through regular interaction. Because such relationships rarely develop spontaneously, deliberate initiatives and suitable formats are required. Agile learning formats offer considerable potential in this context, as they not only support competence development, but also promote the emergence of sustainable networks and collaborative learning processes (Foelsing & Schmitz, 2021; Hufnagel & Ternes, 2024; Ternes & Hufnagel, 2022). One such initiative is Bildung verNetz (English: *education connected*; BiNe). As a networking and continuing education format, it is specifically tailored to the needs of teachers and staff in educational institutions (Geiß et al., 2025).

1.1 Initial situation and target group

Current dynamics in the education sector present institutions such as universities as well as training and continuing education providers with significant opportunities and complex challenges. Technological developments, particularly digitalisation and AI, create possibilities for integrating digital media into teaching and learning processes. At the same time, these developments necessitate the design and implementation of new, innovative teaching and learning formats to keep pace with ongoing transformation (Rost & Hafer, 2020). Addressing these challenges effectively requires a dual focus: the continuous development of individual competencies and the establishment of collaborative approaches that enable knowledge sharing and joint problem-solving across institutional boundaries.

Against this backdrop, BiNe positions itself as an inclusive initiative targeting all employees within educational institutions, irrespective of their professional field, role, or hierarchical position. The current scope of BiNe encompasses 15 educational institutions within the Wissensstadt Heilbronn*. These institutions provide (higher) education, offer professional qualification and continuing professional development programmes, and engage in research, innovation, and science communication, all of which have a direct impact on society at large. Existing networking events and cooperation projects within the region demonstrate that pooling expertise and resources can generate substantial benefits for the educational landscape. Consequently, BiNe aims to move beyond mere institutional coexistence by leveraging synergies, consolidating resources, initiating innovative projects, and fostering collaboration, particularly among employees who have not yet participated in joint initiatives.

BiNe offers a platform for bringing together employees from various institutions. A critical prerequisite for successful inter-institutional networking and cooperation is knowing the stakeholders involved and understanding their core topics, objectives, competencies, responsibilities, and interests. In BiNe, participants learn how this knowledge and collaboration can help them achieve their own goals. Over time, this is intended to lead to the creation of a CoP in the Wissensstadt Heilbronn. Consequently, BiNe can be adapted as a training programme for use in other urban contexts characterised by multiple educational institutions, such as Karlsruhe or Munich. By doing so, BiNe has the potential to serve as a scalable model for fostering innovation and cooperation in diverse educational ecosystems.

1.2 Agile learning

Current challenges in the labour market and education sector require a transition from standardised training to more flexible, adaptive continuing education formats (Foelsing & Schmitz, 2021; Graf & Edelkraut, 2021). Agile learning, which originated in agile working practices, supports learners in their individual development while simultaneously generating effects such as networking

* Wissensstadt Heilbronn is an association of 15 educational institutions all located in the city of Heilbronn. These institutions comprise, among others (cooperative state) universities, a university of applied sciences, various research centres, and a science center. They are united by the willingness to promote science transfer, scientific research, academic training and communication.

and collaboration at the organisational level (cf. Foelsing & Schmitz, 2021; Graf et al., 2017; Hufnagel & Ternes, 2024; Krehbiel et al., 2017; Longmuß & Höhne, 2017; Ternes & Hufnagel, 2022).

Agile learning formats are characterised by four key features (cf. Augner et al., 2023; Liebhart, 2022):

- i. The focus lies on the learners, who engage in self-directed and exploratory learning.
- ii. The structure of the content enables iterative learning in small units that can be integrated into everyday work.
- iii. Collaboration and co-creation are actively encouraged.
- iv. Digital technologies are purposefully incorporated into the learning process.

A well-known agile learning format is "Working Out Loud" (WOL; cf. Stepper, 2020; see Augner et al., 2023; Graf et al., 2022 on WOL as an agile format), which supports professional development through transparency, collaboration, and networking in iterative twelve-week learning cycles. Participants work in small groups ("circles") on individual goals through regular exchange, mutual support, reflection, and the use of digital networks. Another example is the collaboratively developed framework "lernOS" (cf. Dückert, 2019; see Graf et al., 2017; Graf & Liebhart, 2024 on lernOS and agile learning), which provides tried-and-tested tools for future work and integrates elements of various methods, including Getting Things Done (GTD), Objectives and Key Results (OKR), Scrum, and WOL, into 13-week learning cycles ("sprints"). Participants pursue their goals through peer support in small groups, regular reflection, and strategic networking.

Agile learning formats are flexible, learner-centred concepts that support participants in achieving their goals through appropriate content tailored to their needs. Reflective and interpersonal learning promotes knowledge building and a deeper understanding of contexts (Foelsing & Schmitz, 2021). Based on openness, flexibility, and a focus on cooperation, initially loose groups develop into lively learning communities that enable the establishment and long-term strengthening of CoPs. This principle also underpins BiNe as a training programme: the content is specifically tailored to employees in educational institutions and is based on experience with previous agile methods. It is condensed in eight learning loops ("BiNe-Loops"), which can be worked through flexibly over a period of ten weeks ("BiNe-Journey"). In addition, BiNe emphasises local networking within the Wissensstadt Heilbronn and off-site locations of the local institutions.

1.3 Lessons learned from agile learning implementations

To date, agile learning formats have been studied primarily in a corporate context (cf. Augner et al., 2023; Graf et al., 2022; Longmuß & Höhne, 2017). The BiNe project partners also have experience with students (Ondrusch et al., 2021; Quandt & Ondrusch, 2024; see also Meißner et al., 2024) and university employees (Hufnagel & Ternes, 2024; Ternes personal communication; see also Engelhardt & Warbeck, 2021; Wetterauer, 2020).

Agile learning formats, especially WOL, have shown positive effects on three levels:

- i. at the individual level through improved reflective abilities, increased perseverance, and greater openness and generosity in sharing knowledge (Augner et al., 2023; Graf et al., 2022; Longmuß & Höhne, 2017; Ternes, personal communication; Wetterauer, 2020);
- ii. at the network level through the establishment of personal contacts, a heightened awareness of one's own abilities, the strengthening of soft skills such as team spirit, appreciation, and multi-perspectivity, the support of collaborative work, and the visualisation of results (Augner et al., 2023; Engelhardt & Warbeck, 2021; Graf et al., 2022; Longmuß & Höhne, 2017; Ternes, personal communication; Wetterauer, 2020);
- iii. at the organisational level through improved communication, networking, and cooperation skills, as well as a greater willingness to share knowledge (Graf et al., 2022; Wetterauer, 2020).

WOL also promotes a positive feedback and error culture by viewing mistakes as opportunities for growth and improvement. The aim is to enable long-term behavioural changes that empower

participants to take initiative in the future (Graf et al., 2022). Similar effects have been observed among students. Here, WOL primarily improved digital collaboration as well as communication, reflection, and self-organisation skills (Meißner et al., 2024; Ondrusch et al., 2021). Even though students have different needs than employees in the education sector, the framework conditions are still quite similar. Agile learning formats thus contribute to the acquisition of future-relevant skills (cf. Kirchherr et al., 2018), including digital skills, critical thinking, cooperation skills, self-management, and resilience. In addition, they encourage participants to organise and adapt their own goals and to continuously reflect on new content, a core aspect of lifelong learning.

Despite these advantages, WOL participants also report challenges. For employees from educational institutions, the time required was a major point of criticism (Hufnagel & Ternes, 2024; Ternes, personal communication). Participants also often found the strong focus on visibility on social media inappropriate (Ternes, personal communication). Among students, (virtual) networking was not always perceived as relevant (Meißner et al., 2024; Ondrusch et al., 2021). In addition, self-directed learning requires a high level of personal responsibility, which can be challenging for both students and employees (Longmuß & Höhne, 2019; Meißner et al., 2024; Quandt & Ondrusch, 2024). These findings suggest that individuals in a higher education context have specific requirements and that different approaches are sometimes necessary, for example, with regard to visibility.

For continuing education and training measures to be successful, whether traditional or agile, it is also crucial that the content is aligned with the target group's needs. However, agile learning formats have a special feature: while the content and learning objectives in traditional continuing education courses (e.g., Excel or communication training) are specified by the instructor, agile learning formats allow adaptation to individual needs. Learners set their own goals, and the content provided serves as a support rather than a prescription. This flexibility appears to be particularly relevant in a higher education context (cf. Hufnagel & Ternes, 2024; Ondrusch et al., 2024; Quandt & Ondrusch, 2024; Ternes, personal communication).

Overall, these findings justify the development of a special learning format such as BiNe, which is based on the principles mentioned above and emphasises reflective as well as interpersonal learning. In addition, the resources and time constraints of employees are taken into account by offering less content, but in a more targeted manner. Flexible options for implementation make it easier to schedule meetings in small groups, which enhances overall participation. Based on past experiences, four central themes or success factors for agile learning formats can be derived and are applied in BiNe: (i) developing individual skills while fostering interaction and cooperation with others; (ii) willingness to share knowledge and experience, (iii) working within a network, and (iv) working on the skills and mindsets needed now and in the future to keep pace with the changing world of work.

In the following sections, we present the concept of BiNe and discuss findings from three completed BiNe-Journeys. We conclude in a short summary and an outlook on further development and scientific support.

2 Methodology

BiNe was developed in response to the challenges identified in the educational sector and draws on insights from established agile learning formats. The programme has been iteratively refined based on participant feedback to ensure relevance and applicability. The “BiNe-Journey” constitutes a ten-week learning and networking journey under the guiding principle “vernetzt & inspiriert wachsen” (grow connected & inspired). During this journey, participants pursue individual goals, engage in professional and/or personal development, and expand their networks.

At the heart of the programme is the “BiNe-Guide”, which serves as a resource for both individual work and collaboration within small, fixed groups (“BiNe-Teams”). The Journey is framed by a total of three accompanied and direct online events involving all participants (“BiNe-Talks”), scheduled at the beginning, midpoint, and conclusion of the programme.

Following an overview of key terminology (see Table 1), the next section takes a closer look at the BiNe-Guide as the foundation for the developed format and its selected topics.

Table 1. Terminology of BiNe

<i>Term</i>	<i>Definition</i>
BiNe-Journey	The ten-week learning and networking journey
BiNe-Guide	The accompanying material
BiNe-Loop	Thematic block within the BiNe-Guide
BiNe-Team	Group of 3-4 people
BiNe-Talks	Online event with all participants of the journey

Finally, experiences from the first three BiNe-Journeys with participants from educational institutions in Heilbronn as well as some external locations are presented.

2.1 The BiNe-Guide as a central element of the agile learning format

As a central component of BiNe, the BiNe-Guide consolidates support, guidance and self-management strategies. Its design incorporates the four key features of agile learning outlined above (cf. Augner et al., 2024; Liebhart, 2022). As participants pursue their individual goals, the format also enables self-directed learning (cf. Foelsing & Schmitz, 2021) and includes elements of informal learning as it supports learning in authentic, practice-oriented contexts (cf. Noe et al., 2014).

In contrast to formats such as WOL or lernOS, BiNe deliberately limits itself to eight compact topic blocks, the "BiNe-Loops", to reduce the time burden on participants (cf. Ternes, personal communication). These structured learning loops promote iterative learning, deepen or reinforce prior knowledge, and enable sustainable development through reflection and feedback (cf. Foelsing & Schmitz, 2021). At the same time, they remain flexible enough to be integrated into everyday work.

Participants work alone or in small groups of three to four people. These "BiNe-Teams" are heterogeneous in composition in terms of institution, field of activity and, where possible, gender, in order to bring diverse perspectives and experiences into the process. In the exchange, this diversity can be specifically used as a resource for individual and collective learning and mutual support. Regular changes of perspective promote a deeper understanding of different approaches and highlight the value of mutual impulses, regardless of the subject area or field of work. Meetings typically last one hour, are held online, and can be conducted according to the participants' individual preferences. This approach supports exploratory learning, emphasises collaboration and co-creation (cf. Augner et al., 2023; Liebhart, 2022), and enables cross-institutional networking.

The BiNe-Guide functions as a digital "travel guide" that combines various forms of learning. New technologies such as an online course on the ILIAS learning management system and digital whiteboards enable virtual collaboration within the teams. The use of these tools is a core element of agile learning and particularly relevant for flexible learning through exchange and self-study (cf. Augner et al., 2023; Liebhart, 2022; Noe et al., 2014). In addition, participants use the BiNe-Guide Workbook (a PDF document) for individual work and tasks such as familiarization, consolidation, goal pursuit, and reflection. This allows the learning process to be designed independently of time and location while giving participants active control over their learning process.

The structure of the BiNe-Guide and the work in the BiNe-Teams promote activation, networking, knowledge exchange, openness, and interest in new things (cf. Foelsing & Schmitz, 2021). Participants act not only as learners but also as initiators. Beyond the teams, they develop strategies to make themselves and their work visible, for example, via internal platforms such as SharePoints or at events. This approach also addresses previous criticism of the increased use of and heavy reliance on social media in previous WOL implementations (Ternes, personal communication).

Overall, BiNe allows for a flexible design of the learning and networking process by offering many possibilities for individualisation and exploration. According to agile learning principles, participants are at the centre of the training programme (cf. Augner et al., 2023; Liebhart, 2022) and are free to decide which content and impulses are relevant to their goals and development. The goals can be both personal and professional in nature and may vary from concrete plans to

intermediate steps in larger projects. In addition, coaching methods are used to support practical implementation in everyday work and to facilitate applicability for different target groups.

2.2 The main topics of BiNe

BiNe content is based on the central goals, which focus on individual goal achievement and development, stronger networking, and the future establishment of a CoP, as well as on the needs of the heterogeneous target group. By combining proven elements from other formats with new approaches, such as coaching, the aim is to strengthen participants and their institutions and prepare them for future challenges – especially with regard to the further development of the Wissensstadt. The content covered in individual and group work can be divided into the following four key topics:

- i. *Working on the self and with others*
The focus is on self-selected goals, the creation of individual plans for achieving goals, and (self-)reflection. Participants critically examine existing resources and identify gaps that may impede progress. In doing so, they recognise the strategic importance of networking and professional exchange – consistent with the BiNe guiding principle “grow connected & inspired.” Initial relationships within the BiNe-Teams are established to provide mutual support and feedback. Beyond goal setting, this topic addresses fundamental aspects of personal development, including cultivating an open mindset (growth mindset), embracing lifelong learning, and fostering cooperative practices. These elements are essential for navigating complex professional environments and for sustaining adaptability in the face of change.
- ii. *Sharing knowledge and experience*
The second key topic focuses on collaborative practices and the active exchange of knowledge and experience among participants. Central to this process is the enhancement of communication skills and the deliberate visibility of one’s work and professional contributions. The quality of interpersonal relationships, particularly dimensions such as appreciation, trust, and generosity, plays a decisive role in enabling sustainable collaboration. Although these factors are often overlooked in fast-paced organisational contexts, they constitute critical prerequisites for effective teamwork and long-term cooperation.
- iii. *Working in a network*
This topic addresses the systematic development of networking competencies within the Wissensstadt. Participants begin by analysing existing network structures and assessing their own network profiles, followed by strategies for targeted expansion and maintenance of their network. Reflection on one’s role and influence within these networks is integral to understanding how individual actions contribute to broader institutional objectives. In addition, participants explore approaches for overcoming barriers to networking, such as limited time resources or uncertainty in initiating contact. Through these activities, the programme seeks to strengthen participants’ capacity to engage in purposeful, cross-institutional collaboration that supports innovation and knowledge transfer.
- iv. *The future self*
The final key topic provides impetus for engaging with uncertainty, complexity and change in dealing with current societal and organisational dynamics. Participants determine future-oriented competencies relevant to their professional roles and experiment with self-management techniques, such as time management strategies and planning tools. These practices aim to enhance resilience and adaptability in environments characterised by rapid transformation. Furthermore, the topic encourages participants to acknowledge and document their own achievements, thereby reinforcing motivation and fostering a sense of progress. This reflective process contributes to the development of a proactive stance towards personal and professional growth.

Each BiNe-Loop deals primarily with one of the four key topics (see Table 2: ●).

Table 2. Assignment of BiNe-Loops to key topics

Key topic	L1	L2	L3	L4	L5	L6	L7	L8
Working on oneself and with others	●	●	○		○		○	○
Sharing knowledge and experience		○	●	○		○		○
Working in a network	○		○	●	●	●		
The future self		○		○		○	●	●

However, in order to deepen certain elements over a longer period of time and allow habits to develop, individual elements pertaining to one of the four key topics are also found in several loops (see Table 2: ○).

3 Results and discussion

To date, three BiNe-Journeys have taken place, the first in autumn 2024, the second in spring 2025 and the third in autumn 2025. Across these iterations, the format involved approximately fifty individuals (see Table 3 for an overview), the majority of whom were women.

Table 3. Profiles of BiNe participants

	Journey 1	Journey 2	Journey 3
<i>N Participants</i>	18	21	12
<i>Ratio male:female</i>	4:14	3:18	1:11
<i>N Institutions</i>	5	6	5
<i>N Teams</i>	4	6	3
<i>N Participants per team</i>	4-5	3-4	4

Participants represented ten institutions within the education sector, including universities, research institutes, and organisations working in areas such as entrepreneurship, science, and the application of AI. This composition reflects a deliberate effort to include actors from both academic and applied contexts, thereby providing diversity of perspectives and experiences.

The participant group was characterised by a wide range of professional roles. These included academic and research positions such as professors, doctoral candidates, and research associates; roles in programme coordination and internationalisation; and administrative and strategic functions covering areas such as quality management, talent development, project management, organisational development, event organisation, and community operations. Additionally, some participants held responsibilities in fields related to educational support, digital learning, and technology transfer.

In terms of qualifications, participants exhibited a broad spectrum of educational backgrounds, ranging from vocational training to diploma, bachelor's, master's, and doctoral degrees, extending to professorial appointments. This diversity not only reflects the structural complexity of the education sector but also highlights the need for flexible learning formats capable of addressing varied professional requirements. By bringing together individuals with such heterogeneous profiles, BiNe creates an environment conducive to cross-institutional exchange and collaborative problem-solving, which are essential for fostering innovation and strengthening institutional networks.

To ensure the quality of the programme and to generate meaningful benefits for both employees and their institutions, BiNe is subject to systematic scientific monitoring. This evaluation process is designed to provide an evidence-based foundation for assessing the programme's effectiveness and for guiding its ongoing development. The research framework addresses two analytical levels: the micro level, which focuses on individual participants' personal and professional development, and the macro level, which examines the programme's impact on participating

institutions. Overall, short- and long-term outcomes will be analysed. In this article, we report short-term effects at the micro level and address the following research questions:

- RQ1: What are the participants' goals and expectations?
- RQ2: To what extent does BiNe support personal development?
- RQ3: To what extent does BiNe contribute to networking?

To address these research questions, participants' experiences were recorded using three short questionnaires at the beginning (T0) and the end of the journeys (T1), and additionally three months after completion (T2). For the purpose of this paper, only data from T0 and T1 will be used. The questions included items rated on a five-point Likert scale (from strongly disagree to strongly agree) as well as open-ended questions for free responses.

The participants started their journeys with a variety of individual goals, reflecting both professional and personal aspirations (RQ1). These goals can be grouped into four main categories* demonstrating the multifaceted nature of lifelong learning and individual personal development, as addressed through BiNe:

- i. *Expanding competencies and enhancing personal effectiveness*
Many participants expressed an ambition to enhance their skills and increase their effectiveness in their day-to-day work. Their objectives included improving communication and decision-making skills, cultivating stronger prioritisation abilities, and establishing systematic approaches to time and task management. Other participants focused on language learning or acquiring new technical knowledge to support their professional growth. For example, some aimed to enhance their communication skills and develop greater confidence in decision-making, while others set goals such as learning a foreign language or preparing for an MBA application. Additionally, participants sought to broaden their understanding of SEO and website analytics to strengthen their digital expertise.
- ii. *Addressing current challenges and strengthening digital visibility*
Several participants focused on mastering technological developments and improving their digital presence. Their goals included understanding and applying AI in practical contexts, identifying relevant use cases for AI tools, and promoting their effective adoption within teams. Participants also aimed to strengthen their visibility on professional platforms by creating structured content plans and expanding their networks through consistent engagement and targeted outreach.
- iii. *Advancing one's work through strategic projects, networking initiatives and planning*
A number of participants focused on driving forward strategic projects and shaping their long-term career paths. Their goals included developing internal employee training concepts, the restructuring of existing programmes, and the planning of future endeavours such as the launch of a new intranet or starting a programme for international students. Others aimed to design and implement a quality management concept, prepared workshops on technological change or finalised scientific publications. Career-oriented objectives were also prominent, such as drafting a business plan or defining career paths as freelance lecturers or trainers.
- iv. *Exploring needs and trends in the professional environment*
Some participants aimed to deepen their understanding of external requirements and emerging trends to guide their professional activities. Their objectives included clarifying key decision-making criteria for competence management, gaining insights into the regional educational landscape and its future developments, and identifying effective strategies for delivering relevant learning opportunities. In addition, others sought to strengthen collaboration by expanding networks and initiating joint projects with partners beyond their immediate professional environment.

* AI tools (Microsoft Copilot) were used to cluster the goals. The authors reviewed and validated all AI-assisted outputs.

The majority of the selected goals were professionally oriented and had the capacity to be integrated seamlessly into everyday working activities. Concurrently, the heterogeneity of objectives – ranging from personal skill development and digital transformation to strategic programme design and environmental analysis – underscores BiNe's distinctive strength: the convergence of individuals from diverse backgrounds, experiences, and ambitions to facilitate mutual learning and impactful progress.

Overall, the distribution of goals across the three journeys indicates distinct areas of focus for each. The primary focus of the first journey was strategic projects and career planning. Such projects included programme restructuring, process development and organisational initiatives. Digital and AI-related objectives were found to be of particular significance, while competency development exhibited a moderate level of importance and exploration of external trends was less prevalent. Journey 2 was marked by a strong emphasis on competencies, with a focus on personal effectiveness, communication skills, and professional growth. Digital objectives were also prominent, while strategic projects and goals related to external trends were present but less dominant. In Journey 3, there was a balanced distribution between competency development and strategic projects. Digital and AI-related objectives were moderate in nature, with some goals addressing external trends and collaboration opportunities.

In BiNe, personal development is strongly fostered through the exchange and interaction with the BiNe-Team (RQ2). Approximately 85% of participants stated that the exchange within the BiNe-Team was highly valuable to them. Particularly positive aspects highlighted by participants were the heterogeneous composition of the team, which provided diverse perspectives, as well as the open and trusting nature of the exchange (see e.g., Augner et al. 2023, Graf et al. 2022 for similar findings on WOL). In addition, participants appreciated the combination of goal-oriented discussions and the content provided in the BiNe-Guide. Mutual support among team members, through the sharing of tips, experiences, and practical examples, was also frequently mentioned as a key contributor to personal development. Prior to the journey, participants rated their perceived preparedness for their professional future as an average of 3.8.* After the BiNe-Journey, this rating increased to 4.0, indicating that participants felt better prepared to face upcoming professional challenges. According to participant feedback, this was achieved not only through the discussions with team members but also through the information and impulses provided in the BiNe-Guide.

Beyond skill development, participants repeatedly noted a shift in awareness. That is, through BiNe they became more conscious of the value of their own skills and experiences and recognised that these are worth sharing with others (see also Engelhardt & Warbeck, 2021; Graf et al., 2022; Wetterauer, 2020 for similar findings on WOL). Moreover, participants reported gaining a clearer understanding of how exchange and collaboration can support the achievement of their own goals, even when team members are pursuing different or seemingly unrelated objectives. Here is a selection of statements that illustrate the importance of the BiNe-Team for personal development:

- *"I like about BiNe that you form a team to reach your personal goals which have a positive effect on your work (but also private) life."* (J2-T1-04)[†]
- *"BiNe promotes the exchange between different institutions which helped me reach my personal goal."* (J2-T1-08)
- *"I was able to share my experience and knowledge and learnt that this was actually of use for others."* (J2-T1-11)

BiNe not only aims at promoting personal development but also places emphasis on fostering networking activities among participants. With respect to networking (RQ3), the majority of participants highlighted the importance of the BiNe-Team for achieving their goals, either directly through the provision of useful tips and advice or indirectly through encouragement, feedback and motivation.

* All information refers to the number of completed questionnaires before (n=23) and right after the journey (n=19), not to the total number of participants in the three BiNe-Journeys conducted so far.

† The participant code is composed of the journey, the questionnaire and an arbitrarily assigned number.

Many participants further indicated that BiNe increased their awareness of the importance of networking (see also Wetterauer, 2020 for similar findings) and reinforced the perception that investing time and effort in building professional relationships is worthwhile. This indicates that the BiNe-Teams successfully established initial, small-scale networks that support participants in reaching their individual goals. Importantly, these networks, along with the strategy of leveraging networking for goal attainment, can serve as a foundation for continued relationship-building beyond the duration of BiNe. In the long run, this may enable the development of a CoP (see e.g., Foelsing & Schmitz, 2021; Hufnagel & Ternes, 2024; Ternes & Hufnagel, 2022 on the relation of agile learning and CoPs). By embedding networking within the learning process, BiNe contributes to the development of professional ecosystems characterised by openness, reciprocity, and shared responsibility, i.e., elements that are essential for addressing the complexity of contemporary educational environments.

Moreover, more than half of the participants felt more confident and competent when attending networking events after completing the BiNe-Journey. This finding suggests a positive influence of BiNe on networking skills. These skills include, among others, improved communication abilities (also in online communication), as well as an enhanced capacity to reflect on one's own role within professional networks. Participants also reported a greater awareness of the importance of actively sharing information and knowledge with others (see also Graf et al., 2022; Wetterauer, 2020 for similar effects of WOL).

In addition to skill development, participants engaged in reflective processes throughout the journey that allowed them to identify potential inhibitions related to networking, such as language barriers or contacting unknown people. With the support of their team and the guidance provided in the BiNe-Guide, many participants were able to address and overcome some of these barriers. This highlights the importance of both social support and structured learning materials in fostering networking competence and confidence. The selection of responses below illustrates the participants' perspectives on networking:

- *"BiNe has made me appreciate the value of networking more and I have taken more time for it."* (J1-T1-01)
- *"I am now more conscious of how I use my network."* (J2-T1-03)
- *"I think differently now about how I can use networking and that it's okay to ask for help because you're happy to offer it yourself."* (J1-T1-02)
- *"I now understand that I can easily hold informal conversations in German."* (J2-T1-04)
- *"I like the idea of having an easy-to-access network [BiNe-Team]."* (J2-T1-10)

The short-term effects observed at the macro level indicate that BiNe provides a structured and purposeful platform for fostering both personal development and networking among employees in educational institutions. Participants not only succeeded in achieving their individual goals but also contributed to the progress of others by sharing knowledge, expertise, and practical insights. This reciprocal exchange underscores BiNe's potential to generate collaborative learning processes that extend beyond the boundaries of individual tasks.

Within this context, the BiNe-Teams functioned as initial networking units, offering participants opportunities to analyse and reflect on their own professional behaviours while simultaneously addressing inhibitions related to networking. These teams created a safe and supportive environment in which participants could experiment with new interaction strategies, receive constructive feedback, and gradually build confidence in their networking abilities. Such experiences represent an important foundation for the emergence of a CoP, which constitutes a central long-term objective of the programme.

Despite these positive outcomes, participants also reported challenges associated with maintaining focus on individual goals throughout the ten-week duration of the journey. This timeframe, while designed to allow for iterative learning and habit formation, requires a considerable degree of commitment, time management, and organisational skills. These observations highlight the need for continued refinement of programme structures to balance flexibility with sustained engagement, ensuring that participants can derive maximum benefit without experiencing undue workload.

BiNe is designed to establish new routines that facilitate the achievement of individual goals. Recognising that the development and consolidation of such routines require time and repeated practice, the format adopts a ten-week timeframe for each journey. This duration is intended to provide sufficient opportunity for iterative learning and habit formation while maintaining a manageable scope for participants. Nevertheless, the programme is structured to avoid imposing additional burdens on participants' everyday work. On the contrary, its design seeks to ensure that engagement with BiNe yields tangible benefits that can be integrated into professional practice.

To support this objective, accompanying materials are continuously adapted from one journey to the next, enabling participants to maximise the value of their experience. Participants' feedback is actively considered, and materials are modified when changes are broadly beneficial for the group and future journeys. This iterative approach reflects a commitment to responsiveness and user-centred design, ensuring that the programme evolves in alignment with participants' needs and expectations. Such adaptability was particularly critical during the initial project phase, when foundational structures were refined to enhance clarity, usability, and practical applicability.

4 Conclusion and outlook

In light of rapid changes and limited resources, educational institutions need to strengthen their employees' individual competencies and establish collaborative structures across institutional boundaries. Agile learning formats support both aims by fostering personal development and collaborative learning. BiNe is an agile learning format tailored to the needs of employees in the educational sector. To date, the programme has been delivered three times, with more than 50 participants in total, in the Wissensstadt Heilbronn.

The findings indicate that participants pursue a range of individual goals. This heterogeneity of objectives ultimately highlights BiNe's distinctive strength: enabling individuals from diverse backgrounds to foster mutual learning and achieve meaningful progress (RQ1). Personal development is further supported through exchange and interaction with the BiNe-Team (RQ2). Participants benefited from both the heterogeneous group composition and the material provided in the BiNe-Guide, which together increased the perceived preparedness for their professional future. They also developed a stronger awareness of the value of their skills and an understanding of how collaboration can support goal achievement, even when objectives differ. Furthermore, BiNe promotes networking by increasing awareness of its importance and strengthening participants' abilities to build and maintain professional relationships (RQ3). In doing so, it initiates small-scale networks that support goal achievement and can serve as a foundation for collaboration beyond the programme, and may potentially evolve into a CoP. Overall, the results suggest that agile learning formats such as BiNe create valuable impulses for professional development and cross-institutional collaboration.

BiNe relies fundamentally on the active engagement of its participants and the involvement of multiple educational institutions within the Wissensstadt, as these factors constitute the basis for establishing a stable and sustainable CoP. The long-term viability of such a community depends on continuous participation and the gradual expansion of its member base. Consequently, future iterations of BiNe aim to attract an increasing number of participants from all institutions of the Wissensstadt. The format is designed to accommodate both long-term employees and newcomers, thereby supporting the development of cross-institutional networks through the initiation of new contacts and the deepening of existing relationships. For this network to grow in a sustainable manner, broad participation is essential; only through collective engagement can the full potential of the initiative be realised, generating benefits for all stakeholders involved.

Resilient quality assurance is also required to establish BiNe in the institutions. To this end, the project is being scientifically monitored at the micro (individual development) and macro level (institutional level), analysing short- and long-term effects. Initial experiences with BiNe demonstrate the potential of agile learning formats for networking among educational institutions. In particular, the heterogeneous team composition and flexible structure proved to be success factors. Challenges remain in retaining participants in the long term and in the transition from the journey to a permanent

CoP. The findings may serve as examples of good practice beyond the educational institutions of the Wissensstadt.

Acknowledgement

AI tools (Microsoft Copilot) were used for language refinement to improve clarity and grammar without altering scientific content. All AI-assisted outputs were reviewed and validated.

We wish to thank the Dieter Schwarz Stiftung for funding and the participants of the three journeys for their willingness to participate and provide us with valuable feedback.

References

- Augner, T., Schermuly, C. C., & Jungmann, F. (2023). Working Out Loud: An intervention study to test an agile learning method. *Journal of Workplace Learning*, 36(1), 43–58. <https://doi.org/10.1108/jwl-04-2023-0067>
- Engelhardt, N., & Warbeck, N. (2021). Working Out Loud – Peer-Coaching für eine neue Offenheit in Wirtschaft und Wissenschaft. [Working Out Loud – Peer coaching for a new openness in business and academia]. Last accessed: 08.09.2025 <http://www.hochschulforumdigitalisierung.de/working-out-loud-peer-coaching-fuer-eine-neue-offenheit-in-wirtschaft-und-wissenschaft>
- Foelsing, J., & Schmitz, A. (2021). *New Work braucht New Learning: Eine Perspektivreise durch die Transformation unserer Organisations- und Lernwelten*. [New Work needs New Learning: A journey of perspectives through the transformation of our organisational and learning worlds]. Springer. <https://doi.org/10.1007/978-3-658-32758-3>
- Dückert, S. (2019). lernOS als Betriebssystem für die Arbeit der Zukunft. [lernOS as an operating system for the future of work]. In D. Brommer, D., S. Hocking, S. & A. Leopold, A. (eds.), *Faszination New Work: 50 Impulse für die neue Arbeitswelt* (p. 189–198). Springer. https://doi.org/10.1007/978-3-658-24618-1_24
- García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The Transformation of Higher Education After the COVID Disruption: Emerging Challenges in an Online Learning Scenario. *Frontiers in Psychology*, 12, 616059. <https://doi.org/10.3389/fpsyg.2021.616059>
- Geiß, M., Ondrusch, N., Ternes, D., Majunke, J., & Quandt, V. (2025). Bildung vernetzt – Ein agiles Weiterbildungsformat zur Entwicklung einer Community of Practice. [Bildung vernetzt – an agile learning format for developing a community of practice]. *Weiterbildung*, 1(2025), 28–30.
- Graf, N., & Edelkraut, F. (2021). Wo bitte geht's zur Personalentwicklung? Die Rolle der PE neu gedacht. [Excuse me, how do I get to personnel development? Rethinking the role of HRD]. In J. Foelsing, & A. Schmitz (eds.), *New Work braucht New Learning: Eine Perspektivreise durch die Transformation unserer Organisations- und Lernwelten* (p. 231-244). Springer. https://doi.org/10.1007/978-3-658-32758-3_8
- Graf, N., Gramß, D., & Edelkraut, F. (2017). *Agiles Lernen: Neue Rollen, Kompetenzen und Methoden im Unternehmenskontext*. [Agile learning: new roles, competencies, and methods in the corporate context]. Haufe. <https://doi.org/10.34157/9783648095348>
- Graf, N., Kemmether, K., & Liebhart, U. (2022). #WOL – Effekte von organisationsinternen Einsätzen von Working out Loud: Eine Expertenstudie zu den Effekten durch den organisationsinternen Einsatz von Working out Loud-Zirkeln. [#WOL – Effects of internal organisational deployments of Working Out Loud: an expert study on the impacts of using Working Out Loud circles within organizations]. Last accessed: 08.09.2025 <http://www.workandfeelgood.de/wordpress/wp-content/uploads/2022/07/Studienbericht-Effekte-von-WOL.pdf>
- Graf, N., & Liebhart, U. (2024). Die Kraft der Learning Circles: Umsetzung, Wirkung und Einsatzmöglichkeiten. [The Power of Learning Circles: implementation, impact, and possible applications]. Vahlen. <https://doi.org/10.15358/9783800673889>
- Hufnagel, J., & Ternes, D. (2024). Hochschulübergreifende Kooperation mit Transparenz und agilen Tools: Erfahrungsbericht aus dem landesweiten Kompetenznetzwerk für digitale Lehre und Studienorganisation. [Cross-university cooperation with transparency and agile tools: a field report from the statewide competence network for digital teaching and study organization] Last accessed: 08.09.2025 <http://www.hochschulforumdigitalisierung.de/kooperation-mit-transparenz-und-agilen-tools>
- Kirchherr, J., Klier, J., Lehmann-Brauns, C., & Winde, M. (2018). Future Skills – Diskussionspapier 1: Future Skills: Welche Kompetenzen in Deutschland fehlen. [Future Skills – Discussion Paper 1: Future Skills: Which competencies are lacking in Germany]. Last accessed: 08.09.2025 <https://www.stifterverband.org/medien/future-skills-welche-kompetenzen-in-deutschland-fehlen>
- Krehbiel, T. C., Salzarulo, P. A., Cosmah, M. L., Forren, J., Gannod, G., Havelka, D., Hulshult, A. R., & Merhout, J. (2017). Agile Manifesto for Teaching and Learning. *Journal of Effective Teaching*, 17(2), 90–111.
- Liebhart, U. (2022). Agile Lernformate: Freestyle im Rahmen. [Agile learning formats: Freestyle within a framework]. *managerSeminare*, 288, 87–94.
- Longmuß, J., & Höhne, B. P. (2017). Agile Learning for Vocationally Trained Expert Workers. Expanding Workplace-based Learning One Sprint at a Time. *Procedia Manufacturing*, 9, 62–268. <https://doi.org/10.1016/j.promfg.2017.04.003>
- Meißner, A., Klatt, T., Schlieper, N., Dotz, S., & Knackstedt, R. (2024). Vernetzungs- und Selbstorganisationskompetenzen durch Working Out Loud™ fördern. [Fostering networking and self organization skills through Working Out Loud™]. *Zeitschrift für Hochschulentwicklung*, 19(4), 181–199. <https://doi.org/10.21240/zfhe/19-4/10>

- Muzam, J., Bendkowski, J., Mah, P. M., & Mudoh, P. (2023). The state-of-the-art of modern workplace learning: an applied assessment method of a pre-train deep learning on modern learning tools. *The Learning Organization: An International Journal*, 30(5), 607–629. <https://doi.org/10.1108/tlo-01-2023-0019>
- Noe, R. A., Clarke, A. D. M., & Klein, H. J. (2014). Learning in the Twenty-First-Century Workplace. *Annual Review of Organizational Psychology and Organizational Behavior*, 1, 245–275.
- Ondrusch, N., Premnavas, S., & Schönbrunn, J. (2021). Networking and student collaboration in times of virtualized contacts: Working Out Loud as a method to promote group cohesion. *European Journal of University Lifelong Learning*, 5(1), 59–69. <https://doi.org/10.53807/0501g4u0>
- Quandt, V. I., & Ondrusch, N. (2024). Learning Sequence „Learning | Growing | Working“: A Helpful Approach to Facilitate the Entry into the IT Faculty. *International Journal of Higher Education Pedagogies*, 5(2), 56–70. <https://doi.org/10.33422/ijhep.v5i2.585>
- Rheinhardt, K. (2020). *Digitale Transformation der Organisation: Grundlagen, Praktiken und Praxisbeispiele der digitalen Unternehmensentwicklung*. [Digital transformation of the organization: foundations, practices, and real world examples of digital corporate development]. Springer. <https://doi.org/10.1007/978-3-658-28630-9>
- Rost, S., & Hafer, J. (2020). Digitalisierung der Hochschulbildung in lernenden Organisationen. [Digitalization of higher education in learning organizations]. *Potsdamer Beiträge zur Hochschulforschung*, 6, 213–234.
- Stepper, J. C. (2020). *Working out Loud: A 12-Week Method to Build New Connections, a Better Career, and a More Fulfilling Life*. Page Two.
- Ternes, D., & Hufnagel, J. (2022). Ein Netz, das pulsiert. [A network that pulses]. *DUZ Wissenschaft & Management*, 9(2022), 26–30.
- Wenger, E. (2011). Communities of practice: A brief introduction. Last accessed: 08.09.2025 <https://scholarsbank.uoregon.edu/items/6baf09ba-c319-4949-acef-cb220dc2953a>
- Wetterauer, M. (2020). Weils gemeinsam besser klappt. [Because things work better together]. Last accessed 01.04.2026 <https://transfertogether.de/working-out-loud/>

WIN-WIN-WIN FOR INDUSTRY, RESEARCH AND INDIVIDUALS: SUPERVISORS' INSIGHTS FROM THE TANDEM PROGRAMME AT TH KÖLN

Anastasia Asiedu ^{1*}, Dagmar Linnartz ¹ and Hendrik Thesing ¹

¹ TH Köln – University of Applied Sciences, Germany

Keywords:

Dual employment
Supervision quality
Industry-academy partnership
Sustainable career path
University of applied sciences

Article history:

Received: 14 January 2026

Revised: 10 April 2026

Accepted: 14 April 2026

To cite this article:

Asiedu, A., Linnartz, D. & Thesing, H. (2026). Win-Win-Win for Industry, Research and Individuals: Supervisors' Insights from the Tandem Programme at TH Köln. European Scientific Journal for Dual Higher Education (ESJ DHE), 2 (3), 29-45.
<https://doi.org/10.82321/07ma-34m611>

Abstract

The tandem programme at TH Köln is a five-year dual qualification programme in which participants are simultaneously employed by a partner organisation and by TH Köln as doctoral student or postdoc. This study investigates the roles of academic and industry supervisors, the perceived benefits and costs of the tandem programme, and collaboration among stakeholders. Social Exchange Theory (SET) is used to examine how supervisors evaluate the benefits and costs of collaboration. Semi-structured interviews were conducted with 20 supervisors from academia and industry who oversaw 23 doctoral and postdoctoral researchers in the programme, several of whom had participated since 2022. The findings revealed a broad spectrum of perceived roles, benefits, and approaches to collaboration. Win-win-win scenarios were analysed alongside suggestions for minimising costs and maximising benefits. The study underscores the importance of supervision quality and outlines best practices for guiding future tandem collaborations that advance flexible career pathways and support the achievement of the 2030 sustainability goals.

1 Introduction

The 2030 Agenda for Sustainable Development emphasises the importance of fostering strong connections and collaboration between industry, research, and policy to drive meaningful and positive societal change (United Nations General Assembly, 2015). In alignment with these global objectives, the tandem programme at TH Köln exemplifies a practical approach to bridging academia and industry and fostering collaboration that supports sustainable innovation and professional development.

1.1 The context of the tandem programme

The tandem programme at TH Köln is a dual qualification programme that fosters ongoing collaboration and knowledge exchange between research and industry by enabling participants to hold dual employment for up to five years: an industry position alongside a doctoral or postdoctoral

* Corresponding author

E-mail address: anastasia.asiedu@th-koeln.de

research position. During this period, participants are supported by supervisors from both academia and industry*. Participants are expected to gain valuable teaching and applied professional experience alongside their research, thereby building a skills base for work in industry, the public sector, or research, including a pathway to a professorship at a university of applied sciences. The programme is designed to remain open in terms of outcomes, enabling participants to decide in favour of an industry career as an alternative pathway. As a result, the programme encourages more flexible career pathways.

The tandem programme is a subproject within the broader P_{LAN}_CV initiative, which supports academic personnel development at TH Köln. P_{LAN}_CV is a German acronym that translates as "Rethinking Professorial Careers at Universities of Applied Sciences". Funded by the Federal Ministry of Research, Technology and Space (BMFTR) and the Joint Science Conference (GWK) (Funding reference number 03FP09), P_{LAN}_CV aims to strengthen career pathways towards professorships at universities of applied sciences. It aims to achieve this goal by broadening the pool of qualified candidates and enhancing their competencies. Anticipating a large number of professorship vacancies at universities of applied sciences in Germany by 2030 (In der Smitten et al., 2017), the initiative adopts a holistic approach that addresses multiple stages of the academic career life cycle, from student research assistants through promotion, postdoctoral qualification, to professorship, while integrating cross-cutting themes such as diversity, high-quality supervision, and career development across its five coordinated subprojects.

As one of the five P_{LAN}_CV subprojects, the tandem programme was guided by a Trias principle developed specifically in the TH Köln context. The term "Trias" stems from the Latin word meaning "a group of three," referring here to the three core academic missions: teaching, research, and transfer (Szczyrba et al., 2025). The Trias principle emphasises that teaching, research, and transfer are closely interconnected and should actively support and enrich one another, rather than being treated as separate or competing responsibilities of a scholar (Hausstein et al., 2022). Inspired by Boyer's influential critique (1990) of the traditional focus on research output alone as the main measure of academic success, this approach calls for recognising teaching and meaningful engagement with society and real-world problems as equally vital components of scholarly work. At TH Köln, the Trias principle forms a foundational part of the tandem programme (Szczyrba et al., 2025). Supervisors and participants alike are introduced to this concept, which encourages them to embrace their multiple roles as researchers, educators, and practitioners and to see these roles as mutually reinforcing.

In this article, we examine the tandem programme from the perspective of supervisors at both the university of applied sciences and the partner organisations. Using interview data, we focus on how supervisors describe their roles, what benefits and costs they perceive in the tandem programme, and how collaboration between the two settings is shaped.

1.2 Supervisors' roles and quality of supervision

The supervisor's role has been described as central to a candidate's success in academia as well as in an industry workplace environment. Academic supervisor support has been reported to be associated with lower drop-out rates, better academic performance, and improved well-being (Kunz et al., 2021; Ringo, 2025; Wollast et al., 2023). Academic supervisors can facilitate networking, provide support in times of difficulty, offer intellectual input and relevant information (Jaksztat et al., 2021; Mainhard et al., 2009; Skopek et al., 2022). Similarly, high-quality industrial supervision correlates with lower attrition rates, better job performance, higher job satisfaction, and well-being (Herawati et al., 2023; Mohr et al., 2021; Zeb et al., 2023).

Given the importance of the supervisor position, prior research has attempted to analyse supervisors' roles and examples of exemplary and flawed supervision, sometimes providing a handbook as a guideline for doctoral supervision (Taylor & Kiley, 2024). To understand the aspects of the academic supervisor's role, an extensive international study identified clusters of meaning associated with that role (Guarimata-Salinas et al., 2024). The authors provided a list of 18 functions

* In this article, the term industry supervisor or industry partner is used broadly to refer to all partners involved in the tandem programme who are situated outside academia, including public, private, and non-profit organisations. Academic supervisor refers to the university supervisor from TH Köln.

of a supervisor, including supervising, directing, guiding, leading, managing, advising, and mentoring. They also refer to the Sapir-Whorf hypothesis, which states that language affects perception and behaviour. Accordingly, the way supervisors linguistically frame their role may shape their approach to supervision. One more study investigated the role of workplace supervisors in the context of work-integrated learning (Fleming et al., 2021). The authors argue that supervisors have an educational role in helping students acquire skills such as software knowledge, digital office skills, understanding workplace expectations and culture, communication, problem-solving, critical thinking, and professional behaviours (work ethic and networking, etc.).

Some studies have investigated styles and types of supervision. Deuchar (2008) applied four supervision styles to analyse doctoral supervision: *laissez-faire*, where the supervisor largely observes and allows the candidate to independently manage both research and personal progress; *pastoral*, in which the supervisor provides mainly personal and emotional support while expecting the candidate to manage their research; *directorial*, characterised by active and structured guidance focused on managing the research process; and *contractual*, where supervisor and candidate negotiate the extent of academic and personal support needed throughout the research journey. The author emphasised that these styles should be adapted and combined flexibly to suit the candidate's changing needs and context rather than applied rigidly. In a qualitative study, Reis and Szczyrba (2011) outlined the following types of doctoral supervisors: (a) fatherly friend and group moderator, (b) teacher with therapeutic ambitions, (c) boss and evaluator, and (d) guide in self-realisation processes. The authors emphasise the importance of ensuring the quality of supervision and, as an example, suggest a two-day workshop in which supervisors can reflect deeply on their roles and develop an intentional course of action. However, they underscore that such a one-off workshop is not sufficient. Rather, supervisors need to participate regularly in ongoing professional development to maintain and enhance their supervisory skills.

Indeed, the issue of supervision quality has interested a number of researchers, as Motshoane and McKenna (2021) wrote: "crossing the border from being a doctoral candidate to becoming a doctoral supervisor entails significant shifts in identity and an understanding of postgraduate pedagogy and institutional expectations" (p. 1). They also underline the need for opportunities for supervisor development.

Another aspect to consider in the context of the tandem programme at TH Köln is communication between supervisors, since doctoral and postdoctoral candidates have two supervisors from the university and industry guiding them. When supervisors jointly develop a shared understanding of the processes in research, teaching, and transfer, uncertainties for doctoral candidates are minimised (Müller-Otto & Szczyrba, 2025). When left alone with this task, their uncertainties grow. Thus, strong collaboration between supervisors is essential to support candidates in their transdisciplinary work.

1.3 Social Exchange Theory: Costs and benefits of supervision

Social Exchange Theory (SET) applies economic principles of cost-benefit analysis to social relationships, suggesting that individuals engage in interactions much like transactions in which they seek to maximise rewards and minimise costs. People tend to maintain relationships that provide greater benefits than costs and may end those where the costs outweigh the gains (Emerson, 1976). Initially focused on one-to-one exchanges or dyads (Blau, 1986; Homans, 1958), the theory was later expanded by Emerson (1976) to encompass broader networks involving multiple actors. These exchange networks show how exchanges connect many people, creating systems where resources and influence flow across social ties. This broader view highlights the importance of collaboration through so-called productive exchange, where several actors work together to create greater value. Instead of simple trade, *productive exchange* involves joint efforts leading to outcomes that are magnified through cooperation. What Emerson described is closely related to the idea of synergy effects, when the combined efforts produce a result greater than the sum of individual contributions (Klimuk et al., 2020).

SET has been used as an underlying theory in a number of works on supervision relationships in workplace contexts (Zeb et al., 2023) and academia, including research on doctoral (Fan et al., 2019) and postdoctoral (Karalis Noel et al., 2022) levels. Zeb et al. (2023) have differentiated

between extrinsic and intrinsic rewards that employees receive in a workplace setting. While extrinsic rewards are mostly monetary, intrinsic rewards include, for example support and appreciation from the supervisor, which have been found to lead to better performance. In the academic setting, doctoral researchers have been shown to provide greater benefits in the form of innovative ideas and creativity when they perceive support from the supervisor (Fan et al., 2019). In line with prior research, the authors also emphasise that when each stakeholder sees value in the exchange, this positively affects reciprocity within the social exchange. Regarding the relationship between supervisor and a postdoc, prior research states that this relationship is not unidirectional, as previously assumed, with the mentor extending benefits to the postdoc, but rather, in accordance with SET, bidirectional. A postdoc may benefit the supervisor, the field of research, or other graduate students. Postdocs reported they appreciate regular meetings with supervisors, clear communication on roles and expectations, and conversations on their research and career goals (Karalis Noel et al., 2022). In sum, prior research has shown that SET has been applied to reciprocal supervisor-supervisee relationships, and has shown that the collaboration was more effective when the perceived value of the exchange was high. These findings confirm the value proposition of SET, which states that perceived value drives commitment and willingness to maintain a relationship (Emerson, 1976).

The tandem programme offers a compelling context for applying SET because it operates within a multi-stakeholder supervision model. Unlike traditional dyadic supervision, the tandem structure distributes resources, responsibilities, and potential costs across three parties: the doctoral or postdoctoral candidate, the academic supervisor, and the industry supervisor. Examining this triadic form of supervision is particularly important given the increasing prevalence of programmes involving industry-academia collaboration. SET provides a useful framework to understand how these stakeholders evaluate the costs and benefits of their involvement and how perceptions of reciprocity affect the quality and sustainability of their collaboration. Applying SET to the tandem programme allows us to analyse supervision dynamics within this complex exchange network and investigate how the perceived value of exchanges shapes collaborative outcomes.

1.4 Study objectives and research questions

The overall objective of this study was to identify, from the supervisors' perspective, the success factors within the tandem programme, so that future dual qualification programmes can benefit from these insights. The decision to focus on supervisors' perceived roles is based on their central importance: supervision quality critically influences the success of such programmes, and prior research emphasises the need to understand how clearly supervisors comprehend their responsibilities. Exploring the benefits and challenges experienced by both academic and industrial supervisors offers a balanced view of this dual qualification pathway, considering the perspectives of all stakeholders involved: academic supervisors, industrial supervisors, and tandem participants. Finally, examining collaboration seeks to uncover what has proven effective within the supervisory triads, allowing future dual qualification programmes to build on these successful practices. We therefore pose the following three research questions:

- RQ1: How do supervisors perceive their role within the tandem programme?
- RQ2: What benefits and costs do academic and industry supervisors experience in their tandem supervision set-up?
- RQ3: How do supervisors describe their collaboration with the tandem participants and partner organisations?

2 Methodology

Since the start of the project in 2022, a total of 23 doctoral and postdoctoral researchers with different start times have participated in the tandem programme. While doctoral candidates' full-time positions are divided similarly between the two employers (mostly 40% at TH Köln and 60% at the partner organisation), the postdocs are predominantly employed by the partner organisation (mostly

80%) and the remaining time at TH Köln (mostly 20%). Six tandem employees ended their tandem employment before the programme ended, for example, after completing their doctorate or because they transitioned to another job. 17 tandem employees were employed in the tandem programme at the time of the supervisor interviews. Of these, nine were doctoral and eight postdoctoral researchers employed simultaneously at TH Köln and a partner organisation. 11 of the 17 tandem employees worked in the industrial sector, one in finance, one in construction, one in culture, one in the non-profit sector, and two in the public sector. Accordingly, there were nine tandem employees at the Faculty of Computer Science and Engineering Science (F10), one at the Faculty of Automotive Systems and Production (F08), one at the Faculty of Process Engineering, Energy and Mechanical Technology (F09), one at the Faculty of Civil Engineering and Environmental Technology (F06), 1 at the Faculty of Business, Economics and Law (F04), one at the Faculty of Information Science and Communication Studies (F03), two at the Faculty of Cultural Studies (F02), and one tandem employee at the Faculty of Applied Social Sciences (F01).

Stakeholders in the tandem programme signed the relevant agreements: the supervision agreement for doctoral candidates, the agreement on developing an individual career profile for postdocs, and the cooperation agreement between TH Köln and partner organisations. These agreements included roles and responsibilities of the parties involved and suggested a structure of collaboration. The agreements specified clear timeframes and work plans with milestones and called for regular meetings: several times a year for doctoral candidates and at least once a year for postdocs, bringing together academic and industry supervisors to review progress and refine objectives as needed. Academic supervisors focused on academic guidance, fostering scientific independence, and supporting career development in research, teaching, and practice. Industry supervisors provided professional mentoring aligned with applied research and industry perspectives. Both supported conference participation, publication activity, and skills development.

All supervisors of the tandem employees from both organisations (TH Köln and the partner organisation) were invited by the project lead by email to participate in an interview. The purpose of the interviews for evaluation (e.g., identification of roles) was communicated transparently. Several supervisors subsequently responded and agreed to participate (14 professors and 6 non-academic partners). Because one professor supervises three tandem employees, almost all TH Köln professors could be reached. Written informed consent, including consent to record the interview, was obtained. The interviews were conducted between October 2024 and January 2025 using videoconferencing software (ZOOM) to minimise the effort required for voluntary participation. A semi-structured interview guide was developed for both professors and non-academic partners, with most questions remaining consistent across both versions (see Appendix A for the interview guide with specific questions).

With the interviewees' consent, the first interviews were conducted jointly by two interviewers (the second and third co-authors) to ensure a consistent interview approach. The remaining interviews were randomly assigned between the two interviewers. The average interview length was 51 minutes. After each interview, a postscript was written to document disruptions, initial impressions, and emerging ideas for interpretation.

The interviews were recorded and transcribed by the transcription service provider "Buero24". Thereafter, the interviewers created a coding scheme informed by the theory and the project goals. The first two interviews were double-coded in MAXQDA. After discussions about the disagreements, the establishment of clear coding rules, and the refinement of the codes, a 100% intercoder agreement was achieved. Following the finalisation of the coding scheme, the remaining interviews were subsequently coded individually. The interview transcripts were analysed in order to explore supervisors' perspectives on success factors within the tandem programme. Specifically, three thematic codes reflecting the study's objectives and research questions were applied: "perceived role" (RQ1), "benefits" and "costs" (RQ2), and "collaboration" (RQ3). Finally, the codes were analysed according to the principles of qualitative content analysis by the first author of this article (cf. Mayring, 2008). The interviews were translated from German into English using TH Köln ChatGPT.

3 Results

Our analysis revealed that the implementation of the tandem programme varied considerably depending on the constellation formed among a given tandem participant, industry supervisor, and academic supervisor. The results reflect a spectrum of implementation regarding perceived roles, benefits and costs, and collaboration within the programme.

3.1 Perceived roles

Supervisors' perceptions of their roles varied. These included, for example, roles such as coach, mentor, adviser, and sparring partner. Figure 1 provides an overview of the roles mentioned.

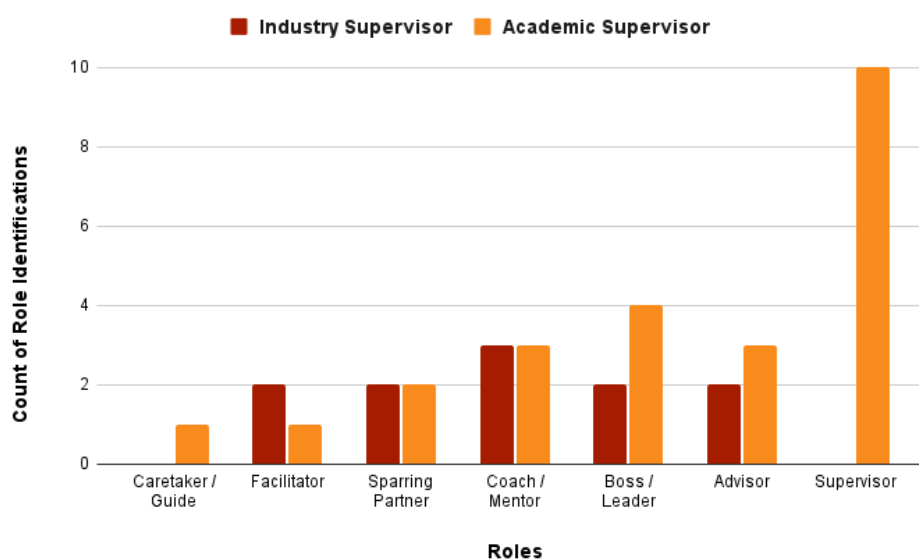


Figure 1. Perceived roles of industry and academic supervisors*

The roles the supervisors named reflected the nuanced and multifaceted nature of supervision. One aspect is the leadership and evaluation role of a boss or thesis supervisor. Another aspect frequently mentioned by both groups of supervisors is coaching or mentoring, particularly with regard to research goals, the acquisition of skills relevant to working in a company and career development. Some referred to their role as caretakers (German: "Kümmerer") and guides (German: "Wegweisende"), emphasising that they provide substantial help and support to guide the participants through the research or workplace processes and their career path. In a similar category is the advising role, which supervisors associate with giving advice on teaching or the technical side of work. Facilitator (German: "Ermöglicher") was mentioned as a role, in terms of giving participants the opportunity to undertake this dual employment within the tandem programme, pursuing their career goals in academia and at a company simultaneously. Another role mentioned by both industry and academic supervisors was that of sparring partner or collaborator. They described how, in this role, they feel a more reciprocal exchange of knowledge and ideas, emphasising the contribution of the participant.

Perceptions of the roles and of how many roles supervisors held at the same time also ranged from no role, through a single role, to a combination of two or more roles. A few supervisors reflected on multiple roles they are balancing in different aspects of the project. For instance, one industry supervisor mentioned simultaneously being a mentor, coach, boss or leader (German: "Führungskraft"):

* Note: The x-axis shows the roles mentioned by both industry and academic supervisors, while the y-axis illustrates the number of supervisors who identified with a given role. Some supervisors identified with more than one role.

These are different roles. There is a coaching role, a mentoring role, and also an indirect supervisory role. Therefore, I have different roles depending on the focus and task. In coaching, it is more about addressing interpersonal issues, lateral leadership in the project, and other matters to help advance the candidate. Mentoring, on the other hand, focuses more on the tasks and questions related to the doctoral thesis, breaking things down and moving them forward. And as a leadership figure, it involves the usual things like other tasks that need to be completed alongside the doctoral thesis, and that are part of everyday work. (O2P-3)

It should be noted that participants were employed in either doctoral or postdoctoral positions at TH Köln. Depending on their status, the academic supervisors viewed their role differently:

So, the role as a supervisor is, of course, different depending on whether I have someone in a post-doc position or working on a PhD. With a PhD student, I am much more of a caretaker and support them with guidance, but I don't necessarily feel on the same level. You first have to explain to them: How do I publish? What are the important framework conditions for that? What is a good strategy to successfully complete the PhD? I see myself as a helper and as someone who provides the guardrails on how best to navigate the process. (D2-3)

As such, supervisors for PhDs mentioned they had the traditional thesis supervisor role, which in some cases developed into collaboration in the case of students with a very high degree of independence. Meanwhile, postdoc supervisors voiced higher expectations towards postdocs, and said their role was to minimally advise and support in the necessary matters, such as the tandem programme or teaching:

And with a post-doc, it's of course quite different. There, we are totally on the same level. In my view, she is already fully qualified for a professorship. It's more than I act like a kind of mentor, giving her advice on what might be helpful on the path to a professorship. Right? And I also try to encourage her more to independently develop her own profile. (D2-3)

This section has outlined the diversity and complexity of supervisors' roles. The following section shifts focus to the perceived benefits and costs experienced by supervisors and participants within the tandem programme.

3.2 Benefits and costs

Perceptions of benefits and challenges varied considerably among supervisors. One industry supervisor, for example, said he did not see any particular benefits or downsides of the tandem programme, although he would have preferred to have all of the participant's time:

Yes, as I said, everything is going well. (laughs) But of course, I'm comparing it to a regular employee who works with us one hundred percent. And, as I said, I can't identify any disadvantages. So everything is going well, yes. Of course, I also can't identify any advantages; that's clear as well. Naturally, I wouldn't mind if he were employed by us as a regular full-time employee. But we just couldn't make that happen, yes. But I'd say it's a compromise that everyone can live with. (I2P-29)

By contrast, another industry supervisor identified a wide range of benefits across different areas, enough to "fill an A4 page":

An enrichment for the team. Not just for me personally, but the candidate works in product management or is anchored there. Of course, he also gains a lot of insight and enriches the team through small trainings, software implementation, or data platforms that were previously not accessible to us. So there is enrichment within the respective adjacent department but also beyond that: towards sales, data processing, etc. There are many areas. I believe I could easily fill an entire A4 page with points of intersection and added value. (O2P-27)

These two viewpoints illustrate the strongly contrasting perspectives present in the sample, with other answers falling into the spectrum between the two. Most supervisors, however, recognised the value and certain benefits of the programme.

Figure 2 presents a visualisation of the benefits for all stakeholders as reported by supervisors, and is based on the Social Exchange Theory, reflecting what each stakeholder brings to and gains from the collaboration. The benefits gained by the industry supervisor extend to the entire company, just as the academic supervisor's benefits contribute to the university as a whole.

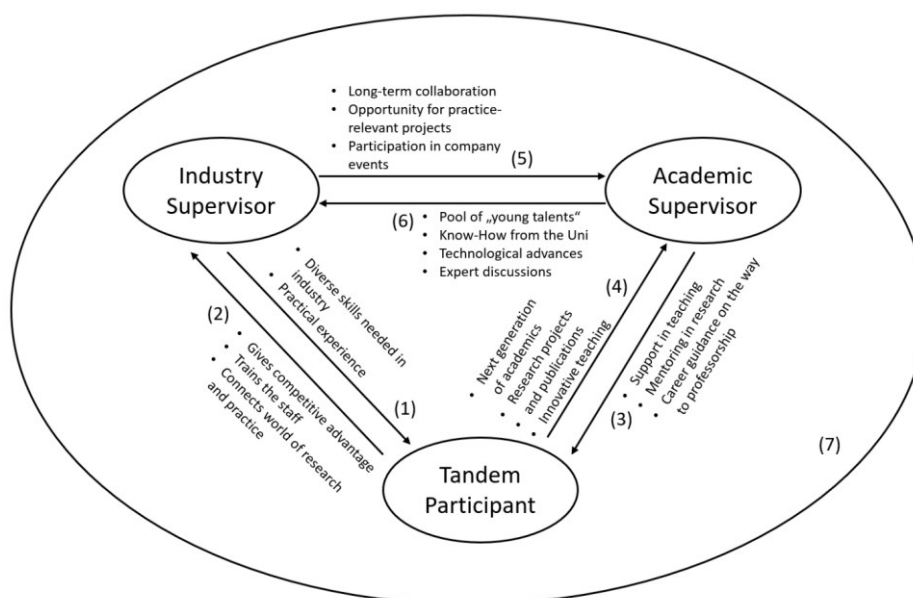


Figure 2. Benefits of tandem programme by supervisors

(1) The industry supervisor provides access to the industry work environment, projects, networks, and resources. This enables the tandem participant to apply research-oriented thinking to problems within the specific context. It was reported that participants learn a diverse set of skills needed in each line of work. Depending on their expertise, some participants supported improvements in teaching approaches.

(2) The tandem participant makes a meaningful contribution to the company. As mentioned by the industry supervisors, by connecting the “two worlds” of industry and academia, the tandem participant provides a competitive advantage to the company. This often happens through activities such as teaching staff members data analysis or the use of software tools, as well as through applied research.

(3) Academic supervisor supports the participant in various ways, including mentoring on good scientific practice and assisting with publication writing. Some supervisors also provide advice on teaching methods and pedagogical approaches, contributing to the participant's professional development beyond research skills. In addition, many of the academic supervisors provided career guidance, especially for postdocs on the way to professorship.

(4) The benefits that tandem participants offer academic supervisors vary depending on the individual case. For some, having a tandem participant “saved that research direction” in their institute; for others, the participant “brought innovative pedagogical approaches.” Many mentioned the benefit of participants acting as a connecting link between industry and research. Overall, tandem participants contribute to the next generation of academics through practice-based research projects, publications, and teachings.

(5) Industry supervisor serves as a long-term collaboration partner for the academic supervisor, which is particularly important, especially at universities of applied sciences. This partnership establishes sustainable cooperation that strengthens both academic programmes and industry innovation. In certain cases, such benefits as being invited and participating in company events and workshops were seen as valuable benefits.

(6) Thanks to the academic supervisor or tandem employee themselves, the company (supervisor) gains access to a “pool of young talents,” a benefit consistently mentioned by all industry supervisors. This pool includes not only tandem participants but also interns, master’s and bachelor’s students with thesis projects. Furthermore, industry supervisors have reported engaging in discussions with professors beyond the tandem programme: discussions about potential future research directions and valuable exchanges of perspectives due to their overlapping fields of expertise. Some also benefit from technological advances and tools developed at the university, which further support their practice.

(7) If we consider interactions among all three stakeholders: industry supervisor, academic supervisor, and tandem participant, synergies emerge that surpass dyadic relationships. This triadic collaboration creates a system where academic knowledge, practical expertise, and individual career development converge. The results may include enriched learning environments, co-created knowledge, and a robust partnership benefiting the university, industry, and participants alike. Both academic and industry supervisors mentioned the synergy effects:

So these synergies from both worlds - I wasn't really aware before of how much impact they could have. I think this could be highlighted well for future projects. Or maybe prepare some best practices and show what this has actually brought overall. If I were to spend two or three hours on it, I think a pretty extensive mind map would come out of it, outlining what we have implemented in these two years, actually two and a half years. That's quite a lot. (O2P-105)

After outlining the benefits, we now turn to the costs associated with the tandem collaboration.

Industry supervisors identified several challenges, including uncertainty about the tandem participant’s future career path (whether they would remain in academia or fully transition to industry), which complicated planning and commitment. Practical issues, such as long commutes between cities, added logistical burdens. The “special conditions” applied to tandem participants sometimes caused envy among colleagues. Additionally, unforeseen needs, such as IT support that delayed project initiation, highlighted the importance of planning adequate infrastructure from the start. Another common concern was that supervisors did not have exclusive access to the participant’s time, requiring them to “share” and negotiate competing demands.

Academic supervisors described a different set of challenges related to the unique dual role of tandem participants. Many noted that participants often prioritised company tasks over research, making it difficult to maintain academic progress. The dual focus placed extra demands on participants, who faced more complexity than regular PhD students or postdocs. Conflicts were seen as unavoidable when balancing company deadlines, publication pressures, and multiple responsibilities. Some academic supervisors felt they lost a degree of control over the research project because of the company’s involvement. There was also concern about participants overworking to meet expectations in both settings. For postdocs, especially, limited university time, sometimes described as a homeopathic dose, hindered their ability to make substantial progress or reach key milestones.

The main cost mentioned by both industrial and university supervisors was having to “share” the participants’ time. Several industry and academic supervisors shared the perspective that they seemingly “lose” the time of the participant while the other stakeholder gets it, and they have to compromise. However, another common perspective was that it is a win-win situation, from which synergies between academia and industry arise. In some cases, uncertainty about the future career choice of the participant was also a common cost. In other constellations, however, there already existed an agreement on future employment plans.

As seen from this section, the perceived benefits and costs varied greatly, forming a wide spectrum of options. In a similar manner, the collaboration efforts were also different in each constellation, which is discussed in detail in the following section.

3.3 Collaboration

Tandem participation provided a core structure: a doctoral researcher or a postdoc is simultaneously employed and supervised at TH Köln and at the partner organisation. Additionally,

the agreements outlined the roles, expectations, and suggested structure. Nevertheless, how each trio collaborated in practice varied. Through the interviews with both industry and academic supervisors, we observed that the following aspects were of importance when it comes to collaboration: structure, mode of work, flexibility, emotional climate, and stakeholder interaction. Table 1 summarises the findings, underlining these main aspects, the corresponding practices within each aspect, and sample quotes from the supervisors.

Table 1. Collaboration practices in the tandem programme

<i>Aspect</i>	<i>Practices</i>	<i>Quote</i>
Structure (or lack thereof)	- Well-organised interactions - Set goals and milestones - Regular meetings and status updates vs. no regular meetings - Emails with next steps, meeting details	It's about communication, without any competition or power struggles over who works where and when. Instead, we've agreed on a solid approach. The focus is on communication, collaboration, and ongoing development within the project itself. This happens through breaking down the work into milestones and goals, asking, "Okay, what would we like to achieve by this date?" (O2P-37)
Mode of Work	- In-person meetings - Hybrid format with on-site meetings every 2-4 weeks - Weekly meetings	He actually works most of the time from home in [Place]... He simply records the hours he's worked... Every two weeks, he comes here for two days. Then we have general meetings. Although it's not always exactly every two weeks, sometimes it's every three or four weeks. It really depends on current needs. (I2P-27)
Flexibility (or lack thereof)	- Company – allows time for teaching and publishing vs. requires more time - University – allows time for urgent company matters vs. expects more input	From what I understand, as a company, we have the opportunity to really emphasise personal responsibility and use flexibility in how we shape things. For example, if a new research area emerges at the TH, and we think, "Okay, just go for it — this is interesting," we're open to allowing or enabling that, even if it doesn't directly fit within our usual business scope. It's a kind of risk management approach. I believe the TH must be a bit more structured and stricter because of its organisational setup and its responsibilities, like ensuring teaching requirements are met. So, it probably can't be as flexible as we are. (F2P-59)
Emotional Climate (if mentioned)	- Appreciative - Commitment - Soft skills - Joy in working and collaborating	It's going really well. Nothing to complain about because there's mutual understanding and genuine interest. She also actively said yes and didn't have to do it. I don't know how it works with other tandems or trios, but I believe that commitment is really important for things to continue working well afterward, right? (O2P-99)
Stakeholders Interactions	- Industry supervisor with tandem participant - Industry supervisor with academic supervisor	Exactly, we have regular meetings. Yes, exactly. Both I and the candidate and the three of us together. And the professor also has regular meetings with the candidate because he is really on site fifty-fifty. (O2P-39)

Table 1. Collaboration practices in the tandem programme (continued)

Aspect	Practices	Quote
Stakeholders Interactions	- Academic supervisor with tandem participant - All 3 stakeholders together	So, as a major project, he has a [project], and other [topic areas], where the colleague from the university serves as a sparring partner. So, I can also bring up questions or topics where I think I need a bit of input or a fresh pair of eyes to take a look and give feedback from her experience and expertise. (O2P-67)

The analysis showed a range of experiences regarding the structure and organisation of the interactions. Some trios created a clear structure, including goals, milestones, and regular update meetings supported by follow-up emails. However, some other groups lacked the structure. Most groups had recurring meetings, but not necessarily a common vision. It is evident from the stakeholder interaction aspect that some of the trios were only linked by the tandem participant. As such, an industry supervisor would have meetings with the participant to discuss the matters of the company, and an academic supervisor would meet with the participant on research matters. However, the closer collaboration and mutual benefit for research and practice seemed to be lower in such trios. In other instances, all three stakeholders met together to keep up with research updates that were relevant for the company and to find other common ground, such as sharing knowledge on the best tools or advanced technology in the field. Furthermore, some supervisors met separately without involving the participant. In this case, an industry supervisor reported that the meetings with the professor were fruitful beyond themes that concerned the participant, but rather as an exchange of experts.

Modes of work varied widely as well. Some teams met regularly in person, while others followed a hybrid approach, with on-site meetings every few weeks combined with remote interactions. Weekly meetings were common in some cases, but others had less frequent or irregular contact. Especially in cases of postdocs, the reported frequency of meetings with academic supervisor was considerably low. Alongside these differences in working modes, the emotional climate during collaboration also varied. While some participants did not mention the emotional aspect explicitly, others emphasised its importance, noting that soft skills, mutual appreciation, commitment, and enjoying the work together were key to positive and productive relationships.

Flexibility was essential for balancing responsibilities between industry and academia, and supervisors approached it in different ways. Many expressed a perspective that they had to share the participant's time, while preferring full availability. Some supervisors were more understanding, intentionally allowing space for the participant's commitments in the other setting. Some adopted a "live and let live" attitude, with the company and academic sides operating independently. Meanwhile, other supervisors viewed themselves as facilitators who actively supported participants in both environments and ensured collaboration between the two.

Collaboration was shaped by varying degrees of structure, flexible working arrangements, differing emotional climates, and diverse stakeholder interaction patterns. These factors collectively influenced how smoothly and effectively the participants worked together.

4 Discussion

4.1 Perceived roles

In our analysis, we observed that the roles largely correspond to the ones described in prior research. Roles such as supervisor, advisor, mentor, and guide were among the main functions of a supervisor outlined by a large international study (Guarimata-Salinas et al., 2024). Another specific example, facilitator (German: Ermöglicher), corresponds to the role of guide in self-realisation processes (Reis & Szczyrba, 2011), or "pastoral" supervisor (Deuchar, 2008). In our sample, such a "facilitator" reported to have the best interests of the participant at heart, providing him with the opportunity to fulfil his professional goals in both the academy and industry. The perceived roles

differed as to the degree of involvement of the supervisor. While some supervisors reported that they see themselves as caretakers, others as guides and advisors supporting with expert recommendations, yet others portrayed the earlier described laissez-faire style (Deuchar, 2008), defined by letting the participant work independently. What stood out in our analysis was the role of collaborator or sparring partner. The prior literature focuses rather on the hierarchical relationship between supervisor and the individual, whereas several supervisors in the sample spoke about an equal partner exchange, be it with a postdoc or a doctoral student.

In reviewing the literature and interview data, the roles of supervisors can generally be categorised into three key aspects: (1) introducing participants to foundational knowledge, essential procedures, and practical skills required for their research or work (encompassing the roles of supervisor and advisor); (2) providing ongoing support and guidance to facilitate individual career development (including the roles of mentor, coach, and facilitator); and (3) ensuring the quality and integrity of work outcomes (reflecting the roles of supervisor, boss, and leader).

As discussed in the theoretical framework, the Sapir-Whorf hypothesis suggests that the way individuals perceive and conceptualise roles influences their behaviour and actions. Applied to supervisors, this means that their understanding of their role shapes how they act in practice. Our data support this: supervisors describe their roles in markedly different ways, which correspond to variations in their attitudes and behaviours. For example, one supervisor stated that they see no role for themselves in relation to the tandem programme and therefore do not engage with the participant on this matter. In contrast, another supervisor identified multiple roles (such as boss, coach, and sparring partner) and established a structured approach involving regular meetings, status updates, and thorough discussions. Others viewed themselves primarily as advisors focusing on technical and pedagogical support, and accordingly, their communication and interactions revolve around these aspects. This variability illustrates how role perception directly informs supervisory behaviour and interaction patterns.

The findings of this study reveal that, although the role of a supervisor encompasses a diverse range of functions (such as to guide the skill development, to mentor regarding career path, to supervise the quality of work), supervisors themselves rarely perceive their role as encompassing this full spectrum. Rather, most participants described their supervisory role in more limited terms, identifying primarily with one or two functions, such as acting solely as an advisor or a guide, or providing minimal support while promoting independent work. Only a few supervisors reported integrating multiple roles. This observation points to a broader systemic issue: the absence of a clearly defined, shared understanding or standardised benchmarks for supervision. Without such common frameworks, the nature and quality of supervision largely depend on individual supervisors' experience, engagement, and commitment to fostering early-career researchers. This variability affects doctoral students, post-doctoral scholars, and workplace supervisees alike. Addressing this challenge calls for the establishment of formal quality standards and a consensual conception of supervisory roles that can be adapted to different career stages. Given the distinct needs of doctoral and post-doctoral researchers, differentiated expectations and guidelines are warranted. This has already led to a large number of guidelines and charters for both postdoctoral and doctoral supervisors. Supervision agreements were dutifully signed by all supervisors in the tandem programme and are also essential as a first step towards quality assurance. However, like guidelines, they do not encourage reflection on one's own role and leave room for individual interpretation (Confirmation bias). Their utility is also limited if supervisors lack the time or motivation to engage with them fully. Therefore, workshops and supervisor networking meetings are recommended as particularly effective and feasible strategies to promote continuous development and shared understanding of supervisory roles.

Current approaches to enhancing supervisory practice, such as workshops (Reis & Szczyrba, 2011), signing agreements, and having regular support meetings as used in the tandem programme, offer promising avenues for ongoing professional development. These formats facilitate reflection, peer learning, and practical skill-building in a manner that is more accessible and goes deeper than comprehensive handbooks or guidelines. While our study does not prescribe the exact content of such interventions, future research should focus on tailoring these initiatives based on empirical findings and existing literature.

In sum, enhancing supervision requires the articulation of clear role definitions and quality benchmarks, alongside the provision of accessible, ongoing support and training opportunities for supervisors.

4.2 Benefits and costs

Our findings suggest a possible pattern between perceived benefits and the perceived value of the tandem programme among supervisors. For instance, supervisors who reported minimal or no value from the programme often described their role as limited and viewed the arrangement more as an uncomfortable compromise than a mutually beneficial collaboration. One such supervisor expressed a preference for having 100% of the participant's time, seeing the tandem setup as a constraint rather than an asset. On the other hand, an industry supervisor highlighted substantial value in the programme: not only in supporting the participant but also in fostering expert exchanges with the academic partner. This supervisor valued gaining access to university know-how, technical advances, and tools, as well as opportunities for the tandem participant to train company staff. Academic supervisors' views also varied: some felt the company's involvement dominated, leaving little room for research. While others emphasised the long-term partnerships developed through the programme, which even allowed their research direction to keep existing. A third group gave mildly positive evaluations, recognising some benefits but remaining relatively uninvolved with the other supervisor, limiting interaction to the participant serving as the sole link between academia and industry. These perspectives point to a pattern where supervisors' perceived value and benefits from the tandem programme appear connected to the extent of their engagement and the quality of tandem interactions.

According to Social Exchange Theory, the relationships endure when perceived benefits outweigh such costs, resulting in a positive profit for all stakeholders involved. Recognising and addressing these challenges is essential to minimising costs and maximising benefits.

The described costs could be minimised in the following way. First, the potential benefits of the programme, visualised in Figure 2, may be brought to the attention of all the stakeholders in a structured way. According to SET, the quality of interaction and collaboration improves when the perceived value of exchange is high. In other words, all participants need to be on the same page about the mutual benefits and synergies they may get out of the collaboration. Second, some supervisors mentioned it would be easier with having clearer roles and expectations:

I would prefer if the roles were more clearly defined. If this dual function didn't exist. That is actually the main problem. I would actually prefer if it were clear that we are doing something together. (A2-107)

Within the tandem project, the supervision agreements were signed later on in the project as a response measure, in order to bring more clarity to the roles and expectations. Another way of minimising that cost was organizing meetings between supervisors and supervisor workshops. Third, although essential settings and equipment were in place for the tandem participants, one of the suggestions on minimising costs was to meticulously plan the infrastructure needed for the participant in advance (i.e., what technology, software, tools, and resources are needed for the success of the project):

At the beginning, we realised we needed to set up an internal database or have the right connection and computing power. This was a challenge because IT wasn't really on our radar from the start. That's why we couldn't get going as quickly as we would have liked. However, this was resolved fairly quickly. I think for future tandem projects, it's important to keep this in mind: to consider what kind of infrastructure the candidate will need and what the project goals are. (O2P)

Given that such practice-research partnerships maximise the benefits and minimise costs, they may, as some of the tandem programme stakeholders, experience the synergies between the industry and academia.

4.3 Collaboration

Collaboration in the trios varied considerably in our sample. Supervisors differed in how flexibly they engaged with participants, how regularly they met, and how structured their joint processes were. When we consider these patterns together, several elements emerge that appear to support more effective collaboration. First, supervisors emphasised the importance of clearly articulated expectations and a transparent structure, including defined goals, milestones, and meeting routines. Second, collaborative relationships benefitted from a degree of mutual flexibility and a shared understanding of the demands on both sides (i.e. “sharing” the participant’s time), which enabled compromise. Third, a positive interpersonal climate, characterised by appreciation, soft skills, and genuine commitment, seemed to be of importance for better collaboration.

Interpreted through the lens of Social Exchange Theory, these elements reflect conditions that foster a “productive exchange” (Emerson, 1975, p.357). Productive exchange occurs when multiple actors work together to create a combined outcome that is more valuable than the sum of their individual contributions. Although not used by SET theoreticians, this concept is very close to the notion of synergy, also mentioned by tandem supervisors. Productive exchange seemed to take place when supervisors perceived tangible value in the tandem arrangement. Both industry and academic supervisors saw significant value in the collaboration. Industry supervisors appreciated benefits such as gaining a competitive advantage by supporting each other, having participants teach company staff, and utilising university tools. Meanwhile, academic supervisors valued the long-term partnerships with companies, opportunities to participate in company events and workshops, and being part of a meaningful synergy between practice and research. We noticed that supervisors who mentioned many benefits of the tandem employment, that is, had a high perceived value of it, also reported having a high-quality collaboration characterised by clear structure, flexibility, and a positive emotional climate.

4.4 Limitations

This study has several limitations to consider when interpreting the findings. First, the sample was somewhat unbalanced, including only 6 participants from partner organisations compared to 14 supervisors from TH Köln. This uneven distribution may have influenced the range and depth of perspectives represented, particularly from the side of the partner organisation, potentially limiting the generalisability across the groups. Second, the analysis did not explore differences related to gender or participants’ areas of expertise. As a result, any variations in perceptions along these lines remain unexamined. Third, the relatively small sample size, typical of qualitative interview studies, limits the extent to which the findings can be generalised beyond the specific context of this study. Finally, the study exclusively focused on supervisors’ perspectives and did not include other stakeholders such as trainees or organisational leaders, which may offer additional insights into the collaboration process. Future research could address these limitations by including a larger and more balanced sample, integrating demographic and professional variables into the analysis, and broadening the stakeholder groups interviewed.

5 Conclusion

This study aimed to investigate the perceived roles of academic and industrial supervisors, analyse the perceived benefits and costs of the tandem programme, and explore the collaboration among the stakeholders. Applying Social Exchange Theory (SET) provided valuable insight into how perceived value influences the quality of such collaborative endeavors.

Our findings show that, in optimal conditions, all stakeholders benefit significantly, creating a synergistic “win-win-win” scenario. Participants gain the unique opportunity to pursue both academic and industrial workplace pathways, enriching their learning experience through guidance from both supervisors. Industry supervisors acquire cutting-edge knowledge, tools, and a fresh research perspective that contributes directly to company innovation. Meanwhile, academic supervisors and universities deepen their impact by engaging in meaningful, long-term partnerships that ground research in practical relevance.

Looking towards the 2030 goals, the insights gained here support the development of more effective frameworks for bridging academia and industry. By fostering these tandem collaborations, we not only advance individual and organisational growth but also contribute to sustainable practice-research ecosystems. Encouraging such cross-sector partnerships aligns with global sustainable goals.

In summary, by capturing supervisors' insights, this research brings attention to the critical question of supervision quality and its continuous improvement. It also lays the groundwork for understanding potential benefits and best practices in collaboration, which can guide the development of more effective and impactful tandem programs in the future.

Acknowledgement

The project is funded through Federal Ministry of Research, Technology and Space (BMFTR) and the Joint Science Conference (GWK) (Funding reference number 03FP09).

References

- Blau, P. (1986). *Exchange and Power in Social Life* (2nd ed.). Routledge. <https://doi.org/10.4324/9780203792643>
- Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. Carnegie Foundation for the Advancement of Teaching. Retrieved from: <https://www.umces.edu/sites/default/files/al/pdfs/BoyerScholarshipReconsidered.pdf>
- Deuchar, R. (2008). Facilitator, director or critical friend?: contradiction and congruence in doctoral supervision styles. *Teaching in Higher Education*, 13(4), 489–500. <https://doi.org/10.1080/13562510802193905>
- Emerson, R. M. (1976). Social exchange theory. *Annual Review of Sociology*, 2, 335–362. <https://doi.org/10.1146/annurev.so.02.080176.002003>
- Fan, L., Mahmood, M., & Uddin, M. A. (2019). Supportive Chinese supervisor, innovative international students: A social exchange theory perspective. *Asia Pacific Education Review*, 20(1), 101–115. <https://doi.org/10.1007/s12564-018-9572-3>
- Fleming, J., Rowe, A. D., & Jackson, D. (2021). Employers as educators: The role of work placement supervisors in facilitating the transfer of skills and knowledge. *Journal of Education and Work*, 34(5-6), 705–721. <https://doi.org/10.1080/13639080.2021.1969343>
- Guarimata-Salinas, G., Carvajal, J. J., & Jimenez Lopez, M. D. (2024). Redefining the role of doctoral supervisors: A multicultural examination of labels and functions in contemporary doctoral education. *Higher Education*, 88(4), 1305–1330. <https://doi.org/10.1007/s10734-023-01171-0>
- Hausstein, A., Held, T., & Kaiser, S. (2022). Wissenschaft fuer eine grosse Transformation. Herausforderungen auf dem Weg zum transformativen Institut. [Science for a great transformation: Challenges on the way to a transformative institute] (TRANSFORM Discussion Paper No. 01). Karlsruhe Institute of Technology (KIT), Institute for Technology Futures. <https://doi.org/10.5445/IR/1000148758>
- Herawati, H., Setyadi, D., Michael, M., & Hidayati, T. (2023). The effect of workload, supervisor, and coworker supports on job performance through job satisfaction. *International Journal of Finance, Economics and Business*, 2(1), 13–33. <https://doi.org/10.56225/ijfeb.v2i1.168>
- Homans, G. C. (1958). Social behavior as exchange. *American Journal of Sociology*, 63, 597–606. <https://doi.org/10.1086/222355>
- In der Smitten, S., Sembritzki, T. & Thiele, L. (2017). *Bewerberlage bei Fachhochschulprofessuren - Unzureichend strukturierte Karrierewege erschweren die Stellenbesetzung*. [Applicant situation for university of applied sciences professorships: Insufficiently structured career paths hinder the filling of positions] (DZHW Brief No. 1/2017). Deutsches Zentrum für Hochschul- und Wissenschaftsforschung (DZHW). https://www.dzhw.eu/publikationen/pub_show?pub_id=5049&pub_type=kbr
- Jaksztat, S., Neugebauer, M., & Brandt, G. (2021). Back out or hang on? An event history analysis of withdrawal from doctoral education in Germany. *Higher Education*, 82(5), 937–958.
- Karalis Noel, T., Miles, M. L., & Rida, P. (2022). Using social exchange theory to examine minoritized STEM postdocs' experiences with faculty mentoring relationships. *Studies in Graduate and Postdoctoral Education*, 13(1), 90–108. <https://doi.org/10.1108/SGPE-12-2020-0080>
- Klimuk, V., Tarasova, A., Yulia, K., & Laura, D. (2020). Synergistic interaction of education, science, and industry. *Leadership, Education, Personality: An Interdisciplinary Journal*, 2(1), 53–58. <https://doi.org/10.1365/s42681-020-00009-y>
- Kunz, A., Vries, S., & Siegrist, J. (2021). Work and mental health of early career researchers: The role of the psychosocial work environment. *International Archives of Occupational and Environmental Health*, 94(8), 1885–1895.
- Mainhard, T., Van Der Rijst, R., Van Tartwijk, J. & Wubbels, T. (2009). A model for the supervisor–doctoral student relationship. *Higher Education*, 58, 359–373. <https://doi.org/10.1007/s10734-009-9199-8>
- Mayring, P. (2008). *Qualitative Inhaltsanalyse: Grundlagen und Techniken* (10., überarb. Aufl.). Beltz Verlag.

- Mohr, C. D., Hammer, L. B., Brady, J. M., Perry, M. L., & Bodner, T. (2021). Can supervisor support improve daily employee well-being? Evidence of supervisor training effectiveness in a study of veteran employee emotions. *Journal of Occupational and Organizational Psychology*, 94(2), 400-426. <https://doi.org/10.1111/joop.12342>
- Motshoane, P., & McKenna, S. (2021). Crossing the border from candidate to supervisor: The need for appropriate development. *Teaching in Higher Education*, 26(3), 387-403. <https://doi.org/10.1080/13562517.2021.1900814>
- Müller-Otto, S., & Szczyrba, B. (2025). Transformative Wissenschaft als Beruf. [Transformative scholarship as a profession] *Sozialmagazin*, 2, 57–65. Retrieved from: <https://content-select.com/de/portal/media/view/423dfd5f-9a31-4e0e-9c4e-81cdfa7fe284>
- Reis, O., & Szczyrba, B. (2011). Beraten und Beratenwerden in der Doktorandenbetreuung. Rollengestützte Forschung und Weiterbildung zur wissenschaftlichen Nachwuchsfoerderung. [Advising and Being Advised in Doctoral Supervision: Role-Based Research and Training for the Promotion of Early-Career Scholars] *Zeitschrift für Psychodrama und Soziometrie*, 10(1), 81-98. <https://doi.org/10.1007/s11620-010-0092-3>
- Ringo, D. S. (2025). When relationships make a difference! Supervisor support and PhD students' academic performance in the journey: the moderating effect of supervisor-student relationship quality. *Cogent Education*, 12(1), 2479403. <https://doi.org/10.1080/2331186X.2025.2479403>
- Skopek, J., Triventi, M., & Blossfeld, H. P. (2022). How do institutional factors shape PhD completion rates? An analysis of long-term changes in a European doctoral program. *Studies in Higher Education*, 47(2), 318-337.
- Szczyrba, B., Varney, V., & Heuchemer, S. (2025). "Transformative scholarship" – Teaching, research, and transfer as elements of integrated scientific practice. *Neues Handbuch Hochschullehre*, 122. <https://doi.org/10.25162/NHHL-2025-0012>
- Taylor, S., & Kiley, M. (2024). *A Handbook for Doctoral Supervisors* (3rd ed.). Routledge. <https://doi.org/10.4324/9781003432159>
- United Nations General Assembly. (2015). *Resolution A/RES/70/1: Transforming our world: The 2030 agenda for sustainable development*. <https://undocs.org/A/RES/70/1>
- Wollast, R., Aelenei, C., Chevalère, J., Van der Linden, N., Galand, B., Azzi, A., Frenay, M. & Klein, O. (2023). Facing the dropout crisis among PhD candidates: the role of supervisor support in emotional well-being and intended doctoral persistence among men and women. *Studies in Higher Education*, 48(6), 813–828. <https://doi.org/10.1080/03075079.2023.2172151>
- Zeb, A., Goh, G. G. G., Javaid, M., Khan, M. N., Khan, A. U., & Gul, S. (2023). The interplay between supervisor support and job performance: Implications of social exchange and social learning theories. *Journal of Applied Research in Higher Education*, 15(2), 429-448. <https://doi.org/10.1108/JARHE-04-2021-0143>

Appendix A - Interview guide for supervisor interview, tandem programme

1. Roles

- How would you describe your role in relation to the tandem participant and why?
- What role does the industrial supervisor/ academic supervisor* play in the supervision and support of the tandem employee?

2. Benefits and costs

- What added value does the tandem employment model have in your view for you personally? What do you think has gone well in your tandem constellation so far? Follow-up: What do you think has led to these positive experiences or results?
- What challenges do you see in your tandem constellation so far? Please also consider tandem employment in general, the collaboration with the industrial supervisor, the integration of the tandem employee into research and teaching, and the integration of the areas of research, teaching, and practice.
- How do you deal with these challenges?

3. Collaboration

- How do you perceive the cooperation or collaboration between you, the industrial supervisor/ academic supervisor, and the tandem employee?
Follow-up: Can you tell us how and how often communication or exchange between you and the industrial supervisor/ academic supervisor is organized?
Follow-up: What content-related overlaps do you have with the supervision of the industrial supervisor / academic supervisor?

* For the sake of space, we combined two interview guides: one for industrial supervisors and one for academic supervisors, into a single document. Whenever a question refers to the role or collaboration with the "other" supervisor, this is reflected as follows: if the question is posed to industrial supervisors, the question mentions academic supervisors, and vice versa.

Follow-up: Do you perceive different interests between you and the industrial supervisor/ academic supervisor? If yes, how do you handle these different interests Follow-up: Where do you see similarities and differences regarding the understanding of science between you and the industrial supervisor/ academic supervisor? What effects does this have on your collaboration?

- How do you deal with any discrepancies?
Follow-up: Which other aspects do you find helpful in working with the industrial supervisor/ academic supervisor? Which do you find rather disturbing?
- How would you describe an ideal state of collaboration with the industrial supervisor/ academic supervisor? Please also consider the supervision of the tandem employees.

THE THIRD LEARNING SPACE IN DUAL HIGHER EDUCATION: A SYSTEMATIC REVIEW

Ulf-Daniel Ehlers ^{1*}, Gerhard Götz ¹, Myriam Hamich ¹, Martin Lachmair ¹ and Doris Ternes ¹

¹Baden-Wuerttemberg Cooperative State University (DHBW), Germany

Keywords:

Third learning space
Dual higher education
Theory-practice integration
Learning place cooperation
Boundary crossing

Article history:

Received: 24 March 2026

Revised: 15 May 2026

Accepted: 19 May 2026

To cite this article:

Ehlers, U.-D., Götz, G., Hamich, M., Lachmair, M. & Ternes, D. (2026). The Third Learning Space in Dual Higher Education: A Systematic Review. European Scientific Journal for Dual Higher Education (ESJ DHE), 2 (3), 47-65. <https://doi.org/10.82321/07ma-34m612>

Abstract

Dual higher education seeks to integrate academic learning with workplace-based experience; however, research has consistently reported persistent structural, curricular, and didactic discontinuities between higher education institutions and workplace learning environments. These challenges are frequently described as weaknesses in learning place cooperation rather than as a lack of genuine pedagogical integration. In response, the notion of a third learning space (Dritter Lernort) has emerged as a promising but under-theorised approach for moving beyond dyadic university-workplace models. This article presents a conceptually guided systematic literature review that synthesises research on third learning spaces relevant to dual higher education. Structured searches across international and German-language databases, supplemented by repository searches and citation chaining, yielded a documented corpus of $n = 74$ publications covering the period 2000-2026, of which $n = 71$ were included in the conceptual analysis and $n = 3$ served as methodological references for the review design. Inclusion was based on conceptual relevance rather than terminology alone and captured adjacent strands such as learning place cooperation, boundary crossing and boundary spaces, and work-integrated learning (WIL). An iterative coding and synthesis procedure mapped the literature in terms of educational sectors, disciplinary perspectives, functions, modalities, learner roles, and curricular integration. Across the strands reviewed, the third learning space emerges as a functional, learner-centred intermediary that supports theory-practice integration through reflection, competence development, standardisation, and innovation, often in hybrid learning arrangements. Building on this synthesis, the article proposes an integrative zonal model and discusses its implications for curriculum design, assessment, and future research in dual higher education.

* Corresponding author

E-mail address: ulf-daniel.ehlers@dhbw-karlsruhe.de

1 Introduction

Dual higher education has become one of the most visible and dynamic formats for linking higher education and professional practice. Particularly in Germany, but increasingly also in other international contexts, dual study programmes are regarded as an attractive response to demands for employability, relevance, labour-market orientation, and closer cooperation between higher education institutions and professional fields (Wissenschaftsrat, 2013; Nickel et al., 2022). The promise of these programmes is compelling: by systematically combining academic learning with workplace-based experience, students are expected to acquire disciplinary knowledge, apply it in authentic contexts, and develop professional competences in ways that neither higher education institutions nor workplaces could achieve alone.

However, this promise of integration has long been accompanied by critical debate. Research has consistently shown that the coexistence of academic and practical learning phases does not automatically result in meaningful theory-practice integration. Instead, many dual programmes are characterised by parallel structures, loosely coordinated expectations, and discontinuities in content, pedagogy, timing, and assessment. In this regard, the central problem is not only that universities and practice partners do not cooperate sufficiently, but also that the relationship between the two contexts often remains organisational rather than genuinely educational. Learners are expected to move between these two worlds, yet the connective pedagogical structures that would enable them to integrate their experiences are frequently weak or missing (Langfeldt, 2018; Gerstung & Deuer, 2021a).

This challenge has often been discussed in German-speaking literature under the heading of *Lernortkooperation*, that is, cooperation between learning places. While this discourse has generated important insights into governance, coordination, and curricular alignment, it tends to focus on the relationship between institutions rather than on the learning processes through which students construct coherence across contexts. As a result, the question of how integration occurs at the level of learners remains comparatively underdeveloped. The recurring observation that theory and practice often remain insufficiently connected suggests that dual higher education needs a more nuanced conceptual vocabulary to describe intermediary learning arrangements.

This is where the notion of a **third learning space** becomes relevant. The concept points to learning environments, practices, and arrangements that are reducible neither to the higher education institution nor to the workplace, but that mediate, connect, and transform experiences from both. In German-speaking vocational education and training (VET) research, the idea of a *Dritter Lernort* has mainly referred to supplementary institutional settings such as inter-company training centres within the dual VET system (Dehnbostel, 2002, 2017; Landwehr, 2002). These settings fulfil compensatory and standardising functions, especially where companies cannot provide the full range of learning opportunities required for occupational development. When applied to dual higher education, however, the concept becomes more complex. Here, the third learning space is rarely established as a fixed third institution. Instead, it appears in fragmented and often implicit ways: in integrative project formats, reflective seminars, hybrid digital learning environments, cross-sectoral collaborations, or pedagogical arrangements that help students relate academic learning to professional learning.

Internationally, related ideas are discussed under a variety of labels. Work-integrated learning (WIL) research has long emphasised the need for structured mediation between academic study and workplace experience (Billett, 2011; Jackson, 2015; Ferns et al., 2022; Zegwaard & Pretti, 2023). Boundary-crossing research analyses how learners navigate different social and epistemic worlds and how learning emerges in the spaces between them (Akkerman & Bakker, 2011). Third-space approaches in higher education describe hybrid environments in which academic and professional, formal and informal, institutional and participatory practices intersect (Whitchurch, 2008; Barnett, 2014). Although these strands of literature often address similar phenomena, they remain only loosely connected, and there is still no systematic synthesis that brings them together for the specific case of dual higher education.

This article addresses that gap. It argues that the concept of a third learning space offers a productive lens for rethinking theory-practice integration in dual higher education beyond binary institutional models. Rather than treating university and the workplace as two poles that are already

integrated, the article proceeds from the assumption that integration must be pedagogically supported, reflectively mediated, and actively constructed by learners. From this perspective, the third learning space becomes a conceptual tool for identifying and designing those intermediary arrangements through which learners connect heterogeneous experiences, develop professional judgement, and form coherent competences across contexts.

The article pursues three objectives. First, it clarifies and differentiates conceptualisations of the third learning space across disciplinary and educational contexts. Second, it synthesises research strands that are relevant to dual higher education, even where different terminology is used. Third, it derives an analytical framework that can support future empirical research and curriculum development, especially in the context of the Baden-Wuerttemberg Cooperative State University (DHBW). The DHBW is particularly suitable as a reference context because its institution-wide model of alternating academic and workplace learning across programmes makes it a paradigmatic case for analysing third learning spaces in higher education (Ternes & Schneckenburger, 2020). At the same time, the insights generated extend beyond this institutional setting and contribute to a broader theoretical advancement of dual higher education research.

2 Conceptual framework: The third learning space in dual higher education

In this article, the **third learning space** is understood as a cognitive, virtual, physical, and/or hybrid space in which learners actively integrate, reflect upon, reinterpret, and further develop competences acquired in academic and workplace contexts. Unlike the first learning space, represented by the higher education institution, and the second learning space, represented by the workplace or professional field, the third learning space is not primarily defined by a single institutional location. Its defining feature is instead its **integrative function**. It is the space in which discontinuous experiences are related to one another, where theory and practice become mutually interpretable, and where learners engage in reflective and boundary-crossing meaning-making.

This definition deliberately moves beyond a narrow institutional understanding. In vocational education, the third learning place has often been conceived as an additional organised setting that complements company and school-based learning, for example, through inter-company training centres. Such settings remain highly relevant as historical and conceptual reference points. Yet in dual higher education, the phenomenon appears in more differentiated forms. It may take the shape of reflective seminars, practice-linked research projects, digital platforms, mentoring structures, portfolios, cross-institutional workshops, communities of practice, innovation labs, or self-organised learning settings in which students connect their experiences across contexts. The third learning space therefore cannot be reduced to a “third place” in the literal sense; it is better understood as an **intermediary pedagogical arrangement** that may be materialised in multiple ways.

This broader conceptualisation is supported by several strands of literature. Research on learning place cooperation highlights that successful dual learning requires more than administrative coordination; it requires meaningful connections between learning goals, content, and responsibilities across settings (Dehnbostel, 2017; Langfeldt, 2018). Work-integrated learning research similarly argues that workplace experience becomes educationally valuable only when it is intentionally integrated into academic learning through reflection, supervision, and curricular design (Billett, 2011; Jackson, 2015). Boundary-crossing theory contributes the insight that learning occurs not only within practices but also at the boundaries between them, where learners encounter difference, tension, and a need for translation (Akkerman & Bakker, 2011). Third-space research in higher education adds a focus on hybridity, participation, identity formation, and the breakdown of conventional institutional divisions (Whitchurch, 2008; Barnett, 2014).

Taken together, these perspectives suggest that dual higher education should not be conceptualised merely as the alternation of two already coherent learning worlds. Rather, it involves learners moving between different epistemic cultures, organisational expectations, temporal rhythms, and assessment logics. Academic learning may privilege abstraction, disciplinary reasoning, and systematic inquiry, while workplace learning often emphasises situated action, tacit knowledge, productivity, and context-specific judgement. The relationship between these modes is not self-evident. Students must actively connect them, often under conditions of asymmetry and

tension. This is precisely where the third learning space becomes important: it names the space in which such connections are made possible, supported, and educationally deepened.

The concept also implies a specific understanding of learner agency. Integration is not something that institutions can simply provide as a finished product. As Dehnbostel (2017) and Nickel et al. (2022) indicate in different ways, learners themselves must participate actively in relating knowledge, reflecting on experience, and developing coherence across learning contexts. However, the emphasis on learner agency should not be misunderstood as transferring responsibility from institutions to individuals. Rather, the third learning space foregrounds the interplay between **institutional design and learner activity**. Students need support structures, pedagogical scaffolding, time for reflection, and tasks that invite translation across contexts. At the same time, such structures only become effective if learners use them as spaces for active mediation rather than passive reception.

In the context of a fully integrated dual higher education model such as the DHBW, this perspective can be operationalised through a **zonal understanding** of third learning spaces. Instead of assuming one uniform format, the third learning space may consist of multiple zones that differ in the degree to which they are curricularly structured, institutional anchoring, learner autonomy, and relation to practice. Some zones may be strongly supported by higher education institutions, such as reflective modules or theory–practice seminars. Others may emerge more strongly from workplace or project contexts, while still others are self-organised by learners themselves. What unites them is not their format but their integrative function: they create opportunities for learners to connect, reinterpret, and further develop experiences gained across heterogeneous contexts.

In this sense, the third learning space is best conceptualised as a **meta-level construct**. It is not simply another place added to an existing system, but an analytical and pedagogical perspective that helps to identify those conditions under which theory–practice integration becomes possible. It moves beyond linear ideas of transfer and instead emphasises mediation, reflection, and the active production of coherence. This makes the concept particularly relevant for dual higher education, where the educational challenge lies not merely in linking study and work administratively, but in enabling learners to build meaningful bridges between them.

3 Methodology: Conceptually guided systematic literature review

3.1 Review design

This study uses a **conceptually guided systematic literature review** (Booth et al., 2016) in order to synthesise a fragmented and terminologically heterogeneous body of research on intermediary learning arrangements between higher education and workplace contexts. The choice of design is grounded in the nature of the field itself. The notion of a third learning space is neither stable nor consistently used across educational sectors and disciplinary traditions. Relevant publications often discuss comparable phenomena under adjacent concepts such as learning place cooperation, boundary crossing, connectivity, work-integrated learning, practice-based learning, or hybrid learning spaces. A narrowly keyword-based review would therefore risk omitting precisely those contributions that are most important for understanding the concept in a broader analytical sense.

The review was thus designed to combine systematic search procedures with conceptual openness. Rather than searching only for exact occurrences of “third learning space” or “third learning place,” the study aimed to identify literature addressing functionally similar arrangements and theoretical problems. This approach makes it possible to reconstruct a broader discourse field and to compare perspectives that have often evolved in parallel. It also aligns with the aim of the article, which is not only to map terminology but to clarify the conceptual terrain relevant to dual higher education.

At the same time, the review retains systematic procedures. Search strategies, inclusion criteria, coding categories, and synthesis steps were explicitly defined. Database searches were complemented by citation chaining and targeted repository searches in order to ensure sufficient depth and conceptual saturation. The review therefore follows a logic of systematic comprehensiveness within a conceptually broadened scope.

3.2 Search space and inclusion criteria

The search space was defined along three dimensions in order to capture the breadth of relevant literature while maintaining a clear analytical focus.

First, the review covered different **educational sectors** in which the concept or related intermediary arrangements are discussed: vocational education and training (VET), dual higher education, higher education more broadly, and continuing education. This was important because the concept of a third learning place has strong roots in VET, while comparable integrative arrangements in higher education are often discussed using different terminology.

Second, the search addressed several **disciplinary perspectives**, including educational sciences, vocational education research, higher education research, workplace learning, organisational learning, and work-integrated learning research. This reflected the assumption that the problem of connecting theory and practice is not confined to a single field, but appears in different theoretical languages.

Third, the review focused on a wider range of **conceptual labels**. These included explicit references to third learning space/place, but also adjacent framings such as learning place cooperation (*Lernortkooperation*), boundary crossing and boundary spaces, connectivity, work-integrated learning, cooperative education, work-based learning, and related notions of hybrid or intermediary learning environments.

Searches were conducted in both English and German using clustered query strings that combined these conceptual labels with sector-specific terms such as dual study, higher education, vocational education, workplace learning, and continuing education. The database search included multidisciplinary international databases such as Scopus, Web of Science, and ERIC, as well as German-language educational databases such as FIS Bildung. These searches were supplemented by exploratory Google Scholar searches, targeted repository searches including peDOCS and BIBB-related collections, and backward and forward citation chaining from central publications.

Publications from **2000 to 2026** were prioritised in order to capture both the consolidation of dual higher education and the evolution of related theoretical debates. Included publication types comprised peer-reviewed journal articles, monographs, edited book chapters, policy reports, and empirically grounded conceptual papers. The corpus comprised different publication types, reflecting the conceptual and interdisciplinary nature of the field. It included peer-reviewed journal articles, monographs and research books, edited book chapters, policy or institutional reports, and empirically grounded conceptual or framework papers (see Annex 1). This heterogeneity was considered appropriate for the purpose of the review, as the third learning space is discussed not only in peer-reviewed research but also in policy-oriented, vocational education, and institutional development literature. At the same time, the heterogeneity of publication types was taken into account in the interpretation of findings: the review does not treat all sources as equivalent forms of empirical evidence, but uses them to reconstruct conceptual patterns and functions across different knowledge traditions.

Literature was included if it either (a) explicitly used a third-space or third-place framing in relation to learning across academic and professional contexts, or (b) developed a clearly articulated intermediary, connective, or integrative arrangement that fulfilled comparable functions. This second criterion was crucial, since many highly relevant contributions in WIL or boundary-crossing research do not use the third learning space label, yet address the same underlying educational problem.

The final documented review corpus comprised $n = 74$ publications, all of which are listed in Appendix 1 together with their analytical labels and codes. Of these, $n = 71$ were included in the conceptual frequency analysis, while $n = 3$ methodological sources informed the review design itself. Appendix 1 therefore functions not merely as a reference list but as the underlying coded data table for the review. The results reported below draw directly on this coded corpus, especially the categories educational sector, disciplinary origin, conceptual label, function, modality, learner role, and curricular integration.

3.3 Analytical procedure

The analysis followed an **iterative coding and synthesis procedure** informed by systematic review methodology and qualitative comparative analysis (Gough et al., 2017). The coding was conducted at publication level. Each included source was assigned one or more codes in the predefined categories of the review matrix. Codes were entered into a structured data table and subsequently used for two analytical purposes: first, to generate descriptive mappings of the corpus, and second, to support the interpretive synthesis across research strands. The coded data table is provided in Appendix 1, where each publication is listed together with its sectoral, disciplinary, conceptual, functional, modal, learner-role, and curricular labels. Each publication was first screened for relevance and then coded deductively using a predefined review matrix. During the coding process, categories were refined inductively where necessary in order to accommodate divergent terminology and conceptually hybrid cases.

A central methodological decision was the use of **non-exclusive coding**. Publications could be assigned to more than one educational sector, conceptual label, or functional category where this was analytically justified. This reflects the fact that many texts operate across boundaries: for example, a publication may address both VET and higher education, combine WIL with boundary-crossing perspectives, or discuss both competence development and innovation. The aim was therefore not to force mutually exclusive classification, but to map patterns of conceptual engagement.

The coding process focused not only on terminology, but also on the functions attributed to the intermediary arrangements described in the literature. Particular attention was paid to whether texts conceptualised the space in question as primarily compensatory, reflective, standardising, innovative, identity-forming, or learner-centred. Additional coding dimensions captured modality, learner role, and curricular integration. These dimensions were chosen because they allow systematic comparison across strands that otherwise differ strongly in theoretical language and institutional context.

The synthesis proceeded in two steps. First, descriptive patterns in the corpus were mapped. Second, these patterns were interpreted comparatively in order to identify recurring functions, shared assumptions, and important differences between research traditions. This procedure ultimately enabled the development of an integrative conceptual model of the third learning space in dual higher education.

For transparency, Table 1 reports the distribution of conceptually relevant publications across educational sectors and dominant conceptual labels. Because publications may be assigned to more than one label, totals are not mutually exclusive. The table therefore indicates patterns of emphasis within the reviewed corpus rather than field-wide prevalence in a strict bibliometric sense.

Table 1. Included corpus by educational sector × conceptual label

<i>Educational sector</i>	<i>Third learning space / place</i>	<i>Learning place cooperation</i>	<i>Boundary crossing / space</i>	<i>WIL / Co-op / placements</i>	<i>Total included</i>
VET	3	8	4	2	17
Dual Higher Education	2	5	1	1	9
Higher Education (broad)	12	4	9	15	40
Continuing Education	1	1	2	1	5
Total	18	18	16	19	71

Publications may be assigned to more than one conceptual label; therefore, column totals exceed row totals.

Table 2 provides a second overview of the coded corpus by dominant analytical categories. It shows how the reviewed literature frames intermediary learning arrangements in functional, modal, and pedagogical terms. As with Table 1, codes are non-exclusive where publications address more than one category.

Table 2. Dominant analytical categories

<i>Analytical category</i>	<i>Main codes used in the review</i>	<i>Function in the analysis</i>
Function	Integration & reflection; standardisation & innovation; competence development	Identifies the pedagogical purpose attributed to the intermediary space
Modality	Physical; digital; hybrid	Describes how the intermediary space is operationalised
Learner role	Active designer; passive recipient; mixed role	Captures whether learners are positioned as agents of integration or mainly as participants in pre-structured arrangements
Curricular integration	Mandatory; project-based; optional/informal	Indicates how strongly the third learning space is embedded in formal programme structures
Conceptual label	Third learning space/place; learning place cooperation; boundary crossing/space; WIL/co-op/placements	Shows which research tradition or terminology frames the phenomenon

3.4 Review matrix (analytical framework)

A structured review matrix guided data extraction, coding, and synthesis. The matrix was applied to all $n = 71$ publications included in the conceptual analysis; the resulting labels are documented in Appendix 1. It included the following dimensions: educational sector, disciplinary origin, conceptual label, function, modality, learner role, and curricular integration. These categories were chosen to support systematic comparison across heterogeneous strands of literature and to make visible the different ways in which intermediary spaces are framed and operationalised.

Table 3. Review matrix

<i>Dimension</i>	<i>Categories</i>	<i>Guiding Questions</i>
Educational Sector	VET, Dual HE, HE, Continuing Education	In which educational contexts is the third learning space addressed?
Disciplinary Origin	VET research, Higher education research, Workplace learning/WIL, Educational sciences	Which theoretical traditions inform the concept?
Conceptual Label	Third learning space/place; learning place cooperation; boundary crossing/space; WIL	How is the intermediary space named and framed?
Function	Integration & reflection; standardisation & innovation; competence development	What purposes does the third learning space serve?
Modality	Physical; digital; hybrid	How is the space operationalised?
Learner Role	Active designer; passive recipient	What agency is attributed to learners?
Curricular Integration	Mandatory; project-based; optional/informal	How is the third learning space embedded in curricula?

The matrix first asked in which educational contexts the third learning space or related phenomena are discussed. Second, it examined which theoretical traditions inform the concept. Third, it considered how the intermediary arrangement is named and framed. Fourth, it analysed the functions attributed to it, such as integration and reflection, standardisation and innovation, or competence development. Fifth, it captured whether the space is realised physically, digitally, or in hybrid form. Sixth, it assessed the degree of agency attributed to learners, ranging from passive participation to active design. Finally, it considered how strongly the third learning space is embedded in curricula, distinguishing mandatory, project-based, and optional/informal forms.

This framework allowed the review to compare literatures that are often disconnected. It also supported the development of a synthesis that is not limited to nominal similarities, but instead focuses on underlying pedagogical functions and structures.

This review deliberately follows a **conceptually guided** rather than a fully database-exhaustive protocol. This allows a nuanced synthesis across heterogeneous and partially overlapping research traditions, but it also implies certain limitations. The corpus reflects conceptual relevance and theoretical saturation rather than complete coverage of every potentially related publication. Quantitative distributions should therefore be interpreted as patterns within the included corpus, not as a definitive measure of field-wide frequency. Future research could complement this approach through bibliometric or database-exhaustive studies in order to trace the historical development and disciplinary diffusion of the concept more comprehensively.

3.5 Trustworthiness and ethical considerations

As this study is based exclusively on published literature and publicly available documents, no human participants were involved and no ethical approval was required. Nevertheless, ethical and quality-related considerations remained relevant to the conduct of the review. Trustworthiness was addressed through transparent documentation of the search space, inclusion criteria, coding categories, and synthesis procedure. The review corpus is documented in Appendix 1, including the analytical labels assigned to each publication. This allows readers to trace how the synthesis is grounded in the reviewed literature.

Given the conceptual heterogeneity of the field, the review did not aim at statistical representativeness or exhaustive bibliometric coverage. Instead, it followed a conceptually guided logic of relevance and theoretical saturation. To reduce the risk of arbitrary interpretation, the analysis focused on recurring functions and patterns across different research traditions rather than isolated claims from individual sources. The use of non-exclusive coding further supported analytical sensitivity to publications that cut across sectors, concepts, or pedagogical functions.

A limitation of the review is that the coding and synthesis involve interpretive judgement. This is inherent in conceptually guided reviews, especially where terminology is fragmented and partially overlapping. The review therefore makes its analytical decisions explicit and treats the resulting model as a conceptual synthesis rather than as a definitive empirical taxonomy.

4 Results: Systematic synthesis of literature on the third learning space

The following synthesis is based on the coded corpus documented in Appendix 1. The results are organised by major literature strand rather than by individual publication, because the aim of the review is to reconstruct conceptual patterns across heterogeneous research traditions. Where appropriate, the synthesis refers to exemplary sources that are particularly representative of each strand.

4.1 German-speaking research on dual studies and learning place cooperation

In German-speaking research, dual study programmes have primarily been analysed through the lens of **learning place cooperation**. This literature focuses on the relationship between higher education institutions and companies, especially with regard to coordination, responsibilities, curricular alignment, supervision, and the design of practice phases. It provides important evidence

that dual higher education cannot be understood simply as the juxtaposition of study and work, but requires systematic cooperation if students are to benefit educationally from alternating contexts.

At the same time, this body of research repeatedly shows that cooperation often remains limited in scope. What is formally presented as integrated theory-practice learning often proves to be loosely coupled organisational coexistence. Langfeldt (2018), for example, shows that universities frequently have only limited influence over the design of workplace learning, while companies often prioritise productive integration into operational routines over explicit educational reflection. Gerstung and Deuer (2021a, 2021b) similarly demonstrate that students experience discontinuities between academic and practical learning, especially when expectations, tasks, and feedback structures are insufficiently aligned. These findings suggest that the main challenge is not simply the existence of two learning places, but how their relationship is pedagogically mediated.

This literature is highly relevant for the third learning space debate because it identifies the structural problem that the concept seeks to address. Yet explicit conceptualisations of a third learning space remain comparatively rare in dual higher education research. Even where intermediary or extended formats are mentioned, they are often treated pragmatically rather than theorised systematically. Projects, digital platforms, additional seminars, or reflective assignments may function as integrative elements, but they are seldom analysed as distinct pedagogical spaces with a specific role in theory–practice integration.

Comparative analyses of dual and vocational pathways further highlight this point. Kuhlee and Irmischer (2018), for instance, discuss trial models in which vocational schools or additional institutions take on complementary roles. However, these models often remain tied to institutional supplements rather than to a learner-centred, process-oriented understanding of integration. Policy-oriented documents such as those by the Wissenschaftsrat (2013) also emphasise the need for stronger curricular coordination, but stop short of elaborating a distinct pedagogical model of an intermediary space.

Overall, German-speaking dual higher education research provides a strong diagnosis of coordination deficits and theory–practice tensions. Its limitation lies less in identifying the problem than in lacking a consolidated conceptual vocabulary for describing and analysing intermediary pedagogical arrangements. This is precisely the gap into which the third learning space perspective can intervene.

4.2 Vocational education research and trial models of learning places

In vocational education and training research, the concept of a third learning place has been more explicitly developed and is historically more firmly anchored. Here, the discussion is closely linked to the structure of the dual system and to the question of how learning opportunities can be stabilised across heterogeneous workplaces. Dehnbostel (2002, 2017, 2023) is particularly important in this regard. His work on learning sites, learning place cooperation, and changing learning environments provides an influential conceptual backdrop for understanding how intermediary settings can compensate for limitations in company-based training and support broader competence development.

Within this tradition, third learning places are often conceived as **supplementary institutional arrangements**, such as inter-company training centres, that make up for deficits in workplace provision. Their functions include standardisation, the broadening of occupational competences, access to technologies or procedures unavailable in specific firms, and the pedagogical structuring of learning processes that cannot be left entirely to workplace contingencies. While these settings are more institutionally defined than the broader concept used in the present article, they offer valuable analytical insights. In particular, they show that intermediary arrangements become necessary when learning cannot be sufficiently guaranteed by existing institutional sites alone.

This is highly relevant for dual higher education. Although the institutional structure differs, the underlying issue is similar: workplace experiences vary significantly in quality, scope, and pedagogical guidance. Students do not encounter uniform learning conditions, and universities cannot assume that practice phases will automatically generate those forms of professional understanding that curricula require. The vocational education literature therefore contributes a strong awareness of the **compensatory and standardising function** of third spaces. It shows that

intermediary learning arrangements can help equalise opportunities, broaden access to relevant practices, and create more consistent conditions for competence development.

Recent developments such as **Netzwerk Q 4.0** further expand this perspective by showing how digitalisation transforms learning place cooperation. Hybrid and network-based learning arrangements increasingly supplement or reconfigure traditional institutional settings, allowing new forms of connectivity across sites. These developments resonate strongly with current debates in higher education on digital and hybrid learning environments. They suggest that the idea of a third learning place can no longer be restricted to a physically separate institution, but must also include digitally mediated and networked forms of integration.

Although VET research cannot be transferred directly to higher education, it contributes a crucial conceptual layer: it treats intermediary spaces not merely as optional enrichments but as structurally significant responses to the limits of existing dual arrangements. This insight strengthens the argument that third learning spaces in dual higher education should be seen as educational necessities wherever theory–practice integration cannot be left to chance.

4.3 International work-integrated learning research

Internationally, research on **work-integrated learning (WIL)** provides one of the most substantial and conceptually mature bodies of literature relevant to the third learning space. WIL research generally addresses the intentional integration of academic learning with workplace or community-based experience. Although the specific term third learning space is not always used, many WIL approaches describe intermediary arrangements that are functionally equivalent: reflective seminars, integrative assessment tasks, project hubs, learning centres, mentorship structures, and digital platforms that help students connect workplace experience with academic study.

A core insight of WIL research is that participation in work settings alone is not sufficient for educational integration. Rather, the relationship between experience and learning must be deliberately designed. Jackson (2015), Billett (2011), Ferns et al. (2022), and Zegwaard and Pretti (2023) all stress in different ways that effective WIL depends on intentional curricular architecture, structured reflection, and opportunities for students to articulate, evaluate, and transfer what they learn across contexts. This resonates strongly with the third learning space perspective, because it foregrounds mediation rather than mere exposure to practice.

WIL literature also places strong emphasis on competence articulation and employability. From this angle, intermediary spaces help learners identify and name what they have learned, especially when important forms of professional growth remain tacit or implicit in workplace settings. Reflection, dialogue, and documentation become key practices through which learning is rendered visible and academically meaningful. This is particularly important in dual higher education, where students may engage in rich workplace experiences without necessarily developing the conceptual tools to analyse or communicate them.

Another strength of WIL research is that it conceptualises integration as part of a broader **learning ecosystem** rather than as a bilateral exchange between university and workplace. This ecosystem perspective allows for multiple actors, support structures, and learning environments. It therefore aligns well with the argument that third learning spaces may take multiple forms and need not be concentrated in one institutional site. At the same time, WIL research sometimes remains more pragmatic than theoretically explicit: it often identifies effective practices without always developing a broader conceptual language for hybridity, boundary work, or epistemic mediation. Here, the third learning space perspective can offer additional interpretive depth.

Overall, the WIL literature contributes a strong emphasis on curricular intentionality, reflection, competence development, and ecosystem thinking. It shows that intermediary spaces are essential for turning workplace participation into higher learning. For dual higher education, this is particularly relevant because it underlines that the educational quality of alternation depends on connective pedagogical design.

4.4 Third space and boundary-crossing perspectives in higher education

A further important strand derives from higher education research on **third spaces** and **boundary crossing**. Unlike the more coordination-oriented discourse on learning place cooperation, this literature is particularly attentive to hybridity, role negotiation, identity formation, and the productive potential of crossing institutional and epistemic boundaries. Whitchurch (2008), Salden (2011), and later contributions on hybrid academic roles describe third spaces as environments in which established boundaries between academic, administrative, professional, and social domains become blurred. Although much of this research focuses on staff roles and organisational change, it provides valuable conceptual tools for thinking about student learning in dual contexts.

Boundary-crossing theory, especially as developed by Akkerman and Bakker (2011), is even more directly relevant. It conceptualises learning as emerging at the boundaries between social practices, where differences in language, norms, tools, and knowledge systems require translation and coordination. Boundaries are not only obstacles; they can also be productive sites of learning because they expose learners to difference and compel them to engage in perspective-taking, reflection, and reconstruction. This is particularly applicable to dual higher education, where students move between the epistemic world of academic study and the situated logic of practice.

Higher education research on third spaces also expands the picture by highlighting participatory, project-based, and digitally mediated learning communities. Examples include law clinics, community partnerships, co-creation initiatives, and online or hybrid learning environments in which learners engage with actors and issues beyond conventional curricula. These arrangements show that third spaces are often associated not only with integration but also with innovation, identity work, and civic or professional transformation. They are spaces in which learners are not merely recipients of knowledge, but active participants in meaning-making and design.

For the present study, this literature is significant because it adds a richer understanding of the **qualitative character** of intermediary spaces. Whereas VET and WIL research often foreground structure, competence, and coordination, third-space and boundary-crossing perspectives highlight ambiguity, hybridity, negotiation, and learner subjectivity. They remind us that integration is not only a curricular task, but also an interpretive and developmental process through which learners form professional identities and negotiate belonging across contexts.

This makes the literature highly relevant for dual higher education. Students in dual programmes do not simply apply theory in practice; they move between different expectations about what counts as valid knowledge, competent performance, and legitimate participation. Third learning spaces can therefore be understood as environments that enable learners not only to connect content, but also to develop a more reflexive relationship to the different worlds in which they participate.

4.5 Cross-strand synthesis

Across all literature strands, the third learning space emerges as a **functional rather than a purely institutional construct**. While the terminology varies significantly, a common pattern becomes visible: the literature repeatedly points to the need for intermediary arrangements that help learners connect academic and practical experiences, reflect on differences between contexts, develop competences across boundaries, and turn fragmented experiences into coherent learning trajectories.

Four recurring functions stand out across the corpus. First, third learning spaces support the **integration of theory and practice** by creating opportunities for translation and connection between heterogeneous learning contexts. Second, they enable **reflection and competence development**, often by making tacit experience visible and open to analysis. Third, they can serve **standardising and compensatory functions**, especially where workplace learning opportunities are uneven or incomplete. Fourth, they may foster **innovation and transformation**, particularly in project-based, hybrid, or co-creative environments where boundaries become sites of experimentation and new forms of participation.

Table 4. Conceptual zones of the third learning space and their theoretical foundations

<i>Element in the model</i>	<i>Corresponding literature strands</i>
Zone 1: Self-organised learning	Learner agency; self-directed learning; informal and lifelong learning
Zone 2: Higher-education-induced learning processes	Curricular work-integrated learning (WIL); research-based learning; reflective assignments
Zone 3: Practice-induced learning processes	Workplace learning; service learning; practice-based and experiential learning
Zone 4: Integration of higher education and practice	Boundary crossing; connective learning; integrative theory–practice frameworks
Formal, non-formal, and informal learning	European and international VET, WIL, and lifelong learning frameworks
Learner ownership and agency	Boundary-crossing theory (Akkerman & Bakker); third-space and hybrid-role perspectives (Whitchurch); learner-centred WIL research

At the same time, the strands differ in important ways. Vocational education research is more strongly oriented towards structural compensation and standardisation. Research on learning place cooperation focuses on coordination between institutions. WIL literature emphasises intentional curricular mediation and competence articulation. Boundary-crossing and third-space research foreground hybridity, learner agency, and identity work. These differences are not contradictory; rather, they highlight complementary dimensions of the phenomenon. The central synthesis of the review is therefore that the third learning space should be understood as a **multi-dimensional integrative** construct that combines pedagogical, institutional, epistemic, and developmental functions.

Based on this synthesis, the reviewed literature supports the development of a **Third Learning Space Conceptual Model (TLSCM)**. This model does not describe a single uniform institutional format. Instead, it conceptualises the third learning space as an integrative field made up of different but related zones of learning activity. These zones vary in their degree of institutional support, learner self-organisation, relation to practice, and role in curricular structures:

- **Zone 1** comprises self-organised learning processes in which learners actively initiate and shape their own integrative activities beyond direct institutional control.
- **Zone 2** includes higher-education-induced learning processes, such as reflective seminars, supervised projects, and academic assignments explicitly designed to connect study and practice.
- **Zone 3** refers to practice-induced learning processes, for example workplace-based projects, service learning, and other professionally situated formats that nonetheless generate structured integrative learning.
- **Zone 4** represents the core of integration, where learners actively coordinate, reinterpret, and connect academic and professional learning across institutional boundaries.

The zones should not be understood as separate containers with fixed boundaries. Rather, they describe analytically distinguishable but dynamically connected regions of integrative learning activity. Learners may move between zones over time: for example, a workplace problem may first emerge in a practice-induced setting, then become the object of academic reflection in a higher-education-induced seminar, and later be further developed through self-organised inquiry or peer collaboration. The boundaries between the zones are therefore porous. What matters analytically is not where a learning activity is institutionally located, but how it contributes to the mediation of academic and professional experience. Zone 4 represents the integrative core of the model because

it captures the moments in which experiences from the other zones are actively related, translated, and transformed into coherent professional understanding.

This zonal model makes visible that the third learning space is neither identical with informality nor reducible to formal curricular provision. It spans formal, non-formal, and informal learning; physical, digital, and hybrid arrangements; and varying degrees of learner ownership and institutional scaffolding. Its analytical advantage lies in capturing the diversity of integrative processes without collapsing them into one rigid organisational typology.

The review therefore shows that explicit and empirically grounded models tailored specifically to dual higher education remain underdeveloped, but that the conceptual resources for such models are already present across adjacent literatures. The TLSCM is proposed as one way of bringing these resources together into a coherent framework.

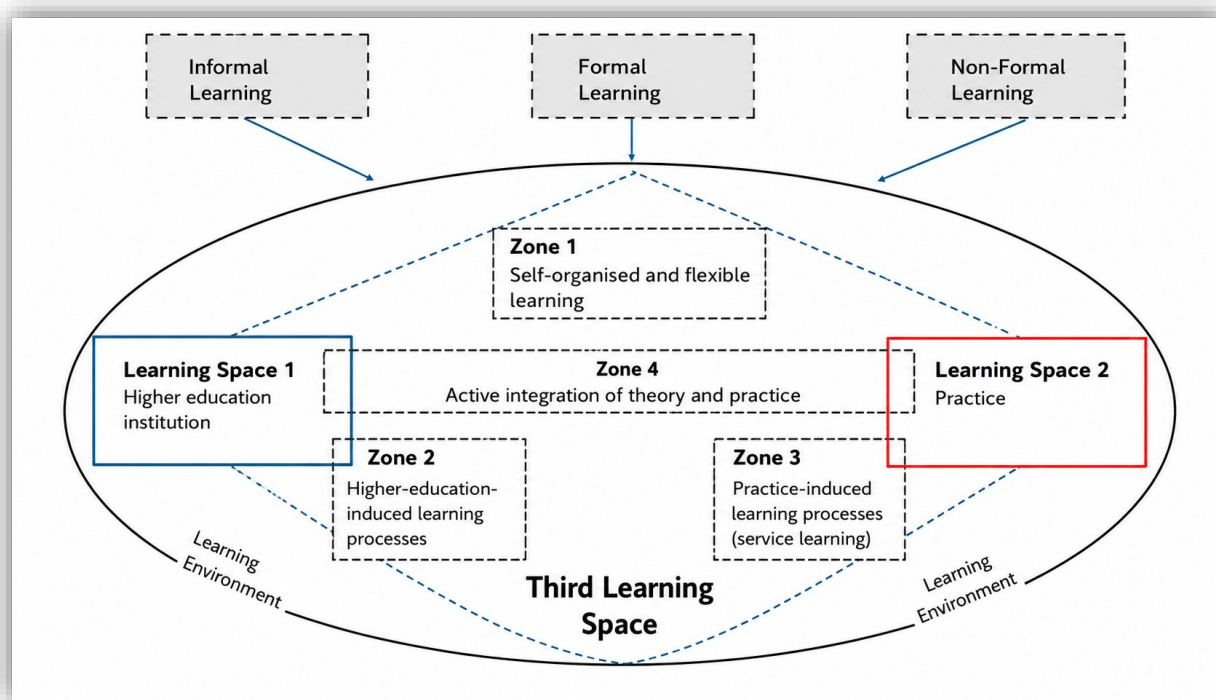


Figure 1. The Third Learning Space Conceptual Model (TLSCM) as an integrative zonal model*

5 Discussion: Implications for dual higher education and research

5.1 Conceptual contribution

The synthesis demonstrates that although notions related to a third learning space are present across vocational education, higher education research, work-integrated learning, and boundary-crossing theory, they remain fragmented, context-dependent, and rarely consolidated into a coherent framework for dual higher education. The main conceptual contribution of this review is therefore not simply to identify an additional concept, but the clarification of a broader analytical perspective: theory–practice integration should be understood as an active, mediated, and pedagogically supported process rather than as an automatic outcome of institutional alternation.

This matters because much of the debate on dual higher education continues to focus on organisational arrangements. Cooperation agreements, alternation structures, contractual partnerships, and curricular coordination are all important, but they do not in themselves explain how

* The zones represent analytically distinguishable but porous and dynamically connected learning regions. The model emphasises transitions, overlaps, and mediation processes rather than fixed institutional locations.

students integrate heterogeneous experiences into coherent competences and professional understanding. The third learning space shifts the analytical focus towards those spaces, practices, and arrangements in which this integration work becomes possible. It therefore complements and extends existing models of learning place cooperation by bringing the learner and the learning process more clearly into view.

A central insight of the review is that the third learning space cannot be adequately described as a single additional institutional learning site. Such a reading would be too narrow for the context of dual higher education and would risk reproducing the very spatial logic the concept seeks to overcome. The reviewed literature instead suggests that the third learning space is best understood as a **meta-space of mediation**. It is a functional and relational space in which learners engage with differences between academic and practical contexts, reflect on them, and develop new forms of coherence. This makes the concept more flexible and analytically more powerful. It allows the inclusion of physical, digital, hybrid, formal, informal, self-organised, and institutionally scaffolded arrangements, as long as they serve integrative purposes.

At the same time, the concept should not become so broad as to lose analytical sharpness. Not every hybrid environment or practice-linked project automatically constitutes a third learning space. What is decisive is whether the arrangement supports the active mediation of heterogeneous knowledge, experiences, and expectations across contexts. In practical terms, an arrangement can therefore be regarded as a third learning space only if it fulfils at least one strong integrative function: it must enable learners to relate academic and professional knowledge, reflect on tensions between contexts, translate experience into conceptual understanding, articulate competence development, or negotiate professional identity across boundaries. This functional criterion prevents the concept from becoming a generic label for any hybrid or practice-related learning format. In this sense, the review suggests that the core criteria of a third learning space are not spatial or institutional, but functional: integration, reflection, translation, competence development, and learner agency.

5.2 Implications for dual study models

For dual higher education institutions such as DHBW, the concept of a third learning space provides a productive framework for rethinking curriculum design, pedagogical support, assessment practices, and cooperation with practice partners. The literature suggests that meaningful theory–practice integration does not emerge automatically from alternating phases, but depends on intentional design. This has several consequences.

First, curricula need to include **explicitly integrative elements**. These may take the form of reflective seminars, portfolios, practice-linked research assignments, case-based learning, mentoring conversations, project work, or digitally supported reflection and documentation formats. The key point is that such formats should not merely accompany dual study programmes administratively, but be designed as pedagogical spaces in which learners actively relate academic concepts to professional situations and vice versa.

Second, assessment practices need to recognise integrative learning more clearly. If dual higher education values the capacity to connect theory and practice, this capacity should become visible in the ways students are asked to demonstrate learning. Traditional academic assessments often privilege disciplinary reproduction, while workplace evaluation may focus on performance and adaptation. Third learning spaces point to the need for assessment formats that capture mediation, reflection, transfer, and professional judgement. This may include portfolios, reflective reports, integrative presentations, research-based case analyses, or dialogic assessment formats involving both academic and practice perspectives.

Third, the review implies a stronger role for **pedagogical support structures**. Learners should not be left to undertake with the task of making sense of divergent expectations, knowledge forms, and institutional rhythms alone. Supervisors, mentors, lecturers, and practice partners all have a role in supporting this work. This does not mean controlling student learning in a rigid way. Rather, it means creating opportunities for guided reflection, feedback, and dialogue across boundaries.

Fourth, the third learning space perspective also redefines cooperation between higher education institutions and employers. Cooperation is not only about planning practice phases or ensuring organisational fit. It also entails creating shared pedagogical responsibility for integrative

learning. This includes discussing learning objectives, recognising reflective formats as relevant, and aligning expectations in ways that support rather than fragment student learning.

For the DHBW, these implications are especially relevant because the institution is built around the system-wide alternation of academic and workplace learning. This makes it particularly suitable for the development of structured third learning spaces across programmes. At the same time, it also means that deficits in integration may have system-wide consequences. The DHBW context therefore highlights both the urgency and the opportunity of moving from a coordination-centred model towards a more explicitly integrative educational architecture.

5.3 Tensions, limits, and risks of institutionalisation

At the same time, the review suggests that the implementation of third learning spaces is not without tensions. One of the most important findings across the literature is that the educational value of intermediary spaces often lies in their openness, hybridity, and flexibility. They become productive precisely because they are not fully absorbed into one institutional logic. This creates a paradox for dual higher education: the more intentionally third learning spaces are designed and institutionalised, the greater the risk that they lose the very qualities that make them effective.

If intermediary spaces are transformed too quickly into standardised curricular units, they may become just another formally regulated component of the programme rather than a genuine space for translation and reflection. In such cases, their connective function may be weakened. This is particularly relevant where reflective formats become bureaucratic exercises, where portfolios become compliance instruments, or where integrative seminars are overloaded with formal expectations but underdeveloped pedagogically.

A second risk concerns the distribution of responsibility. The emphasis on learner agency is one of the strengths of the third learning space concept, but it can also be misunderstood. There is a risk that institutions invoke learner self-direction while effectively shifting the burden of integration onto students alone. Yet the review clearly indicates that learner agency only becomes educationally productive when supported by adequate structures, guidance, and recognition. A third learning space should therefore not be interpreted as a space in which institutions withdraw, but as one in which institutional support and learner activity are held in productive balance.

A third tension concerns inequality and variation. Because workplace learning opportunities differ significantly across contexts, students enter third learning spaces with unequal experiences and resources. Some may benefit from rich, reflective practice environments, while others encounter routine tasks or weak supervision. This means that third learning spaces may also have a compensatory role. If this role is neglected, integrative formats may unintentionally reproduce rather than reduce disparities.

These tensions suggest that the implementation of third learning spaces requires careful design. The goal should not be maximal formalisation, but a balanced architecture that combines openness and structure, autonomy and guidance, institutional support and learner ownership. In this sense, the third learning space is not merely a new curricular element, but a pedagogical balancing act.

5.4 Research implications and future directions

The review reveals a substantial lack of empirically grounded and systematised research on third learning spaces in dual higher education. Future research should therefore proceed in at least four directions.

First, further work is needed on **conceptual differentiation**. The relationship between third learning space, learning place cooperation, boundary crossing, connectivity, work-integrated learning, and related concepts should be clarified more systematically. This does not require reducing everything to one label, but it does require a more explicit understanding of how these approaches overlap and differ.

Second, future studies should investigate the **effects of different forms of third learning spaces** on competence development, professional identity formation, academic achievement, and

employability. Comparative studies across disciplines and programme types would be particularly valuable in this regard.

Third, there is a need for stronger research on **design and governance**. Which institutional arrangements, support structures, and partnership models make third learning spaces sustainable? How can academic and practice actors share responsibility for integrative learning? How can reflective and connective formats be embedded without becoming over-formalised?

Fourth, the review suggests that **design-based and practice-based research approaches** may be particularly suitable. Because third learning spaces are not only theoretical constructs but also educational designs, research should accompany their iterative development in real institutional settings. The DHBW offers a promising context for this, since its structural model creates favourable conditions for studying how such spaces can be embedded systematically across programmes.

Overall, the review indicates that the third learning space is a concept with strong theoretical and practical potential, but one that still requires further empirical grounding. Its value lies in providing a more nuanced language for analysing and designing integration in dual higher education. Future research should therefore not only ask whether such spaces exist, but under which conditions they become educationally productive, equitable, and sustainable.

Statement

The peer-review process and editorial decision were handled independently by members of the Editorial Board who were not involved as authors. The authors took no part in the review or decision-making process

References

- Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research*, 81(2), 132–169. <https://doi.org/10.3102/0034654311404435>
- Barnett, R. (2014). *Imagining the university*. Routledge.
- Billett, S. (2011). *Vocational education: Purposes, traditions and prospects*. Springer.
- Booth, A., Sutton, A., & Papaioannou, D. (2016). *Systematic approaches to a successful literature review* (2nd ed.). Sage.
- Dehnbostel, P. (2002). Bilanz und Perspektiven der Lernortforschung in der beruflichen Bildung [Current state and perspectives of research on learning places in vocational education]. *Zeitschrift für Pädagogik*, 48(3), 356–377.
- Dehnbostel, P. (2017). *Lernortkooperation in der beruflichen Bildung* [Learning place cooperation in vocational education]. wbv.
- Dehnbostel, P. (2023). Lernortforschung im Wandel [Learning place research in transition]. In P. Dehnbostel (Ed.), *Berufliche Bildung weiterdenken* [Rethinking vocational education]. wbv.
- Gerstung, M., & Deuer, E. (2021a). Theorie-Praxis-Verzahnung im dualen Studium [Theory–practice integration in dual higher education]. *Zeitschrift für Hochschulentwicklung*, 16(2), 45–62.
- Gerstung, M., & Deuer, E. (2021b). Lernortkooperation aus Sicht Studierender [Learning place cooperation from students' perspectives]. *bwp@ Berufs- und Wirtschaftspädagogik online*, 40.
- Gough, D., Oliver, S., & Thomas, J. (2017). *An introduction to systematic reviews* (2nd ed.). Sage.
- Jackson, D. (2015). Employability skill development in work-integrated learning. *Asia-Pacific Journal of Cooperative Education*, 16(2), 121–140.
- Kuhlee, D., & Irmscher, M. (2018). Duales Studium und berufliche Bildung im Vergleich [Dual higher education and vocational education in comparison]. *bwp@ Berufs- und Wirtschaftspädagogik online*, 34.
- Landwehr, N. (2002). Der dritte Lernort [The third learning place]. In W. Goetze, P. Gonon, A. Gresele, S. Kübler, H. Landolt, N. Landwehr, R. Marty, U. Renold, & P. Egger (Eds.), *Der dritte Lernort: Bildung für die Praxis, Praxis für die Bildung* [The third learning place: Education for practice, practice for education] (pp. 37–71). hep Verlag.
- Langfeldt, B. (2018). Lernortkooperation im dualen Studium: Zu viel oder zu wenig Einfluss der Hochschulen auf die betrieblichen Praxisphasen? [Learning place cooperation in dual higher education: Too much or too little influence of higher education institutions on workplace-based practice phases?]. *bwp@ Berufs- und Wirtschaftspädagogik online*, 34.
- Nickel, S., Püttmann, V., & Schulz, N. (2022). *Das duale Studium: Evaluation und Weiterentwicklung* [Dual higher education: Evaluation and further development]. CHE Centrum für Hochschulentwicklung.
- Salden, P. (2011). Der „Third Space“ als Handlungsfeld in Hochschulen: Hybride Rollen in der akademischen Professionalisierung [The “third space” as a field of action in higher education: Hybrid roles in academic professionalisation]. *Zeitschrift für Hochschulentwicklung*, 6(2), 112–129.
- Ternes, D., & Schneckeburger, C. (Eds.). (2020). *Theorie-Praxis-Transfer* [Theory–practice transfer] (#DUAL, Vol. 4). Duale Hochschule Baden-Württemberg, Zentrum für Hochschuldidaktik und lebenslanges Lernen.

- Whitchurch, C. (2008). Shifting identities and blurring boundaries: The emergence of third space professionals in UK higher education. *Higher Education Quarterly*, 62(4), 377–396.
- Wissenschaftsrat. (2013). *Empfehlungen zur Entwicklung des dualen Studiums* [Recommendations for the development of dual higher education]. Wissenschaftsrat.

Appendix 1: Complete list of literature used for the systematic analysis, including labels and codes

- Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research*, 81(2), 132–169. (HE; Workplace Learning; boundary crossing; integration/reflection; predominantly hybrid; active learners; variably embedded in curricula)
- Apra, C. (2015). Connectivity in vocational education and training. *Empirical Research in VET*, 7(4). (VET; VET Research; connectivity; integration; hybrid)
- Bamford, J., & Moschini, E. (2024). The third space, student and staff co-creation of gamified informal learning: An emerging model of co-design. *London Review of Education*, 22(1), article 21. <https://doi.org/10.14324/LRE.22.1.21> (HE; HE Research; third space; innovation/reflection; digital/hybrid; active learners; optional)
- Barnett, R. (2014). *Imagining the university*. Routledge. (HE; Educational Sciences; third space/imagined spaces; innovation/reflection; predominantly hybrid; active learners; partly optional)
- Barnett, R., & Coate, K. (2005). *Engaging the curriculum in higher education*. Open University Press. (HE; HE Research; curriculum as third space; integration/reflection; hybrid)
- Beaton, F., & Gilbert, A. (2012). *Developing effective part-time teachers*. Routledge. (HE; HE Development; hybrid roles/third space; integration)
- BIBB (2020). *Netzwerk Q 4.0 – Digitale Transformation in der Berufsbildung*. Bundesinstitut für Berufsbildung. (VET; VET Research; learning place cooperation/digital learning sites; standardisation/innovation; digital/hybrid; partly active learners; project-based)
- Billett, S. (2011). *Vocational education: Purposes, traditions and prospects*. Springer. (VET/Continuing; Workplace Learning; WIL/learning at work; integration/competence development; predominantly physical/hybrid; active learners; strongly embedded in curricula)
- Billett, S. (2014). Integrating learning in higher education and work. *Studies in Higher Education*, 39(5). (HE/DHE; Workplace Learning; WIL; integration; hybrid)
- Booth, A., Sutton, A., & Papaioannou, D. (2016). *Systematic approaches to a successful literature review* (2nd ed.). Sage. (Methodological source; used to inform review design; not included in conceptual frequency analysis; Educational Sciences; no explicit third learning space concept, but review framework; analytical background)
- Boud, D., & Rooney, D. (2019). Positioning WIL in life-long learning. *Higher Education Research & Development*, 38(4). (HE/Continuing; Workplace Learning; WIL; integration/competence development; hybrid)
- Boud, D., & Solomon, N. (2001). *Work-based learning*. Open University Press. (Continuing; Workplace Learning; WBL/WIL; integration; physical/hybrid; active learners; curricular)
- Bovill, C. (2020). Co-creation in learning and teaching. *Higher Education*, 79(6). (HE; HE Research; co-creation/third space; innovation; hybrid)
- Brennan, J., & Little, B. (2006). *Towards a strategy for WBL*. Open University. (HE; Policy/WIL; WIL strategy; standardisation; hybrid)
- Busemeyer, M., & Trampusch, C. (2012). *The political economy of collective skill formation*. Oxford University Press. (VET; Policy; learning sites/dual systems; integration/standardisation)
- Carvalho, L., & Goodyear, P. (2018). *The architecture of productive learning networks*. Routledge. (HE/Continuing; Educational Sciences; hybrid learning spaces; innovation/integration; digital/hybrid; active learners; frequently project-based)
- Colley, H., Hodgkinson, P., & Malcolm, J. (2003). Informality and formality in learning. *British Journal of Educational Studies*, 51(4). (Continuing; Workplace/Adult Learning; integration; physical/hybrid)
- Costley, C., Elliott, G., & Gibbs, P. (2010). *Doing work-based research*. Sage. (HE/Continuing; Workplace Learning; WBL/WIL; integration/reflection; hybrid; active learners; project-based)
- Crisp, G., et al. (2020). Integrating employability into the HE curriculum. *Journal of Teaching and Learning for Graduate Employability*, 11(1). (HE; HE Research/WIL; integration; hybrid)
- Cuenca, A. (2011). Creating a “third space” in student teaching. *Teaching and Teacher Education*, 27(7), 1063–1072. (HE/Teacher Education; HE Research; third space; integration/reflection; physical/hybrid; active learners; project-based)
- Curto-Reverte, A., Peguera-Carré, M. C., Cobos-Rius, H., & Vidal-Martí, C. (2025). The role of work-integrated learning in the European Higher Education Area: A systematic review. *Review of Education*, 13(3). <https://doi.org/10.1002/rev3.70114>
- Dehnbostel, P. (2002). Bilanz und Perspektiven der Lernortforschung. *Zeitschrift für Pädagogik*, 48(3), 357–377. (VET; VET Research; learning sites/learning place cooperation; integration/standardisation; physical; predominantly passive learners; compulsory curricular integration)
- Dehnbostel, P. (2017). *Lernortkooperation in der beruflichen Bildung*. wbv. (VET; VET Research; learning place cooperation/third learning place; integration/standardisation; physical; partly active learners; compulsory)

- Dehnbostel, P. (2018). Betriebliche Lernorte, Lernräume und Lernprozesse. *Erwachsenenbildung*, 35/36, 5–19. (VET/Continuing; VET Research; learning sites/learning spaces; integration/competence development; physical/hybrid; active learners; embedded)
- Dehnbostel, P. (2023). Lernortforschung im Wandel. In P. Dehnbostel (Ed.), *Berufliche Bildung weiterdenken*. wbv. (VET; VET Research; analytical third learning place; standardisation/innovation; physical/hybrid; partly active learners; curricular)
- Deißinger, T. (2015). Das duale System in Deutschland. *Zeitschrift für Berufs- und Wirtschaftspädagogik*, 111(3). (VET; VET Research; dual system/learning sites; standardisation)
- Edwards, A. (2005). Let's get beyond community and practice: The many meanings of learning by participating. *The Curriculum Journal*, 16(1), 49–65. <https://doi.org/10.1080/0958517042000336809> (HE/Continuing; Workplace Learning; boundary crossing; integration/innovation; hybrid; active learners; project-based)
- Elton, L. (2005). The third way in HE: Professional learning. *Teaching in Higher Education*, 10(3). (HE; HE Research; third way/space; reflection/innovation)
- Eraut, M. (2010). *Informal learning and knowledge in professional work*. Routledge. (Continuing; Workplace Learning; workplace learning; competence development/reflection; physical/hybrid; active learners; predominantly informal)
- Euler, D. (2013). Akademisierung und Dualisierung. *Zeitschrift für Berufs- und Wirtschaftspädagogik*, 109(3). (VET/DHE; VET Research; dualisation; integration/standardisation)
- Evans, K., Guile, D., Harris, J., & Allan, H. (2010). *Putting knowledge to work*. NIACE. (HE/Continuing; Workplace Learning; boundary crossing; integration)
- Ferns, S., Rowan, L., & Zegwaard, K. (2022). Advancing work-integrated learning theory. *International Journal of Work-Integrated Learning*, 23(4), 15–33. (HE/DHE; Workplace Learning; WIL; integration/competence development; hybrid; active learners; curricular)
- Forster-Heinzer, S. (2015). Lernortkooperation und Kompetenzentwicklung. *bwp@*, 29. (VET/DHE; VET Research; learning place cooperation; integration/competence development)
- Fuller, A., & Unwin, L. (2004). Expansive and restrictive learning environments. *Oxford Review of Education*, 30(4), 437–451. (VET/Continuing; Workplace Learning; workplace as learning environment; competence development; physical; active learners; embedded)
- Gerstung, M., & Deuer, E. (2021a). Theorie-Praxis-Verzahnung im dualen Studium. *Zeitschrift für Hochschulentwicklung*, 16(2), 45–62. (DHE; HE Research; learning place cooperation/WIL; integration; hybrid; predominantly active learners; compulsory)
- Gerstung, M., & Deuer, E. (2021b). Lernortkooperation aus Sicht Studierender. *bwp@*, 40. (DHE; VET/HE Research; learning place cooperation; integration/reflection; hybrid; active learners; curricular)
- Gibbs, G. (2013). Lecturing and large-group teaching. In *University teaching in a digital age*. (HE; HE Research; digital spaces; hybrid)
- Gough, D., Oliver, S., & Thomas, J. (2017). *An introduction to systematic reviews* (2nd ed.). Sage. (Methodology, not included in conceptual frequency analysis; Educational Sciences; review methods)
- Guile, D., & Griffiths, T. (2001). Learning through work experience. *Journal of Education and Work*, 14(1). (VET/HE; Workplace Learning; WIL; integration)
- Gutiérrez, K. D. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, 43(2). (HE/School; Educational Sciences; third space; innovation/identity; hybrid)
- Healey, M., Flint, A., & Harrington, K. (2014). *Students as partners in learning and teaching*. HEA. (HE; HE Research; partnership as third space; innovation/integration; hybrid)
- HEQCO (2016). *Work-integrated learning in Ontario's postsecondary system: A framework for strengthening*. Higher Education Quality Council of Ontario. (HE; Workplace Learning; WIL framework; integration/standardisation; hybrid; active learners; curricular)
- Höning, B., & Schlögl, P. (2019). Lernorte in der beruflichen Weiterbildung. *Zeitschrift für Weiterbildungsforschung*, 42(3). (Continuing/VET; Adult/VET Research; learning places; integration; physical/hybrid)
- Illeris, K. (2018). *Contemporary theories of learning* (2nd ed.). Routledge. (HE/Continuing; Educational Sciences; learning/competence; meta-theoretical)
- Jackson, D. (2015). Employability skill development in work-integrated learning. *Asia-Pacific Journal of Cooperative Education*, 16(2), 121–140. (HE; Workplace Learning; WIL; integration/competence development; hybrid; active learners; curricular)
- Jackson, D. (2017). Developing pre-professional identity in higher education. *Studies in Higher Education*, 42(6), 929–945. (HE; HE Research; third space for identity; reflection/integration; hybrid; active learners; project-based)
- Klotz, V., & Seifried, J. (2014). Lernortvernetzung in der kaufmännischen Ausbildung. *bwp@*, 27. (VET; VET Research; learning place cooperation; integration)
- Kuhlee, D. (2013). Studienintegrierte Ausbildungsgänge. *bwp@*, 24. (DHE; VET/HE Research; trial models; institutional learning place cooperation/third learning place; integration; physical; predominantly passive learners; curricular)
- Kuhlee, D., & Irmischer, M. (2018). Duales Studium und berufliche Bildung im Vergleich. *bwp@*, 34. (DHE/VET; VET Research; learning sites/trial models; integration/standardisation; physical; passive/active learners; curricular)
- Landwehr, N. (2002). *Lernortkooperation in der Berufsausbildung*. Bertelsmann. (VET; VET Research; learning place cooperation/third learning place; integration; physical; predominantly passive learners; curricular)
- Langfeldt, B. (2018). Lernortkooperation im dualen Studium. *bwp@*, 35. (DHE; HE/VET Research; learning place cooperation; integration; physical/hybrid; predominantly passive learners; curricular)
- Little, B., & Harvey, L. (2006). Learning through work placements. *Higher Education Academy*. (HE; WIL; integration/reflection)

- Miles, M. B., Huberman, A. M., & Saldaña, J. (2020). *Qualitative data analysis* (4th ed.). Sage. (Methodology not included in conceptual frequency analysis)
- Neary, M. (2010). Student as producer. *Enhancing Learning in the Social Sciences*, 2(1). (HE; HE Research; third space/praxis; innovation; hybrid)
- Nickel, S., et al. (2022). *Das duale Studium: Evaluation und Weiterentwicklung*. CHE. (DHE; HE Research; dual system, WIL; integration/standardisation; physical/hybrid; predominantly passive learners; curricular)
- Ninnemann, K. (2021). Lernort Hochschule im dualen Studium. *bwp@*, 39. (DHE; HE Research; learning site concepts; integration; physical; predominantly passive learners; curricular)
- Oldenburg, R. (1999). *The great good place* (3rd ed.). Paragon House. (HE/Community; Organisational/Community Studies; third place; innovation/identity; physical; active participants; optional)
- Patrick, C.-J., et al. (2008). *The WIL report*. Queensland University of Technology. (HE; WIL Policy; integration/standardisation; hybrid)
- Raelin, J. (2007). Toward an epistemology of practice. *Academy of Management Learning & Education*, 6(4). (HE/Continuing; Workplace Learning; practice-based learning; reflection/integration)
- Rauner, F. (2007). *Vocational education and training – a European perspective*. (VET; VET Research; learning sites; standardisation)
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu*. Publications Office of the European Union. <https://doi.org/10.2760/159770> (HE/VET/Continuing; Policy/Educational Sciences; digital learning spaces; innovation/competence development; digital/hybrid; active educators; curricular)
- Salden, P. (2011). "Third space" als Handlungsfeld in Hochschulen. *Zeitschrift für Hochschulentwicklung*, 6(2), 112–129. (HE; HE Research; third space; innovation/integration; hybrid; active boundary spanners; project-based)
- Sappa, V., Aprea, C., & Wuttke, E. (2018). Conceptions of connectivity. In *Connectivity in vocational education and training*. (VET/DHE; VET Research; connectivity/boundary crossing; integration; hybrid)
- Sattler, P., & Peters, J. (2013). Work-integrated learning in Ontario's universities. HEQCO. (HE; WIL; integration/standardisation; hybrid)
- Smith, C. (2012). Evaluating the quality of WIL curricula. *Asia-Pacific Journal of Cooperative Education*, 13(1). (HE; WIL; standardisation/integration; hybrid)
- Trowler, P., & Cooper, A. (2019). Teaching and learning regimes in higher education. In *Doing academic practice*. (HE; HE Research; boundary work; integration/innovation; hybrid)
- Trowler, P., & Cooper, A. (2024). Boundary work in hybrid academic roles. *Studies in Higher Education*, 49(1). (HE; HE Research; third space/boundary; innovation; hybrid; active actors; optional/project-based)
- Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review*, 3(2). (HE/Continuing; Workplace Learning; WIL/boundary crossing; integration)
- Tynjälä, P., & Gijbels, D. (2012). Changing world of work and education. In *Work and Learning*. (HE/VET; Workplace Learning; integration/innovation)
- Veith, P. (2016). Duales Studium und Lernort Hochschule. *Die Hochschule*, 25(1). (DHE; HE Research; learning site higher education; integration)
- Whitchurch, C. (2008). Shifting identities and blurring boundaries. *Higher Education Quarterly*, 62(4), 377–396. (HE; Organisational Learning; third space; innovation/integration; hybrid; active actors; project-based)
- Wissenschaftsrat. (2013). *Empfehlungen zur Entwicklung des dualen Studiums*. WR. (DHE; Policy; learning place cooperation; standardisation/integration; physical; passive learners; curricular)
- Zegwaard, K. E., & Pretti, T. J. (2023). Rethinking work-integrated learning ecosystems. *International Journal of Work-Integrated Learning*, 24(1), 1–15. (HE/DHE; Workplace Learning; WIL ecosystems; integration/innovation; hybrid; active learners; curricular)
- Zeuner, C. (2013). Lernorte in der Erwachsenenbildung. *Report – Zeitschrift für Weiterbildungsforschung*, 36(2). (Continuing; Adult Education; learning places; integration; physical/hybrid)

CAUGHT BETWEEN TECHNICAL EXPERTISE AND TRANSDISCIPLINARY STRUCTURE FORMATION: OPPORTUNITIES AND PROSPECTS FOR (INSTITUTIONALISED) COMPETENCE BUILDING IN TRANSFER-ORIENTED RESEARCH USING THE CASE OF THE INNOWEST JOINT RESEARCH PROJECT

Cornelia Kühn ^{1*}, Christine Hobelsberger ², Antje Michel ¹, Verena Graf ², Pauline Hillenbrand ¹ and Gregor Schmidt ³

¹ University of Applied Sciences Potsdam, Germany

² Eberswalde University for Sustainable Development, Germany

³ Brandenburg University of Applied Sciences, Germany

Keywords:

Transdisciplinary research
Competence expansion
Knowledge transfer

Article history:

Received: 15 January 2026
Revised: 24 April 2026
Accepted: 5 July 2026

To cite this article:

Kühn, C., Hobelsberger, C., Michel, A., Graf, V., Hillenbrand, P. & Schmidt, G. (2026). Caught Between Technical Expertise and Transdisciplinary Structure Formation: Opportunities and Prospects for (Institutionalised) Competence Building in Transfer-oriented Research Using the Case of the InNoWest Joint Research Project. *European Scientific Journal for Dual Higher Education (ESJ DHE)*, 2 (3), 67-80.
<https://doi.org/10.82321/07ma-34m613>

Abstract

Research at higher education institutions (HEIs) is increasingly expected to address societal problems. In this context, transdisciplinary research practice is often referred to as a novel co-creative mode of research. However, collaboration with actors from outside the scientific system in transdisciplinary research projects requires specific competences. The article presents the formats for competence development in transdisciplinary research developed as part of the InNoWest joint research project, as well as the results of their formative evaluation. It outlines the potential and limitations of continuing professional development during project work, and reflects on the possibilities for the institutionalised development of transdisciplinary competences at HEIs. Drawing on the experiences of the German InNoWest joint research project, the article elucidates the ambivalence between transdisciplinary research as a mode of inquiry and the qualification and excellence criteria of scientific institutions, which are often based on technical expertise. The article further examines the conditions required to establish transdisciplinary research within German HEIs.

1 Introduction

Research at higher education institutions (HEIs) is increasingly faced with the challenge of enhancing exchange between science and society to address complex and interdisciplinary societal

* Corresponding author

E-mail address: cornelia.kuehn@fh-potsdam.de

problems such as climate change, social inequality, and technological change (WBGU, 2011; Wissenschaftsrat, 2020). To that end, HEIs should not only function as knowledge mediators, but also actively shape societal development. In this context, transdisciplinary research practice is highlighted as a co-creative approach to knowledge production and decision-making (Bruckermann et al., 2025). It is therefore unsurprising that the Germany-based Society for Research on Higher Education (Gesellschaft für Hochschulforschung, GfHf) has defined the examination of transdisciplinarity and transdisciplinary research as a pivotal subject for its annual conference in 2025 (Gesellschaft für Hochschulforschung, 2025).

However, for a transdisciplinary research project to achieve the desired effects, a change in attitude and additional competences is required on the part of scientists in the areas of communication and process management: In addition to disciplinary expertise, researchers are required to develop competences in areas such as communication, process facilitation, and knowledge integration (Barth et al., 2020; Studer & Pohl, 2024; Theiler et al., 2019). These competences differ substantially from traditional academic skill sets and are often not systematically addressed within existing academic training and institutional structures. As a result, there is a need to understand better how such competences and mindsets can be developed, supported, and embedded within HEIs.

Against this background, this article draws on the case of the German InNoWest joint research project to examine the development of capacity-building formats for transdisciplinary research within a research project context. The article is thereby guided by the following research question:

How can needs-based formats for building competences in transdisciplinary research be formatively developed within an ongoing research project?

On the basis of the findings and the general project experiences, the possibilities, as well as the challenges, of establishing transdisciplinary research and respective capacity-building formats in a more institutionalised way at German universities should also be discussed. To provide a more comprehensive contextual framework for the experiences that are being discussed in this paper, the article begins by briefly outlining transdisciplinary research as a novel research approach in its changed scientific mode (2). It then contextualises the InNoWest research network as the case context and outline the research design of our study to explain the conception and methodology of our approach to the reflexive, iterative development of formats to promote transdisciplinary research practice, and its formative evaluation (3). The detailed presentation of the individual offerings, their objectives, and the insights gained from their application and formative evaluation subsequently serves to reflect on their contribution to the project goals of InNoWest and their potential for promoting transdisciplinary research skills (4). Finally, the insights presented in chapter 4 regarding the formative development and evaluation of a portfolio of offerings aimed at expanding competences in transdisciplinary research are summarised and reflected upon within the context of scientific practice. This practice is situated between subject-matter expertise and transdisciplinary structural development. This is done by relating the key findings of our research to the discourse on the structural integration of transdisciplinary research within the current scientific system in the German-speaking region: On the one hand, with regard to its growing importance in addressing societal crises, and on the other hand, concerning its comparatively low recognition relative to disciplinary expertise in terms of excellence funding and career paths (5).

2 Transdisciplinary research: Origins and characteristics

2.1 Understanding of the term "transdisciplinary research" and its origins

To situate the experiences of formative competence development as a case study of implementing transdisciplinary research competences within German higher education structures, the specifics of transdisciplinary work in its origins and principles will be briefly explained here. In recent decades, the scientific system within HEIs and non-university research institutions has undergone a marked increase in specialisation and differentiation across various disciplines. This functional specialisation is increasingly confronted with societal challenges that, due to their

complexity, cannot be divided into problems that can be solved within a single discipline. Rather, an integrated approach is required. This challenges the self-understanding of science and the previous practice of knowledge production, and novel approaches to research that transcend disciplinary boundaries appear necessary.

This context gave rise to a political agenda in the 1990s to make science more societally oriented (United Nations Conference on Environment and Development, 1992). The 2011 flagship report of the German Advisory Council on Global Change was also influential in its call for an understanding of science as a driver of transformation, with the aim of overcoming the major challenges of our time (WBGU, 2011). Finally, in 2020, the German Council of Science and Humanities (Wissenschaftsrat) recommended that basic research and application-oriented research be viewed more as a continuum and that framework conditions be created in the science system for a "sovereign openness of the science system towards society" (Wissenschaftsrat, 2020, p. 5). In order to address societally relevant issues and in line with the demands of this political agenda, various forms of cooperation between science and societal practice have become established within science alongside interdisciplinary research. These include citizen science and open science, as well as user-centred research and real-world laboratories. These approaches may have different objectives and methods, but they also overlap and cannot always be clearly separated from one another (Grunwald et al., 2020, pp. 106-114). Transdisciplinary research fits into this diversity of co-creative research practices (Bundesministerium für Bildung und Forschung, 2023; Bruckermann et al., 2025).

The term transdisciplinarity now has a tradition stretching back more than 30 years, and there are various interpretations. Two of these are referred to here as "schools of thought of transdisciplinarity" (Lawrence et al., 2022, pp. 47-49): Transdisciplinarity, as it is understood especially in the American context, refers to the unification of different scientific knowledge in an effort to overcome disciplinary boundaries and open up new topic-specific fields of research. The other "school of thought" (particularly in the European context) explicitly involves societal actors, for example from politics, administration, business, associations, and citizens' initiatives in the research process in order to achieve societal impact with the research project. This societally oriented understanding of transdisciplinarity with its integrative concept of research practice has been developed particularly in environmental and sustainability science. These approaches to transdisciplinary sustainability research are informed by research questions that emerge from real-life problems, with the objective being to shape these problems and achieve societal transformation (Jahn et al., 2012, pp. 1-10). The InNoWest research network is based on this understanding of transdisciplinary sustainability research.

A characteristic feature of transdisciplinary research projects is that research is understood as a learning process: the aim of transdisciplinary sustainability research is not to provide purely scientific answers to societal challenges, but rather to design a process for understanding and changing the complexities of the societal situation (Thompson Klein et al., 2001, pp. 4-5). This requires a diversity of perspectives, experiences, and types of knowledge. The involvement of actors from outside HEIs in the research process is intended, on the one hand, to integrate this necessary relevant knowledge and take the diverse perspectives into account. On the other hand, the solution to complex societal problems should be conceived as a joint learning process with societal practice in order to design and shape collaborative solutions in transdisciplinary processes. The aim here is to promote personal responsibility for challenges so that the jointly developed ideas for transformation can also be implemented in practice. In this understanding, transdisciplinary research therefore involves a different mode of research; a changed way of conducting science: away from a purely knowledge-focused orientation and towards a stronger design orientation.

Three types of knowledge are often used as structuring elements in the research process in transdisciplinary research: 1) system knowledge as knowledge about the complex societal problem, 2) target knowledge as knowledge about the sustainable change to be achieved and the jointly desired future, and 3) transformation knowledge as knowledge about the options for action to change existing practices and introduce desired ones (td-net, 2025). In order to acquire the different types of knowledge, the transdisciplinary research process integrates the partial findings obtained in different ways depending on the research discipline in a problem-oriented and method-guided manner and – in contrast to interdisciplinary research projects – links them with the empirical

knowledge of the practitioners. Methodologically, both academic knowledge and the experiential and practical knowledge of practice partners are systematically processed, methodically reflected upon, and iteratively fed back into the research process during the transdisciplinary research project (Theiler et al., 2019).

Transdisciplinary research in the context of the environment and sustainability is therefore primarily problem-oriented, in that it not only seeks to gain insights, but also to develop solutions to problems. Transdisciplinary research links societal and scientific problems to apply both scientific and practical knowledge and generate appropriate solutions. Transdisciplinary research in this area is also process-oriented, as the question of research quality also includes the quality of the research process. Communicating what has been achieved and what impact was intended is an important part of the critical-reflective research mode. The transdisciplinary research described here is impact-oriented in that impact potential is considered a central element of the research. Both scientific outputs and their impact as well as societal effects are taken into account. Transdisciplinary research is integrative in that it integrates different disciplinary sub-knowledge and practical knowledge as mutual learning processes in the course of the research process (Bergmann & Schramm, 2008; Hoffmann et al., 2019; Jahn et al., 2012; Pohl & Hirsch Hadorn, 2007).

2.2 Challenges and conditions for success in transdisciplinary research

For this form of transdisciplinary research to succeed, in addition to the disciplinary methods of scientific research, methods for integrating knowledge are also needed from different disciplinary perspectives and the non-scientific practical knowledge of the actors involved. Furthermore, moderation methods must be incorporated into the process design to a greater extent than in other research modes to enable the necessary social and communicative framework for transdisciplinary cooperation and knowledge integration. This integration work runs throughout the entire research process – from the joint recruitment of project partners who are identified as key actors in problem-solving, to the joint development of the problem definition, to joint project planning and the developed project design. In an iterative process, the actors involved, the problem definition, and the project design are repeatedly reflected upon and modified as necessary (Theiler et al., 2019, pp. 62-76). At the same time, however, new scientific insights, new research impulses, and increasing reflexivity among scientists naturally emerge because of the transdisciplinary research process (Marg & Theiler, 2023, pp. 635-647).

The challenge of transdisciplinary research lies particularly in integrating the various scientific and societal actors, along with their respective knowledge and different practices of knowledge production, as well as their respective interests and perspectives, throughout the entire research process. This integration operates at several levels: The level of knowledge integration concerns the linking of scientific expertise with everyday practical knowledge. The level of social integration involves connecting the different demands, expectations, and interests of various individuals, groups, and institutions. At the level of communicative integration, different communicative practices such as technical languages and terminology must be jointly clarified (Bergmann et al., 2010, pp. 41-43). In doing so, existing power structures and inequalities must also be recognised and balanced.

In order to ensure that this integration work is successful, there are various methods and tools that can be employed at different times and with different objectives in workshops with practice partners (see, for example, the td-net toolbox: scnat, n.d.; and the toolbox: tdAcademy, 2025). Even though a successful research and integration process increases the chances of successful implementation, the application of transdisciplinary methods and tools alone is not a guarantee of success. When it comes to the project goal of achieving societal transformation, various external conditions naturally also play a role, and these can be influenced only to a limited extent during the project period (e.g., sudden changes in political support, natural changes, new economic conditions, etc.).

3 Methodology: Formative competence development and reflexive evaluation in the InNoWest joint research project

As outlined in the introduction, the aim of this paper lies in examining how needs-based formats for building transdisciplinary competences can be formatively developed within an ongoing research project. Based on these experiences, the article further reflects on possibilities and limitations of institutionalising transdisciplinary competence building as well as transdisciplinary research as a research mode at German HEIs. To this end, the article draws on the German InNoWest joint research project as a single-case study, which, following a mixed-methods approach, is being informed by multiple sources of evidence (Yin, 2003). The InNoWest project is regarded here as a single case in the sense of a heuristically defined unit of analysis (Hering & Schmidt, 2014). Throughout the research process, which draws on various evaluation methods, the aim is to gain a comprehensive understanding of this specific case, particularly with regard to the factors relevant to the development of a needs-based portfolio of formats for formative competence development in transdisciplinary research. By placing the results within the context of the relevant academic literature, the findings are examined in terms of their relevance beyond the single case.

Accordingly, this section defines the boundaries of the InNoWest case and outlines the research design of the study as well as the data collection instruments and analysis methods underlying the iterative development and formative evaluation of the competence development formats within the subproject "Knowledge Transfer".

3.1 Case context: The InNoWest joint research project

The "Innovative University" programme, a funding initiative of the Federal Ministry of Research, Technology and Space, aims to raise awareness and provide support for the transfer of new research findings and application-oriented innovations as a third mission, particularly at small and medium-sized universities or universities of applied sciences, in order to promote the impact of universities as drivers of innovation in their regions (Bundesministerium für Forschung, Technologie und Raumfahrt, n.d.). The joint research project "InNoWest: Just do it! Working together for sustainability and digitalisation in north-west Brandenburg" (duration 01/2023 – 12/2027) is funded as part of this federal-state initiative. The aim of the project is to establish and consolidate transfer structures between science, municipal actors such as administrations, but also small and medium-sized enterprises (SMEs) and civil society in various communities in the north-west of the federal state of Brandenburg, Germany. Furthermore, the joint research project is also intended to have an impact on universities and to further develop and expand transdisciplinary research practices at the participating universities and HEIs (InNoWest, n.d.-a). InNoWest fosters reciprocal transfer between universities and society through transdisciplinary research: by convening actors from diverse scientific backgrounds (disciplines and universities) with actors from non-scientific practice, the project ensures the transfer of knowledge about relevant problems and working methods from practice to universities on the one hand, and promotes the transfer of jointly obtained results into the working practice of non-scientific actors on the other.

Structurally, InNoWest is a consortium with approximately forty employees and fifteen professors from three universities of applied sciences in Brandenburg – the Eberswalde University for Sustainable Development (HNEE), the Potsdam University of Applied Sciences (FHP), and the Brandenburg University of Applied Sciences (THB). The network comprises six teams, of which three teams are responsible for strategic and structural measures, as well as project coordination. The other three teams are so-called innovation teams that conduct research and work on topic-related projects. These pilot projects are located in the north-west Brandenburg region.

The objective of the InNoWest joint research project is, on the one hand, to provide impetus for sustainable development in and with the region in the areas of user-centred digitalisation, future-oriented restructuring, and education for sustainable development and participation. On the other hand, the project consortium aims to establish knowledge transfer between science and the various practical actors, create an exchange, initiate communication between universities and society, and implement this cooperation with practice in the university structure. The joint research project therefore does not rely on existing and established structures between science and society but aims

to do pioneering work – in establishing and, ideally, perpetuating such transfer structures between science and practice, in passing on knowledge about such successful projects to practitioners, and in establishing transdisciplinary research competences at universities.

The InNoWest sub-project "Knowledge transfer for regional learning processes" or team "Knowledge Transfer" is based in the strategic-structural teams and provides support to the innovation teams in their transdisciplinary research processes and transfer projects (Team Wissenstransfer, n.d.). The innovation teams in the InNoWest research network consist of researchers from various disciplines who contribute their disciplinary expertise to transdisciplinary research projects to help solve societal problems. Some of them already have experience in transdisciplinary or participatory projects, but this was not usually a key selection criterion when filling the positions. The task of the "Knowledge Transfer" team has been to develop and implement formats for transdisciplinary knowledge and competence development within the network, to stimulate reflection on research activities, and to promote the exchange of research at the participating universities of applied sciences.

3.2 Research design and evaluative logic

In developing the portfolio of services of the "Knowledge Transfer" team within the InNoWest research network, an iterative-prototyping and needs-oriented approach was adopted: based on best-practice examples from existing competence development projects aimed at promoting transdisciplinary research skills (Barth et al., 2020; Studer & Pohl, 2024), basic formats for potential offerings were identified. This concept was further developed through needs assessments conducted within the entire InNoWest project team. The content focus was guided by articulated needs. Throughout the duration of the InNoWest project, this approach was intended to develop a portfolio of services that supports the formative skill enhancement of researchers in transdisciplinary projects. For the target group-specific, iterative improvement of the portfolio of services, the individual service formats and contents were formatively evaluated using a mixed-methods design (Döring, 2023). The objects of evaluation were thus both the service formats and the specific content of the individual events. The central target group of the evaluation consisted of the heterogeneous group of scientific project staff, who differed in prior knowledge, professional background, and role within the InNoWest project. The evaluation instruments were each developed to suit the object of evaluation and the requirements of the target groups. Since the members of the stakeholder groups are heavily involved professionally and the individual programme formats are brief in duration, the instruments are designed to be processed quickly and easily. The central function of the evaluation was to determine the extent to which the programme formats and content promoted the participants' learning processes (competence development processes). Since the team members of the "Knowledge Transfer for Regional Learning" team both developed and conducted competence development programmes and also evaluated them, the evaluation concept was an internal evaluation. The potentially lower degree of neutrality associated with internal evaluation compared to an external evaluation form was addressed through critical reflection on potential role conflicts in all phases of the research process, as well as by dividing implementation and evaluation tasks within the team as much as possible.

3.3 Data collection instruments for evaluating competence development formats

The formats presented in more detail in Chapter 4 for promoting transdisciplinary methodological competence and reflection on research practice are listed in Table 1 along with their respective objectives and target groups. The last column of the table lists the data collection instruments used to evaluate the formats with the aim of their formative further development. For each format, an appropriate evaluation instrument was developed by the team "Knowledge Transfer" and used in addition to participation statistics, which on the one hand reflected the design and implementation of the offering and on the other hand served to identify further needs.

In addition, after just over a year of project duration, qualitative guideline-based interviews were conducted by members of team "Knowledge Transfer" with project staff in all roles to reflect on

the onboarding phase in the project consortium. The guideline included explicit questions for reflecting on the competence development formats. It also addressed the institutional context of research activities within the complex consortium project.

Table 1. Overview of the formats developed by the "Knowledge Transfer" team in the InNoWest research network

<i>Format</i>	<i>Target</i>	<i>Participants</i>	<i>Evaluation tools</i>
Methodology workshop "ttt – testing transdisciplinary tools"	Competence expansion in transdisciplinary methods	Researchers and professors of the InNoWest research network and employees of all four universities of applied sciences in Brandenburg	1. List of participants with professional background (standardised) 2. Observation sheets during the workshop (partially standardised) 3. Participant feedback rounds at the end of the workshop (partially standardised) 4. Questionnaire to the participants six weeks later (partially standardised)
Reflection workshops & peer consultation	Reflection on research activities and collaboration, exchange of experiences	Researchers and professors of the InNoWest research network & practice partners	1. Group discussion (partially standardised) 2. Participant feed-back sessions at the end of the workshop (partially standardised) 3. Reflections on the enquiries received by the 'Knowledge Transfer' team regarding peer consultation
Doctoral Day & doctoral and research colloquium	Strengthening cooperation between the four universities of applied sciences in Brandenburg & promoting transdisciplinarity as a research mode	Employees of all four universities of applied sciences in Brandenburg, especially doctoral candidates and students interested in pursuing a doctorate	1. Needs assessment among InNoWest researchers (partially standardised questionnaire) 2. Feedback sessions from the participants at the end of the Doctoral Day and the doctoral and research colloquium
Qualitative semi-structured interviews with members of the InNoWest research network to reflect on the onboarding phase in the collaborative project			Qualitative content analysis

Since most evaluation tools were designed as parts of the individual competence development programmes, their response rate for data collection was 100%. Only the questionnaires administered after the ttt workshops had an average response rate of 60%.

3.4 Analysis methods

The quantitative elements of the evaluation instruments (participant statistics, standardised elements of the observation sheets, and documentation of discussion rounds) were analysed using descriptive statistics. The qualitative elements (observation sheets, interviews, open responses, group discussions and reflections on the enquiries received by the "Knowledge Transfer" team) were analysed using qualitative content analysis according to Kuckartz (2018). The category system was initially developed deductively from the objectives of the programme portfolio and additionally

inductively from the data material during the coding process. To enhance analytical reliability, inter-coding was carried out by two members of the "Knowledge Transfer" team in each case.

3.5 Synthesis of the evaluation data

The findings presented in the results chapter are based on a triangulation of quantitative and qualitative evaluation data. The aim was to make visible the needs of the scientific staff of the InNoWest project as well as organisational and structural factors that influence the effectiveness of the competence development offerings. The triangulation took place in workshops of the entire "Knowledge Transfer" team, in which each member presented the results of the survey they had primarily conducted. The insights were then compiled and interpreted in relation to the common research questions. Explicitly, the possibility of bias in the results due to role conflicts of team members as both programme developers and evaluators was always reflected upon.

3.6 Ethical considerations

Ethical considerations were considered throughout all phases of the research process. Participation in all evaluation activities was voluntary. Participants were informed about the purpose of the study, the use of the collected data, and their right to withdraw at any time without any negative consequences. Data collection and processing were conducted in accordance with applicable data protection regulations, in particular the General Data Protection Regulation (GDPR). Personal data were minimised and, where collected, handled confidentially, pseudonymised where necessary, and stored separately. No personally identifiable information was included in the analysis or reporting of results. To further ensure the protection of participants' identities within the research consortium, results were reported in aggregated form, and potentially identifiable elements – such as the use of anchor quotations in the presentation of results – were deliberately omitted.

4 Results and discussion: Presentation and evaluative reflection of the formats for formative competence development

This section presents the individual formats for formative competence development in transdisciplinary research, which were developed by the "Knowledge Transfer" team. In addition, based on the synthesis of the evaluation results, the challenges and potential of the formats are discussed in terms of their contribution to the project objectives of InNoWest and to the fundamental promotion of transdisciplinary research competences.

4.1 Methodology workshop "ttt – testing transdisciplinary tools"

For transdisciplinary knowledge and competence expansion in InNoWest, a series of workshops entitled "ttt – testing transdisciplinary tools" was developed at the beginning of the joint research project (Kühn & Schmidt, n.d.). The format was designed based on experience gained from existing competence development projects, primarily from the BMFTR-funded "tdAcademy" project network and the td-net toolbox based at the Swiss Academies of Arts and Sciences (SCNAT). After the first workshop was held, detailed feedback on the format was collected and a survey was conducted to determine the need for further content. The aim of the workshop series is to provide innovation teams with process methods for the various phases of transdisciplinary and participatory project work and research. A workshop lasts 1.5 hours and usually takes place once a quarter. Initially, it was held in person, but an online workshop is now being designed and offered so that more employees from all three universities of applied sciences can participate. The workshop is structured in such a way that the respective tool is first briefly presented and then tried out together with the participants in a practical and application-oriented manner using a fictitious scenario. At the end of the workshop, attention is drawn to potential obstacles and moderation tips for using the tool. The idea behind this is that participants will then be able to use the tool themselves in their respective research projects. The tools have so far either come from the td-net toolbox of the Swiss Academy

of Arts and Sciences (schat, n.d.) or a separate workshop has been designed with the presentation of secondary literature on a specific question and a subsequent exchange of experiences on the respective topic.

When selecting topics, the aim is to choose the respective tool or topic in accordance with the needs-based approach to developing offerings in such a way that it also fits in with the respective stage of the innovation teams' project work. However, reflection on the project activities in the various innovation teams has shown that this is only possible to a limited extent due to the asynchronous nature of the projects in the different teams. For instance, some teams were already in close contact with partners in the field, while others were initially busy developing prototypes for practical applications and only approached potential partners in the field at a later stage of the project. Participation in the workshops was voluntary, with an average of five to seven participants per InNoWest workshop, corresponding to 10 to 20 per cent of project employees.

With regard to the participants of the workshops, an analysis of the list of participants showed that so far they have so far come almost exclusively from a specific professional culture and a specific area of work within the network: They were primarily humanities, cultural, and social scientists who already had experience with perspective shifts and reflexivity and whose areas of work within the InNoWest network were compatible with transdisciplinary areas of knowledge and competences, such as project management, stakeholder management, network expansion, or the development of a citizen science project. Based on the analysis of the various evaluation formats, it was determined that participation in the workshops was encouraged by this awareness among employees and depended on whether supervisors and the innovation team considered participation to be relevant to the project work.

Since one of InNoWest's tasks is to promote regional learning processes beyond the project period, the workshop series was opened to members of all four Brandenburg universities of applied sciences from December 2024 onwards. Since then, the workshop has also been used by various employees from all four universities who belong to different disciplines and status groups – from students in higher semesters and research assistants in the doctoral and postdoctoral phases to people in research support positions and professors. The fact that a disproportionate number of participants came from a university with an explicitly transdisciplinary orientation is seen as an indication that, even for those outside the project, familiarity with transdisciplinary working methods and the university's agenda setting in this regard are factors in the decision to participate. Participation in the workshops, which are open to all employees of Brandenburg's universities of applied sciences, has so far ranged between five and ten people. A particular challenge is to establish university-specific formats for promoting the programme.

Based on the findings from the feedback sessions and questionnaires, the formative support of transdisciplinary research activities through needs-oriented competence development offerings has the potential to support the research activities of those who participate in the offers. However, participation depends on specific framework conditions that influence the relevance attributed to transdisciplinary competences. In complex teams or organisations, needs orientation is limited by the asynchrony of the individual research processes.

4.2 Reflection workshops and peer consultation

Specific formats were developed for the researchers in the InNoWest research network to reflect on research activities in the innovation teams and in the network. Twice a year, a retreat or network meeting was held as part of the joint research project, to which all scientific staff and professors and, in some cases, practitioners or intermediaries were invited. To promote cooperation and mutual learning processes within the network and with practitioners, workshops and exchanges of experience were held at these meetings, which were organised or co-organised by the "Knowledge Transfer" team (Hobelsberger, n.d.). In addition, coaching sessions on team building and science communication, collegial advice for individual research projects, and further training on moderation methods for large groups were provided by external experts. In addition, the team working on the "Knowledge Transfer" sub-project was available to facilitate discussions and design workshops within the individual innovation teams. The innovation teams were supported in developing joint milestone plans for their projects, operationalising their goals, and addressing broad

questions about collaboration. The externally facilitated activities were designed directly within the teams and were evaluated positively. The involvement of the "Knowledge Transfer" team in internal team meetings was also initiated and announced by team coordinators, but was not always equally accepted by all, as it gave rise to concerns regarding confidentiality and the internal hierarchy of the teams.

The workshops were documented and the results were fed back into the research network or the relevant team. In response to feedback from the network meetings, in which orientation within the terminology and associated disciplinary discourse was repeatedly articulated as a challenge, a moderated terminology workshop for the entire InNoWest team was offered. In addition, the workshop was used as an impetus to clarify further terminology in the respective teams (InNoWest, n.d.-b). As a further development, the results of the terminology workshop were used to compile a glossary of terms commonly used within the InNoWest network, such as "transdisciplinarity", "transfer", but also "digitalisation" and "sustainability". The glossary was subsequently made available to the teams and the practice partners and was considered helpful for project work in feedback sessions and was further developed within the teams.

Another effect of these workshops was that the work of the "Knowledge Transfer" team became more visible to the innovation teams, who subsequently approached the "Knowledge Transfer" team with a request to design and conduct workshops at their own internal team meetings and in-person attendance days. The topics covered also included clarifying roles and responsibilities within the team.

Formative opportunities for reflecting on research practices and the quality of processes thus provide opportunities for the further development of needs-based initiatives, as illustrated by the example mentioned above of developing a shared glossary within the teams. When designing programmes, consideration should be given not only to thematic priorities but also to staff configurations and project- or institution-specific power structures, as demonstrated by the requests for mediation in team conflicts received by the "Knowledge Transfer" team.

4.3 Doctoral Day and doctoral and research colloquium

The development of the doctoral and research colloquium provides a particularly vivid illustration of the iterative and needs-oriented format development process: Since promoting and strengthening cooperation and exchange on research and transfer among Brandenburg's universities of applied sciences is one of InNoWest's project goals, the "Knowledge Transfer" team developed a concept for a doctoral and research colloquium. As a result of the concept presentation to the project's professorial staff, it was recommended that a needs assessment be carried out among the project staff. The needs assessment showed broad interest in offers to promote doctoral projects, but with a focus on organisational issues. Therefore, the colloquium concept was put on hold and an information day on the topic of doctoral studies was designed first. To establish the programme across all four universities of applied sciences in Brandenburg from the outset, it was developed and implemented in close cooperation with the doctoral programme coordinators of all four universities. In this way, the Doctoral Day also served as a pilot project for the planned Brandenburg doctoral programme for the implementation of the newly created right to award doctorates at universities of applied sciences and was initiated and implemented in autumn 2024 at the Potsdam University of Applied Sciences (Schmidt, n.d.). The Doctoral Day was very well attended for a premiere, with approximately sixty participants. It was continued in autumn 2025 at the Eberswalde University for Sustainable Development (InNoWest, n.d.-c).

The Doctoral Day created a format for strengthening cooperation between the four Brandenburg universities of applied sciences and establishing their practical and application-oriented nature as a "trademark". One piece of emphatic feedback from the Promotion Day was that there was a desire for an exchange of content with examples of research at universities of applied sciences and the opportunities for doctoral studies. The formal offer thus paved the way for initiating a needs-oriented professional exchange, which had been considered less relevant in the initial needs assessment in the project context. The Doctoral Day was the start of a doctoral and research colloquium at Brandenburg's universities of applied sciences, which was held as an online event in the summer semester of 2025 under the title "Application-oriented – problem-solving –

transdisciplinary: Research at universities of applied sciences" (InNoWest, n.d.-d). The number of participants in the colloquium in the summer semester was approximately twenty per session. The doctoral and research colloquium was also continued in the winter semester 2025/26. Since the summer semester of 2026, both tasks have been taken over by the newly established service centre for the doctoral programme at Brandenburg's universities of applied sciences. This meant that both the Doctoral Day and the doctoral and research colloquium were well established and institutionally anchored in such a way that they can continue to take place even after the InNoWest funding has expired.

As the case of the divergent responses at different points in time regarding the need for a research colloquium shows, a consistent focus on needs when developing capacity building programmes may require questioning formulated goals and adjusting them in response to identified needs. It may become apparent that ambitious goals can be accepted through intermediate steps. Linking these formats to institutional structures also appears to be helpful for integrating project structures into university operations.

5 Summary of results and conclusion: Transdisciplinary research between societal application orientation and disciplinary career paths

At the outset, the following research question was formulated:

How can needs-based formats for developing competences in transdisciplinary research be formatively developed within an ongoing research project?

The results of the iterative offer development and its formative evaluation presented in Chapter 4 clearly show, within the framework defined by the project constellation and study design, that a needs-oriented competence development concept for transdisciplinary research can fundamentally be designed effectively, but its impact depends largely on organisational conditions.

The analysis highlighted that formats such as methodology workshops, reflection spaces, or cross-university doctoral programmes can be successfully developed prototypically and adapted based on the results of their formative evaluation. Their benefits – particularly in terms of expanding methodological and reflective competences – are demonstrable through the generally positive feedback from participants as well as through their respective role in the research activities of the actors in the project, provided that they are utilised.

The InNoWest project case study highlights the following key findings: Overall, the concept of competence development accompanying the research process was well received. However, it was not possible to reach all researchers, as their willingness to participate depended on their awareness of the topic and was influenced by the commitment of their supervisors or the university's agenda-setting. In particular, researchers from the humanities, cultural studies and social sciences took part, as well as academics who were generally familiar with transdisciplinary working methods due to their university's agenda. Formative reflection on research practice supported the further development of the InNoWest consortium. Programmes were sometimes more readily accepted when developed incrementally. Moreover, assessing needs involved not only identifying content-related requirements but also considering personnel and hierarchical structures within the consortium.

Furthermore, based on our experience with formative competence development in the case study of the InNoWest joint research project, it can be concluded that a needs-based approach reaches its limits in heterogeneous and asynchronous project constellations: As has been shown, the development of tailor-made programmes within larger consortia or even across an entire organisation is scarcely feasible due to differing project phases, roles and dynamics. This suggests that, whilst iterative format development in transdisciplinary research is a central component of successful competence development, it does not constitute a sufficient or generalisable condition. Additionally, scientists themselves perceive a clear distinction between discipline-specific competences and those transdisciplinary skills that target the social, communicative, and process-related dimensions of knowledge integration (Jahn et al., 2012; Barth et al., 2020). However, in transdisciplinary projects, these two areas of expertise are not only distinct but are often arranged in

a hierarchical order: From a systemic perspective, specialist skills are traditionally valued more highly within the academic system, whilst skills relating to knowledge integration or process management receive less institutional support. As long as disciplinary excellence criteria – such as “originality of research, international competitiveness, and academic reputation” (Verwaltungsvereinbarung, 2022) – remain dominant and the corresponding assessment criteria are primarily focused on disciplinary theories and methods as well as on discipline-specific publication cultures, transdisciplinary skills appear to many researchers to be an “add-on” with little institutional value. Studies also show that doctoral projects in transdisciplinary contexts are often viewed, in the short term, as disadvantageous for career progression (Rogga & Zscheischler, 2021). This reveals a clear discrepancy between the socially demanded transdisciplinary practice and the still discipline-oriented evaluation and incentive structures of the scientific system.

Against this backdrop, it is clear that needs-based initiatives for skills development and networking can indeed help to reduce this perceived gap, but only to a limited extent. As observed in our workshops, opportunities for transdisciplinary skills development are often viewed as supplementary to core disciplinary tasks and are only taken up when time is available, when there is an explicit expectation from line managers, or when the task is embedded in the individual’s job description. The findings from the evaluations also show that while many employees are highly interested in the societal impact of their research, further training in transdisciplinary methods is not always seen as a priority task. At times, even the high application orientation and the associated slowing down of work processes are perceived as a risk to their own professional development. This impression can be reinforced when researchers in transdisciplinary project contexts feel that they are not adequately prepared for the associated demands. The fact that some research staff have left the InNoWest consortium to pursue discipline-oriented doctoral projects also points to structural tensions.

At the same time, the new forms of cooperation and exchange developed within the InNoWest project – such as cross-university retreats, a joint glossary of key terms, or the established doctoral and research colloquium – make visible the potential of structured, institutionally supported learning spaces to anchor transdisciplinary research in the long term. The demands formulated in the tdAcademy position paper for capacity-building initiatives, reliable career paths, and stronger institutionalisation of transdisciplinary and transformative research (Partner:innenkreis tdAcademy, 2023) therefore align directly with the experiences gained in the InNoWest project. Establishing corresponding structural conditions – both in the funding landscape and within academic institutions – would be a central component in addressing the currently visible challenges.

Several limitations of the study should be acknowledged. First, by drawing on the InNoWest project as a single case study, the specific institutional and regional context of the InNoWest project may limit the transferability of the results to other settings. Second, the internal nature of the evaluation entails potential biases related to the dual role of the members of team “Knowledge Transfer” as both programme developers and evaluators. Although efforts were made to mitigate these effects through reflexive practices and a partial separation of roles, the possibility of bias cannot be fully excluded. Third, self-selection effects may have influenced the findings, as participation in the competence development formats was voluntary. It is therefore likely that individuals with a prior interest in transdisciplinary research were overrepresented in the evaluation. Finally, the study focuses primarily on short- to medium-term competence development processes. Long-term effects on research practices, institutional change, or career trajectories could not be assessed within the scope of this study.

Nevertheless, based on the experience of the „Knowledge Transfer” team with the formats offered for developing transdisciplinary research competences, it can be demonstrated that familiarity with the specific characteristics, challenges and conditions for success of transdisciplinary research is key to the acceptance and prioritisation of transdisciplinary tasks. Greater structural recognition of transdisciplinary competences within the academic system could therefore provide crucial incentives for a broader anchoring of this research approach. With the expansion of appropriate institutional structures and recognition systems, the identified challenges could likely be further reduced in the future, and the societal application orientation of HEIs could be sustainably strengthened.

References

- Barth, M., Bruhn, A., Lam, D. P. M., Bergmann, M., & Lang, D. J. (2020). Capacity building for transformational leadership and transdisciplinarity. *GAIA*, 29(3), 195–197. <https://doi.org/10.14512/gaia.29.3.12>
- Bergmann, M., & Schramm, E. (Eds.). (2008). *Transdisziplinäre Forschung: Integrative Forschungsprozesse verstehen und bewerten [Transdisciplinary Research: Understanding and Evaluating Integrative Research Processes]*. Campus.
- Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., & Schramm, E. (2010). *Methoden transdisziplinärer Forschung: Ein Überblick mit Anwendungsbeispielen [Methods of Transdisciplinary Research: An Overview with Application Examples]*. Campus.
- Bruckermann, T., Henke, J., Schrögel, P., & Sturm, U. (2025). Die Vielfalt der Partizipation in der Forschung: Begriffe, Methoden und Perspektiven [Methods of Transdisciplinary Research: An Overview with Application Examples, Preprint]. *Open Science Framework*. https://doi.org/10.31235/osf.io/uyt7z_v1
- Bundesministerium für Bildung und Forschung. (2023). *Partizipationsstrategie Forschung [Participation Strategy Research]*. Retrieved July 7, 2026, from https://www.bmfr.bund.de/SharedDocs/Downloads/DE/2023/partizipationsstrategie.pdf?__blob=publicationFile&v=4
- Bundesministerium für Forschung, Technologie und Raumfahrt. (n.d.). *Transfer in die Praxis: Innovative Hochschule [Transfer into Practice: Innovative University]*. Retrieved December 3, 2025, from https://www.bmfr.bund.de/DE/Forschung/TransferInDiePraxis/InnovativeHochschule/innovativehochschule_node.html
- Döring, N. (2023). *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften [Research Methods and Evaluation in the Social and Human Sciences]*. Springer Berlin Heidelberg. <https://doi.org/10.1007/978-3-662-64762-2>
- Gesellschaft für Hochschulforschung. (2025). *Call for Papers GfHf 2025: Die gesellschaftsrelevante Hochschule – Wie kann Integration von Wissenschaft, Praxis und Gesellschaft gelingen? [Call for Papers GfHf 2025: The socially relevant university – How can the integration of science, practice, and society succeed?]* Retrieved December 2, 2025, from <https://www.gfhf.net/call-for-papers-gfhf-2025-die-gesellschaftsrelevante-hochschule-wie-kann-integration-von-wissenschaft-praxis-und-gesellschaft-gelingen/>
- Grunwald, A., Schäfer, M., & Bergmann, M. (2020). Neue Formate transdisziplinärer Forschung: Ausdifferenzierte Brücken zwischen Wissenschaft und Praxis [New formats of transdisciplinary research: Detailed bridges between science and practice]. *GAIA*, 29(2), 106–114. <https://doi.org/10.14512/gaia.29.2.8>
- Hering, L. & Schmidt, R. (2014). Einzelfallanalyse [Individual case analysis]. In N. Baur & J. Blasius (Eds.), *Handbuch Methoden der empirischen Sozialforschung [Handbook of Methods of Empirical Social Research]*, (pp. 529–541), Springer VS, Wiesbaden, https://doi.org/10.1007/978-3-531-18939-0_37
- Hobelsberger, C. (n.d.). *Austauschformate zu transdisziplinären Forschungsprozessen [Exchange formats for transdisciplinary research processes]*. Retrieved December 2, 2025, from <https://innowest-brandenburg.de/projekte/austauschformate-zu-transdisziplinaren-forschungsprozessen>
- Hoffmann, S., Thompson Klein, J., & Pohl, C. (2019). Linking transdisciplinary research projects with science and practice at large. *Environmental Science & Policy*, 102, 36–42. <https://doi.org/10.1016/j.envsci.2019.08.011>
- InNoWest. (n.d.-a). *InNoWest – Einfach machen! [InNoWest – Just do it!]* Retrieved December 3, 2025, from <https://innowest-brandenburg.de/ueber-uns>
- InNoWest. (n.d.-b). *Unser Glossar [Our glossary]*. Retrieved December 3, 2025, from <https://innowest-brandenburg.de/glossar>
- InNoWest. (n.d.-c). *Promotionstag 2025 [Doctoral Day 2025]*. Retrieved December 3, 2025, from <https://innowest-brandenburg.de/veranstaltungen/promotionstag-2025>
- InNoWest. (n.d.-d). *Promotions- und Forschungskolloquium [Doctoral and Research Colloquium]*. Retrieved December 3, 2025, from <https://innowest-brandenburg.de/projekte/forschungs-und-promotionskolloquium>
- Jahn, T., Bergmann, M., & Keil, F. (2012). Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics*, 79, 1–10. <https://doi.org/10.1016/j.ecolecon.2012.04.017>
- Kuckartz, U. (2018). *Qualitative Inhaltsanalyse. Methoden, Praxis, Computerunterstützung [Qualitative Content Analysis. Methods, Practice, Computer Support]* (4rs ed.). Beltz Juventa.
- Kühn, C., & Schmidt, G. (n.d.). *Transdisziplinäre Tools praxisnah erleben: Workshop-Reihe „ttt – transdisziplinäre tools testen“ [Experience transdisciplinary tools hands-on: Workshop series 'ttt – testing transdisciplinary tools']*. Retrieved December 2, 2025, from <https://innowest-brandenburg.de/projekte/ttt-transdisziplinäre-tools-testen>
- Lawrence, M. G., Williams, S., Nanz, P., & Renn, O. (2022). Characteristics, potentials, and challenges of transdisciplinary research. *One Earth*, 5(1), 44–61. <https://doi.org/10.1016/j.oneear.2021.12.010>
- Marg, O., & Theiler, L. (2023). Effects of transdisciplinary research on scientific knowledge and reflexivity. *Research Evaluation*, 32, 635–647. <https://doi.org/10.1093/reseval/rvad033>
- Partner:innenkreis tdAcademy. (2023). Transdisziplinäre und partizipative Wissenschaft stärken und eine nachhaltige Zukunft gestalten [Strengthen transdisciplinary and participatory science and shape a sustainable future]. *GAIA*, 32(1), 210–212. <https://doi.org/10.14512/gaia.32.1.101>
- Pohl, C., & Hirsch Hadorn, G. (2007). *Principles for designing transdisciplinary research*. Oekom. <https://doi.org/10.14512/9783962388638>
- Rogga, S., & Zscheischler, J. (2021). Opportunities, balancing acts, and challenges: Doing PhDs in transdisciplinary research projects. *Environmental Science & Policy*, 120, 138–144. <https://doi.org/10.1016/j.envsci.2021.03.009>

- Schmidt, G. (n.d.). *Erfolgreicher Promotionstag an der FH Potsdam [Successful Doctoral Day at FH Potsdam]*. Retrieved December 3, 2025, from <https://innowest-brandenburg.de/beitraege/erfolgreicher-promotionstag-an-der-fh-potsdam>
- scnat. (n.d.). *td-net toolbox*. Retrieved December 2, 2025, from https://naturalsciences.ch/co-producing-knowledge-explained/methods/td-net_toolbox
- Studer, S., & Pohl, C. (2024). Methodensammlungen für die transdisziplinäre Forschung [Collections of methods for transdisciplinary research]. In M. Sonnberger, A. Bleicher & M. Groß (Eds.), *Handbuch Umweltsoziologie [Handbook of Environmental Sociology]*, (pp. 563-576). Wiesbaden: Springer Fachmedien Wiesbaden.
- tdAcademy. (2025). *Capacity building: Available online and on request*. Retrieved December 2, 2025, from <https://td-academy.org/en/tdcapacitybuilding/our-offers/capacity-building/>
- td-net. (2025). *Three types of knowledge*. Retrieved December 2, 2025, from <https://en.transdisciplinarity.ch/transdisciplinarity/principles-of-transdisciplinary-research/three-types-of-knowledge>
- United Nations Conference on Environment and Development. (1992). *Agenda 21*. Retrieved July 7, 2026, from https://www.un.org/german/sites/default/files/2024-09/agenda_21.pdf
- Team Wissenstransfer. (n.d.). *Wissenstransfer für regionale Lernprozesse [Knowledge transfer for regional learning processes]*. Retrieved December 2, 2025, from <https://innowest-brandenburg.de/themen/wissenstransfer-fuer-regionale-lernprozesse>
- Theiler, L., Marg, O., Ransiek, A.-C., & Nagy, E. (2019). Anforderungen an wirkungsvolle Methoden für transdisziplinäre Wissensintegration [Requirements for effective methods for transdisciplinary knowledge integration]. In L. Sattlegger, L. Deppisch & M. Rudolphi (eds.) *Methoden umweltsoziologischer Forschung [Methods of environmental sociology research]* (pp. 62–76). ISOE – Institut für sozial-ökologische Forschung.
- Thompson Klein, J., Häberli, R., Scholz, R. W., Grossenbacher-Mansuy, W., Bill, A., & Welti, M. (Eds.). (2001). *Transdisciplinarity: Joint problem solving among science, technology, and society*. Birkhäuser. <https://doi.org/10.1007/978-3-0348-8419-8>
- Verwaltungsvereinbarung. (2026). *Exzellenzstrategie [Excellence strategy]*. Retrieved July 23, 2026, from https://www.gwk-bonn.de/fileadmin/Redaktion/Dokumente/Papers/BLV_ExStra.pdf
- WBGU. (2011). *Welt im Wandel: Gesellschaftsvertrag für eine große Transformation [World in Transition: Social Contract for a Major Transformation]*. Retrieved December 3, 2025, from <https://www.wbgu.de/de/publikationen/publikation/welt-im-wandel-gesellschaftsvertrag-fuer-eine-grosse-transformation>.
- Wissenschaftsrat. (2020). *Anwendungsorientierung in der Forschung: Positionspapier [Application Orientation in Research: Position Paper]*. Retrieved December 2, 2025 from <https://www.wissenschaftsrat.de/download/2020/8289-20.html>
- Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Sage Publications.

SOCIAL INEQUALITY IN ACADEMIC SUCCESS

Luisa Junghänel  ^{1*}

¹ Heinrich-Heine-University Düsseldorf, Germany

Keywords:

Academic success
Academic performance
Social inequality
Dropout
Quantitative research

Article history:

Received: 15 January 2026
Revised: 12 April 2026
Accepted: 14 April 2026

To cite this article:

Junghänel, L. (2026). Social Inequality in Academic Success. European Scientific Journal for Dual Higher Education (ESJ DHE), 2 (3), 81-92.
<https://doi.org/10.82321/07ma-34m614>

Abstract

Educational success is not equally distributed among university students. Although access routes to higher education have expanded, most students still come from more affluent backgrounds. This study examines current students and their trajectories through university. Academic performance is operationalised as students' mean grade to date. Using data from a quantitative questionnaire, linear regressions were estimated to identify factors associated with academic success. Significant associations were found for the grade achieved in the university entrance qualification, school type, dropout intention, and growing up in a single-parent household.

1 Introduction

Attending university has become a common route for young adults leaving school. Around every second person now decides to pursue higher education (Kracke et al., 2024). Routes into higher education have changed, allowing individuals to qualify through work experience rather than solely through a university entrance qualification (Fachabitur/Abitur) (Dahm & Kerst, 2019). Opening universities in this way was seen as an opportunity to strengthen exchange between tertiary education and the labour market. Individuals who had not previously considered university accessible were given new opportunities to begin studying. An increase in student numbers might be expected to increase the diversity of students' social backgrounds, but only 2.5% of all students did not qualify through the usual route of a university entrance qualification (Kroher et al., 2023). Additionally, 69% of students grew up in an academic household with at least one parent holding a university entrance qualification. Parents' education is one of the key components explaining university attendance. 17% of German students have a migration background, making them a minority on campus. Why does this divide persist if access to university is formally available to most people? This study examines differences in academic success in relation to social inequality. Is there a reason why so many people decide against attending university? Is this decision shaped by the expectation that they are unlikely to succeed?

Most students at German universities come from academic families and possess more university-related cultural capital (Heil et al., 2019). High discrepancies between a student's social origins and the conventions at university can lead to dropping out (Heil et al., 2019). International students are more likely to drop out of university, men are less likely to reach a degree compared to

* Corresponding author

E-mail address: luisa.junghaenel@hhu.de

women, and children whose parents have lower education are less likely to attend university (Becker, 2011; Heublein et al., 2017; Zimmermann et al., 2021). These patterns may indicate that the university experience is not the same for all students but rather that there are significant differences in who performs well at university. There has been plenty of research detailing the cumulative disadvantages children from non-academic families face in the education system (Bachsleitner et al., 2022). This pattern is likely to continue into university life. Examining the effects at this level is especially important as university degrees have become more common these days, potentially leading to higher social inequality in the long run.

The focus of the study is on factors contributing to social inequality at university such as parents' education, growing up in a single-parent household, prior school grades, and the type of school attended. A comprehensive survey of students of computer science and social sciences at a university in North-Rhine Westphalia was conducted, which asked students about personality, integration at university, prior school performance, and sociodemographic characteristics. Survey data were matched with performance data from the examination office to analyse possible factors of social inequality affecting academic success. The main question of this paper is how academic success is impacted by social inequality. This is done by examining different explanations of educational attainment and identifying the factors of social inequality within them. On this basis, hypotheses about effects on academic success are formulated. Academic success is operationalised using the mean grade across all examinations. The impact of relevant factors on educational attainment is examined empirically. Variables are compared in their strength for explaining the difference in academic success. Finally, possible further research is proposed. A preliminary version of this work was presented as a poster at the Annual Conference of the German Society for Higher Education Research 2025.

2 Theories

Several theories attempt to explain differences in educational success among university students. To explain why students drop out, Tinto (1975) introduced a model focusing on integration into the university system. He distinguishes between social and academic integration, arguing that university is a new social field which necessitates a specific integration. At university there are different rules for acting, talking, and interacting with peers and professors. Understanding these internalised rules as well as behaving along with them can be especially difficult if this is the first time you encounter them. If you do not have parents who already studied, you will not have encountered the very specialised rules that impact university experiences. Integration into university will be more difficult, leading to higher dropout intentions.

Further explaining the way integration can be more difficult for some students, the capital theory attempts to explain these class differences (Bourdieu, 2012). It posits that there are a variety of capitals humans use to navigate in society. For integration at university, cultural, social, and economic capital are key, therefore parents transmit their own capital to their children to give them better opportunities. Since not all parents have the necessary capital, students are less likely to be successful at university. A lack of relevant capital can be one reason for failing at university. This is also related to the habitus which refers to class-specific behaviour that is internalised in childhood. Growing up in a certain social class leads to specific actions and attitudes we do not actively think about. Interacting with people from different social classes can lead to difficulties if there are big discrepancies in the habitus. University can be viewed as a very specific social world with many unspoken rules. Students who do not have an academic background might struggle to fit in.

Students' social background affects educational attainment (primary effects) as well as educational decisions (secondary effects) leading to disadvantages for students from lower social backgrounds (Boudon, 1974). The resources at home determine the achievements children reach in school. Parents with higher education are more likely to spend their resources on their children's education. They might spend a lot of time reading to them or already teaching them to read or write. Still, even if children from disadvantaged backgrounds reach the same level of educational achievement as children from higher social classes, their socioeconomic status impacts their educational decisions. The decision-making process can be quite different due to subjective

assessments of benefits, costs and risks associated with each educational path. While children from academic families need to attend university to maintain their parents' social class, children from non-academic families would already be moving upwards on the social ladder. This means that the incentive to attend university is not the same across all social classes. On the path through the educational system there are many selection processes, leading to different educational trajectories. Thus, some children do not get the option to attend university since they go to a school that will not grant them the necessary qualifications (Bachsleitner et al., 2022; Kracke et al., 2024). The German school system is characterised by an early transition into secondary school after four years of primary school leading to higher social inequality.

The time spent at university is characterised by many small decisions leading to the level of academic success that is reached. The different decisions students make in similar situations can be explained by the subjective expected utility (Heublein, 2014). Each student has subjective expectations regarding their academic performance. How likely does the student think it is that they will successfully finish their studies? Students also form individual estimates of the expected benefit of getting their diploma. Is the diploma worth the time they put into studying? Additionally, students will think about alternative courses of action. Which realistic alternatives are there to studying? Based on their subjective expectations and assessment students will choose their route through university, i.e. continuing their studies or dropping out. Students might perceive getting their bachelor's degree as more important if their parents also have that level of education. Similarly, they might think it more likely that they will be successful.

For the German case specifically Heublein et al. (2010) confirm that the integration into the structures of university and having interpersonal connections with other students plays a role in performing well at university. Integration into the social circle at university can be an important step for students who did not grow up with people with university degrees. The amount of knowledge students start university with can also be considered a factor as well as the social origin. Parents' education plays a role in the choice of field of study (Heublein et al., 2010).

With widening participation in higher education schools need to provide more knowledge to their students to offer them equal opportunities (O'Sullivan et al., 2019). The first year of university is especially important for retention since early academic success gives an incentive to keep studying. Support therefore needs to begin early (Westrick et al., 2021). Simply increasing educational opportunities does not reduce inequalities in academic success between students of low and high socioeconomic status (Liu et al., 2022). Instead, quality indicators may be important, for example teacher-student ratios, the proportion of disadvantaged children or supportive quality learning environments. Grade point average, ECTS credits, and gender are among the most consistent predictors of academic performance and are mediated by factors like self-efficacy, prior education, finances and academic engagement (Kocsis & Molnár, 2025).

Students with higher self-efficacy are more likely to successfully finish their studies (Sarcelletti & Müller, 2011). Self-reflexivity as well as other psychosocial dispositions are relevant for the academic trajectory at university (Baalmann et al., 2020). These factors can be especially important when it comes to everyday decisions at university. Attending lectures and interacting with other students is a regular activity impacting academic success (Ifenthaler & Yau, 2020).

Usually, dropout is not caused by a single factor but rather multiple factors that coincide (Heublein, 2014). Difficulties with social integration can lead to lower self-efficacy which in turn leads to a dropout due to both happening together. Developing social capital at university is not only important for successfully completing one's degree but also for creating a professional network for finding employment (English et al., 2021).

Increasing numbers of students are leaving university without a degree, especially in the field of computer science (Heublein et al., 2017). This is not only a problem for the students who do not receive a qualification for their studies but also universities since they receive financial support from the state based on their graduation rate.

Research so far has shown that there is social inequality among those who leave university without a degree. Men are less likely to finish their degree as well as foreign students (Falk et al., 2022). Students from non-academic households are also less likely to finish their degree (Isleib, 2019). Dropping out can be related to feeling like they do not fit into the university system for those

students (Heil et al., 2019). Non-traditional students are more likely to drop out, primarily because of financial difficulties or poor academic performance (Herrmann, 2022).

Dropping out of university is not necessarily the opposite of academic success (Ülpenich et al., 2023). Rather, it depends on whose perspective we are examining. Possible dimensions of academic success include: „academic achievement, satisfaction, acquisition of skills and competencies, persistence, attainment of learning objectives, and career success” (York et al., 2015, 9). One’s individual idea of success is also relevant since every student has a different goal in mind (Heil et al., 2019). While some students might perceive certain skills as most important, others might be more focused on their job opportunities when they finish university. From the institution’s perspective, degree completion is most relevant since universities are financially dependent on high success rates (Bornkessel, 2018). For this purpose, the analysis considers all grades that students have received at university to date and uses their mean as an indicator of academic success. Although it is possible to complete a degree with low grades, students with higher grades are generally viewed as more successful. Especially if students are planning to also do a master’s degree, certain grades are necessary to get into the programme.

In the German context, it is important to examine the different school forms students attended beforehand. These school forms differ in how they prepare pupils for further education. While the Gymnasium is explicitly preparing for university, comprehensive schools are more likely to focus on vocational training (Isleib & Woisch, 2018). Apart from those two school forms, no other school immediately leads to the university entrance qualification. Students wanting the necessary qualification for university must spend more years to reach this qualification, which is why most students have attended the Gymnasium. In this study, 72.2% of respondents received their qualification at a Gymnasium.

Single-parent households are becoming more common, raising questions about the impact this has on the children growing up with only one parent. While there has been little research specifically on university, there are several articles discussing education in general. In Germany, parental separation has a substantial negative effect on the probability of attending the Gymnasium as well as on school grades in German and Mathematics (Grätz, 2015). Interestingly, these negative effects were limited to children with low-educated parents. Children with highly educated parents are not negatively affected by parents’ separation in educational outcomes. Especially the father’s education matters for the extent of a compensatory effect of social origin.

It is established that children from single-parent households are less successful at school since they are in a specific risk situation (Peuckert, 2012). According to PISA data there is a substantial achievement gap in mathematics between children from single-parent households and those from two-parent households (Woessmann, 2015). When controlling background factors, the achievement disparity gets smaller but still exists. Growing up in a household where the father is absent is found to negatively impact educational outcomes, specifically mathematics scores (Radl et al., 2017). Students living in two-parent households reach higher GPAs compared to students in single-parent households (O’Malley et al., 2015). This is most likely due to social or relational resources lacking in the home environment. Students from single-parent households recently going through divorce do not only show lower academic performance but are also likely to be more withdrawn, sad or anxious (Iqbal et al., 2021). Anti-social behaviour occurs more often and their development in interpersonal behaviour is more likely to be lacking. Students with divorced parents are found to have a higher intention of dropping out and lower academic success (Baalmann & Feldhaus, 2020). Interestingly, boys seem to suffer stronger negative consequences from growing up in a single-parent household (Barajas, 2011; Garg et al., 2007; Wasserman, 2020). This could be due to missing gender role models in a household or differences between boys and girls in response to parental inputs. Parental separation is especially detrimental for father involvement, which is even more reduced for girls (Grätz, 2017).

Single-parent households are more likely to suffer from economic instability, especially since most single parents are female. Around a third of single-parent households in Germany are in danger of poverty (Zartler & Berghammer, 2023). Poverty is one of the key contributors to lower educational achievements as well as dropping out of school (Jones et al., 2018). Due to the time constraints of providing an income as well as caring for a child alone, single parents have less opportunity to help their child with problems in school (Zartler & Berghammer, 2023). The children are missing out on

the resources of the parent who leaves since parental separation complicates the transmission of human capital (Bernardi & Boertien, 2017). The more resources the leaving parent has, which is usually the father, the more resources the child loses access to. All these risk factors interact with each other, creating a unique challenge for single-parent households. Since 25.32% of respondents answered that they grew up in a single-parent household, it is a significant portion of students who are impacted by this specific constellation of risk factors. Examining the influence of growing up with a single parent is important to distinguish this specific pattern of factors from other factors of social inequality.

3 Method and data

Panel data were collected over three years in the BMBF-supported project “Responsible Academic Performance Prediction” (RAPP). Students at a German university were questioned about their university life as well as their living situations. For this research, we examined two distinct fields of study, social sciences and computer science. Enrolment in social sciences is limited by a numerus clausus and only a few students leave the university without a degree. In contrast, computer science is open to anyone and there is a high number of dropouts. With these opposite fields of study, the study attempts to account for possible influences on university trajectories. Studying with lower school grades is assumed to be less likely to be successful.

The constructs self-efficacy (Beierlein et al., 2014) and self-reflexivity (Knispel et al., 2021) were used in the survey to assess how students rate their own skills. To measure the social integration students were asked about their social network, specifically if they know people who can help them in specific situations, i. e. moving or writing applications. Students were asked about their intention to drop out and whether they grew up in a single-parent household, as this may be associated with lower academic success. Participants also reported their parents’ highest level of education which was recoded according to the ISCED. The students self-reported the grade of their university entrance qualification.

Three waves were collected at the beginning of 2022, the end of 2022, and the end of 2023 via the platform Tivian. With multiple data points, it was possible to follow students during their whole university trajectory. The first questionnaire was thus spread among students at the beginning of their studies. The aim was to reach students in the first, third, fifth and seventh semester. The study was promoted in different classes, forums as well as messages on the university portal. Additionally, there was a raffle to encourage students to participate. The questionnaire asked about personality traits, student behaviour, social origins, sociodemographic markers and the self-reported likelihood of dropping out of university. In addition, students were asked for permission to match these answers with their existing data on educational attainment at the examination office. From this, we obtained direct information on taken classes, collected ECTS, withdrawals from exams and received grades. Using this data, we can quantify the academic performance of the students. For the main variable we use the aggregation of all grades students have received up until data collection. The grades range between 1 (best grade) and 5 (worst grade, meaning failing the exam), with additional distinctions of .3 and .7. For the aggregation the average grade was calculated to ensure a simple but meaningful main variable. While the grades are weighted differently at university, this varies considerably by field of study; in contrast this operationalisation is always easily applicable.

After data cleaning, 399 students remained in the sample, 53.38% studying computer science and 46.62% social sciences. 24.06% of the sample grew up in a single-parent household, 72.18% attended a Gymnasium with only 27.82% going to any other school form. The average grade of university entrance qualification is 2.22 with a standard deviation of 0.58, grades ranging from 1 to 3.7. Since there is a numerus clausus for studying social sciences, any grades lower than around 2.2 are likely to be reported by students of computer science.* For the variable withdrawal from exam the numbers of withdrawals were added up, ranging from 0 to 8 and the average being 3.69 (SD: 0.82). Further descriptive details of the dataset can be found in the appendix.

Linear regressions were estimated for the mean grade. This was done with three models to differentiate the various dimensions impacting academic success.

* The average for computer science is 2.34 and for social sciences 2.09.

4 Results and discussion

Table 1 displays the results of a linear regression on the mean grade at university. In Model 1, psychosocial dispositions and social integration were included. Those three variables can explain 12.2% of the variance in the mean grade. The social network has a positive impact on the mean grade the larger the social network, the better the grade. Self-reflexivity is positively associated with students' grades as well; the higher students rate this the better their grades are. Lastly self-efficacy is positively related to better grades. If students report high self-efficacy, they are more likely to have good grades.

Table 1. Linear regression on the mean grade at university

	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Intercept	4.781*** (0.285)	4.069*** (0.336)	2.521*** (0.338)
Social network	-0.095** (0.029)	-0.061* (0.029)	-0.019 (0.025)
Self-reflexivity	-0.189+ (0.102)	-0.145 (0.103)	-0.152+ (0.089)
Self-efficacy	-0.249*** (0.070)	-0.172* (0.068)	-0.119* (0.059)
Dropout intention		0.064** (0.021)	0.042* (0.019)
Withdrawal from exam		0.101* (0.043)	0.093* (0.037)
Field of study (Ref. computer science)		-0.322*** (0.092)	-0.205* (0.080)
Single-parent household			0.229** (0.086)
Parents' education			-0.003 (0.037)
Attending Gymnasium			-0.490*** (0.081)
Grade of university entrance qualification			0.646*** (0.065)
N	399	399	399
Adj. R ²	0.122	0.196	0.414

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Model 2 study-related variables were added, specifically the self-reported dropout intention, the number of withdrawals from exams, and the field of study. All variables have a significant relation to the mean grade. The higher the dropout intention is, the worse the grades are. Similarly, with higher numbers of withdrawals, the grades get worse. For the field of study students in computer science are found to have significantly lower grades than students in social sciences. With these additions, the model explains 19.6% of the variance in grades.

In Model 3 the variables can explain 41.4% of the variance in mean grade, showing that the added variables play an important role. In the final model, the following variables were added: growing up in a single-parent household, parents' education, attending the upper secondary school track and the grade of the university entrance qualification. Apart from parents' education, all factors have a significant impact on students' grades. Growing up in a single-parent household leads to significantly worse grades at university compared to students growing up in a two-parent household. Attending the upper secondary school track is associated with higher grades compared to any other school form. Lastly, the better the grade of the university entrance qualification the better the grades at university.

The final model shows that there is a wide variety of variables significantly impacting academic success. Both self-reflexivity and self-efficacy can have a positive effect on academic performance. Students who believe that they are in control of their lives are more likely to receive higher grades. The dropout intention can also be linked to academic success although the direction of causality is not clear. It would be both possible that bad grades lead to higher dropout intentions or that high dropout intentions mean students spend less time preparing for exams and receive worse grades. If students withdraw from exams more often, they are likely to perform worse in those examinations. The field of study also needs to be considered for university grades, since there are different patterns for computer science compared to social sciences. This could be either due to differences in grading practices or examination difficulty. Another possibility is that students in the social sciences perform better in general since they need a certain grade to get into the programme. Sociodemographic variables are relevant. Growing up in a single-parent household can be linked to lower academic success, while controlling for school performance. Depending on school form we also find differences in academic success. Attending a Gymnasium leads to significantly higher academic performance. The same pattern was found for the grade achieved in the university entrance qualification. Good grades in school are correlated with good grades in university.

The results of the linear regression are especially interesting concerning the question asked at the beginning of this paper. At university, independent effects of social inequality remain, next to the reproduction of the cumulative effects during the school trajectory. Parents' education does not have a direct effect on the grades in university. This is most likely due to the high correlation between parents' education, the school form the students attended as well as the grade of their university entrance qualification. Interestingly, both the school form and the grade have an independent effect on university grades, implying that these are two separate effects. The grade can be a proxy for educational success at school and integration into the educational system. The school form might indicate how much preparation students received in school for attending university. Effects of social inequality could also be at play here, since the choice of school form is strongly correlated to parents' education.

5 Conclusion

The aim of this study was to examine the role of social inequality for academic success. While there is substantial evidence on school education and university applications, there is less comprehensive evidence on university trajectories. This study focused on the path through university and specifically the grades students receive each semester. For this purpose, data was collected at a German university in two different fields of study, matching the questionnaires to students' specific exam results. The average grade from all received grades was used to provide an indicator of academic achievement.

In particular, attending a Gymnasium, the grade achieved in the university entrance qualification, and growing up in a single-parent household have strong impacts on the grade students

receive at university. At the same time, there are significant differences between the areas of study; grades are, on average, higher in the social sciences than in computer science. The personality-related indicators are less influential, although there are effects for self-reflexivity and self-efficacy. Additionally, a bigger social network can also positively impact academic success. While the variables do not explain as much variance as other factors, they also need to be considered when examining academic success. Knowing other students and being able to ask them for help might not be the main factor determining one's success at university, but it can make many processes easier.

Dropout intention also has a significant association with university grades. Lastly the number of withdrawals from examinations has an impact on the mean grade.

When it comes to early detection of students at risk of dropping out of university, the self-reported intention to drop out can be an easy and reliable indicator. Social inequality appears to be particularly evident among students from single-parent households and their lower academic success. Another relevant marker found in this study is the explicit preparation for university that happens at the Gymnasium which can be seen in the higher success rates of those students. Students coming from any other school form show lower academic achievement. Additionally, the social inequality which can be found in the decision about which school type to attend as well as the grade of leaving school is being reproduced at university. In the final model there is no effect for parents' education, but this is most likely due to the interaction with the school form and the final grade. Like any other transition in the educational system the social inequality accumulates. The difficulty of showing the exact relation and isolating it from other factors at play is due to the prior selection processes on the way to university. Many students are from households with high socioeconomic status, only motivated or talented students from other groups find their way to university.

This study indicates that despite the efforts of opening universities to more people, right now most students are still coming from the Gymnasium and have highly educated parents. Even though good grades from school are not necessary for all areas of study and you do not need to have a traditional university entrance qualification to study anymore, it seems to still be unlikely to get to university without either and be successful as well. The cumulative effect of each selection process in the educational system is relevant at this stage, since many people do not even reach the necessary qualification for university.

Another disadvantage found in this study focuses on students from single-parent households. While there have been findings pointing in this direction, this is an indication of such an effect at a German university. The explanation for this effect is most likely due to the precarious situation single parents often find themselves in. Single parents are mostly women and therefore often have lower levels of education. Additionally, there is only one parent at home who can transmit capital to their child. Single-parent households are also more likely to suffer from poverty which can have detrimental effects on children's educational trajectory. The fact we can isolate this effect at university is an indication of the different life situations these children experience and how they may affect their lives in the long term. More research is needed to provide more detailed knowledge on this relation.

While this paper examined the differences between growing up in a single-parent versus two-parent household, these are not the only possible constellations. Children in the foster care system are especially at risk of having low educational aspirations and thus reaching lower educational achievements. Compared to low-income children, children in foster care score significantly lower on both aspirations and expectations (Kirk et al., 2013).

Another limitation of this study is that the sample included only two fields of study at one university, meaning that these results are not necessarily the same for other fields or at other universities. Only a small part of students participated in this study meaning that the results cannot be generalised. Participants are likely to be more successful than those who did not participate and might be systematically different from each other. Since the survey was mostly promoted in university classes, those who attend them regularly were more likely to participate.

The results of the study show that social inequality can impact the entire education system up to tertiary education and effects can still be observed within universities themselves. The difference between the areas of study is especially interesting since educational success is higher for the area that has a numerus clausus. While we cannot know if this is due to the selection processes into a

certain area, we should take further steps to find out more since the effect can be isolated from school form and the school-leaving grade.

The findings of this study lead to possible implications for universities in Germany. Most universities offer a wide range of support, however, in this case, it does not seem that the students who need it most are finding and using it. A mentoring programme at the beginning of university for students whose parents did not study can be an opportunity to help with the onboarding process and provide a contact person who is knowledgeable about university life. Someone close to their own age is necessary for students to be comfortable asking questions they perceive as concerning basic academic knowledge. The Gymnasium already offers explicit preparation for university, but comprehensive schools could do so as well. Giving students the opportunity to at least think about studying is already an important step. In addition, there could also be measures taken at universities, like a mandatory consultation if students report a high dropout intention or are not consistently collecting ECTS.

Comments

The author declares that there is no conflict of interest. This scientific work was carried out as part of a funding programme by the Federal Ministry of Education and Research (16DHB4020).

References

- Baalmann, T., Brömmelhaus, A., Feldhaus, M., & Speck, K. (2020). Multikontextuelle Einflüsse auf den Studienerfolg: Zusammenführung und Ergänzung der bisherigen Ergebnisse [Multicontextual Influences on Academic Success: Integration and Extension of Existing Findings]. In M. Feldhaus & K. Speck (Hrsg.), *Herkunftsfamilie, Partnerschaft und Studienerfolg* (S. 281–324). Ergon – ein Verlag in der Nomos Verlagsgesellschaft. <https://doi.org/10.5771/9783956507526-281>
- Baalmann, T., & Feldhaus, M. (2020). Die Beziehung zu den Eltern und Studienerfolg [The Relationship to Parents and Academic Success]. *Herkunftsfamilie, Partnerschaft und Studienerfolg*, 169–202.
- Bachsleitner, A., Lämmchen, R., & Maaz, K. (2022). Soziale Ungleichheit des Bildungserwerbs von der Vorschule bis zur Hochschule: Eine Forschungssynthese zwei Jahrzehnte nach PISA [Social Inequality in Educational Attainment from Preschool to Higher Education: A Research Synthesis Two Decades After PISA]. Waxmann. <https://doi.org/10.31244/9783830996248>
- Barajas, M. S. (2011). Academic achievement of children in single parent homes: A critical review. *The Hilltop Review*, 5(1), 4.
- Becker, R. (2011). Entstehung und Reproduktion dauerhafter Bildungsungleichheiten [Emergence and Reproduction of Persistent Educational Inequalities]. In R. Becker (Hrsg.), *Lehrbuch der Bildungssoziologie* (S. 87–138). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-92759-6_4
- Beierlein, C., Kovaleva, A., Kemper, C. J., & Rammstedt, B. (2014). Allgemeine Selbstwirksamkeit Kurzskala (ASKU) [General Self-Efficacy Short Scale (ASKU)]. *Zusammenstellung sozialwissenschaftlicher Items und Skalen (ZIS)*. <https://doi.org/10.6102/ZIS35>
- Bernardi, F., & Boertien, D. (2017). Explaining conflicting results in research on the heterogeneous effects of parental separation on children's educational attainment according to social background. *European Journal of Population*, 33(2), 243–266.
- Bornkessel, P. (Hrsg.). (2018). Erfolg im Studium: Konzeptionen, Befunde und Desiderate [Success in Higher Education: Concepts, Findings and Research Gaps]. Bielefeld: wbv Media GmbH & Co. KG. <https://doi.org/10.3278/6004654w>
- Boudon, R. (1974). *Education, opportunity, and social inequality: changing prospects in Western society*. New York, NY: Wiley.
- Bourdieu, P. (2012). Ökonomisches kapital, kulturelles kapital, soziales Kapital [Economic Capital, Cultural Capital, Social Capital]. In *Handbuch Bildungs- und Erziehungssoziologie* (pp. 229–242). Wiesbaden: VS Verlag für Sozialwissenschaften.
- Dahm, G., & Kerst, C. (2019). Wie erfolgreich sind Studierende mit und ohne Abitur. *Ein bundesweiter Vergleich zu Studienerfolg und Studienleistungen* [How Successful Are Students With and Without the Abitur? A Nationwide Comparison of Academic Success and Performance]. DZHW Brief, 3, 1–8.
- English, P., De Villiers Scheepers, M. J., Fleischman, D., Burgess, J., & Crimmins, G. (2021). Developing professional networks: The missing link to graduate employability. *Education + Training*, 63(4), 647–661. <https://doi.org/10.1108/ET-10-2020-0309>
- Falk, S., Kercher, J., & Zimmermann, J. (2022). Internationale Studierende in Deutschland: Ein Überblick zu Studiensituation, spezifischen Problemlagen und Studienerfolg [International Students in Germany: An Overview of Study Conditions, Specific Challenges, and Academic Success]. *Beiträge zur Hochschulforschung*, 44(2–3), 14–39.

- Garg, R., Melanson, S., & Levin, E. (2007). Educational aspirations of male and female adolescents from single-parent and two biological parent families: A comparison of influential factors. *Journal of Youth and Adolescence*, 36(8), 1010-1023.
- Grätz, M. (2015). When growing up without a parent does not hurt: Parental separation and the compensatory effect of social origin. *European Sociological Review*, 31(5), 546-557.
- Grätz, M. (2017). Does separation really lead fathers and mothers to be less involved in their children's lives?. *European Sociological Review*, 33(4), 551-562.
- Heil, K., Pape, N., Bremer, H., & Lange-Vester, A. (2019). Studienzweifel und Studienabbruch als Ausdruck von Passungsverhältnissen zwischen Habitus und Studium [Doubts About Studying and Dropout as an Expression of the Fit between Habitus and Higher Education]. *Qualität in der Wissenschaft*, 13(3-4), 71-76.
- Herrmann, L. (2022). Abbruchgründe nicht-traditioneller Studierender – Identifikation von Clustern mittels Data Mining [Reasons for Dropout Among Non-Traditional Students – Identifying Clusters Using Data Mining]. *Zeitschrift für Hochschulentwicklung*, 17(4), 133–154. <https://doi.org/10.3217/zfhe-17-04/07>
- Heublein, U., Hutzsch, C., Schreiber, J., Sommer, D., & Besuch, G. (2010). Ursachen des Studienabbruchs in Bachelor- und in herkömmlichen Studiengängen [Causes of Dropout in Bachelor's and Traditional Degree Programs]. (Forum Hochschule F2/2010). Institut für Hochschulforschung (HIS).
- Heublein, U. (2014). Student Drop-out from German Higher Education Institutions. *European Journal of Education*, 49(4), 497–513.
- Heublein, U., Ebert, J., Hutzsch, C., Isleib, S., König, R., Richter, J., & Woisch, A. (2017). *Zwischen Studienerwartungen und Studienwirklichkeit: Ursachen des Studienabbruchs, beruflicher Verbleib der Studienabbrecherinnen und Studienabbrecher und Entwicklung der Studienabbruchquote an deutschen Hochschulen* [Between Study Expectations and Academic Reality: Causes of Dropout, Career Paths of Dropouts, and the Development of Dropout Rates at German Higher Education Institutions]. (Forum Hochschule 1/2017). Hannover: Deutsches Zentrum für Hochschul- und Wissenschaftsforschung (DZHW).
- Ifenthaler, D., & Yau, J. Y.-K. (2020). Understanding Learning Analytics Indicators for Predicting Study Success. ASCILITE's First Virtual Conference. Proceedings *ASCILITE 2020 in Armidale*, 36–41. <https://doi.org/10.14742/ascilite2020.0101>
- Iqbal, M., Khalid, M. S., Rehman, N., & Yanping, L. (2021). Parental divorce: Impact on socio-psychological behavior and academic performance of students in teacher's perception. *Journal of Divorce & Remarriage*, 62(6), 475-492.
- Isleib, S., & Woisch, A. (2018). Studienerfolg jenseits gymnasialer Zugangswege zum Studium [Academic Success Beyond Traditional Pathways to Higher Education]. *Erfolg im Studium*, 29-58.
- Isleib, S. (2019). Soziale Herkunft und Studienabbruch im Bachelor- und Masterstudium [Social Origin and Dropout in Bachelor's and Master's Degree Programs]. In M. Lörz & H. Quast (Hrsg.), *Bildungs- und Berufsverläufe mit Bachelor und Master* (S. 307–337). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-22394-6_10
- Jones, K., Clark, L., Wilson, R., & Dunham, M. (2018). Poverty and Parent Marital Status Influences on Student Achievement. *Educational Research Quarterly*, 42(1), 62-80.
- Kirk, C. M., Lewis, R. K., Nilsen, C., & Colvin, D. Q. (2013). Foster care and college: The educational aspirations and expectations of youth in the foster care system. *Youth & Society*, 45(3), 307-323.
- Knispel, J., Wittneben, L., Slavchova, V., & Arling, V. (2021). Skala zur Messung der beruflichen Selbstwirksamkeitserwartung (BSW-5-Rev) [Scale for Measuring Occupational Self-Efficacy Expectations (BSW-5-Rev)]. *Zusammenstellung sozialwissenschaftlicher Items und Skalen (ZIS)*. <https://doi.org/10.6102/zis303>
- Kocsis, Á., & Molnár, G. (2025). Factors influencing academic performance and dropout rates in higher education. *Oxford Review of Education*, 51(3), 414–432. <https://doi.org/10.1080/03054985.2024.2316616>
- Kracke, N., Schwabe, U., & Buchholz, S. (2024). Neuer Bildungstrichter: Trotz Akademisierungsschub immer noch ungleicher Zugang zur Hochschule [New Education Funnel: Despite the Expansion of Higher Education, Access to Universities Remains Unequal]. (DZHW Brief 02|2024). Hannover: DZHW. https://doi.org/10.34878/2024.02.dzhw_brief
- Kroher, M., Beuße, M., Isleib, S., Becker, K., Ehrhardt, M. C., Gerdes, F., ... & Buchholz, S. (2023). Die Studierendenbefragung in Deutschland: 22. Sozialerhebung: die wirtschaftliche und soziale Lage der Studierenden in Deutschland 2021 [The Student Survey in Germany: 22nd Social Survey: The Economic and Social Situation of Students in Germany 2021].
- Liu, J., Peng, P., Zhao, B., & Luo, L. (2022). Socioeconomic Status and Academic Achievement in Primary and Secondary Education: A Meta-analytic Review. *Educational Psychology Review*, 34(4), 2867–2896. <https://doi.org/10.1007/s10648-022-09689-y>
- O'Malley, M., Voight, A., Renshaw, T. L., & Eklund, K. (2015). School climate, family structure, and academic achievement: a study of moderation effects. *School Psychology Quarterly*, 30(1), 142.
- O'Sullivan, K., Robson, J., & Winters, N. (2019). 'I feel like I have a disadvantage': How socio-economically disadvantaged students make the decision to study at a prestigious university. *Studies in Higher Education*, 44(9), 1676–1690. <https://doi.org/10.1080/03075079.2018.1460591>
- Peuckert, R. (2012). Ein-Eltern-Familien (Alleinerziehende): Soziale Randgruppe, „neues“ familiales Selbstverständnis oder „ganz normale“ Familienform? [Single-Parent Families (Single Parents): A Marginalised Social Group, a "New" Family Self-Concept or a "Completely Normal" Family Form?]. In: Familienformen im sozialen Wandel. VS Verlag für Sozialwissenschaften, Wiesbaden. https://doi.org/10.1007/978-3-531-19031-0_11
- Radl, J., Salazar, L., & Cebolla-Boado, H. (2017). Does living in a fatherless household compromise educational success? A comparative study of cognitive and non-cognitive skills. *European Journal of Population*, 33(2), 217-242.

- Sarcelletti, A. & Müller, S. (2011). Zum Stand der Studienabbruchforschung. Theoretische Perspektiven, zentrale Ergebnisse und methodische Anforderungen an künftige Studien [The State of Dropout Research. Theoretical Perspectives, Key Findings, and Methodological Requirements for Future Studies]. *Zeitschrift für Bildungsforschung*, 1(3), 235-248.
- Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of educational research*, 45(1), 89-125.
- Ülpenich, B., Junghänel, L., Krause, J., & Rosar, U. (2023). Studienerfolg und -misserfolg aus institutionen- und studierendenzentrierter Perspektive: Eine qualitative Untersuchung [Academic Success and Failure from Institutional and Student-Centered Perspectives: A Qualitative Study]. *Beiträge zur Hochschulforschung*, 45(2), 54-74.
- Wasserman, M. (2020). The disparate effects of family structure. *The Future of Children*, 30(1), 55-82.
- Westrick, P. A., Schmidt, F. L., Le, H., Robbins, S. B., & Radunzel, J. M. R. (2021). The Road to Retention Passes through First Year Academic Performance: A Meta-Analytic Path Analysis of Academic Performance and Persistence. *Educational Assessment*, 26(1), 35-51. <https://doi.org/10.1080/10627197.2020.1848423>
- Woessmann, L. (2015). An international look at the single-parent family. *Education Next*, 15(2), 42-49.
- York, T. T., Gibson, C., & Rankin, S. (2015). Defining and measuring academic success. *Practical assessment, research, and evaluation*, 20(1), 5. <https://doi.org/10.7275/hz5x-tx03>
- Zartler, U., & Berghammer, C. (2023). Ein-Eltern-Familien [Single-Parent Families]. In *Handbuch Familiensoziologie* (pp. 543-570). Wiesbaden: Springer Fachmedien Wiesbaden.
- Zimmermann, J., Falk, S., Thies, T., Yildirim, H. H., Kercher, J., & Pineda, J. (2021). Spezifische Problemlagen und Studienerfolg internationaler Studierender in Deutschland [Specific Challenges and Academic Success of International Students in Germany]. In *Studienerfolg und Studienabbruch* (pp. 177-200). Wiesbaden: Springer Fachmedien Wiesbaden.

Appendix

Variable	Coding	Min	Max	M	SD
Social network („Gibt es jemand auf dessen Rat sie sich verlassen können?“)	N numbers of contacts	0	7	6.04	1.55
Self-reflexivity	1 – does not apply at all 5 – applies completely	1	4	2.96	0.52
Self-efficacy	1 – does not apply at all 5 – applies completely	1	5	3.71	0.76
Dropout intention	0 – does not apply at all 10 – applies completely	1	10	3.01	2.16
Withdrawal from exam	N numbers of withdrawals	0	8	3.69	0.82
Field of study	0 – Computer science 1 – Social sciences	0	1	-	-
Single-parent household	0 – no 1 – yes	0	1	-	-
Parents' education (average)*	100 – no qualification 244 – qualification at secondary level I 344 – qualification at secondary level II 645 - Bachelor or equivalent program 844 - doctorate	-1.77	2.44	-0.03	1.02
Attending Gymnasium		0	1	-	-

* The classification is done according to the ISCED: <https://www.datenportal.bmbf.de/portal/de/G293.html>, last checked: 23 February 2026

Appendix (*continued*)

<i>Variable</i>	<i>Coding</i>	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>
Grade of university entrance qualification	Average grade	1	3.7	2.22	0.58
Mean grade		1	5	2.72	0.92

