The Hiring Value of Digital Micro-Credentials

Evidence from a Discrete Choice Experiment in Germany

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Abstract

Micro-credentials such as online certificates or digital badges have been promoted as flexible tools to enhance employability, especially given the growing demand for continuing education and training. Yet, little is known about how employers value such credentials in hiring decisions and whether they function as complements or substitutes for other qualification signals. Drawing on signaling and human capital theory as well as the digital divide literature, this study examines the hiring value of digital and in-person micro-credentials relative to formal qualifications and work experience. The empirical analysis is based on a pre-registered discrete choice experiment conducted with 1,380 human resource professionals in Germany, who evaluated 12,048 applicant profiles across 24 occupations requiring higher education. Results based on conditional logit models show that digital micro-credentials do not increase hiring probabilities and are valued significantly less than equivalent certificates obtained through in-person courses. This difference is independent of recruiters' prior experience with digital micro-credentials and largely driven by trust in the signal quality of the two credential formats. We also find that in-person micro-credentials issued by universities improve hiring chances compared to other providers. Furthermore, among applicants with weaker field-of-study matches, in-person micro-credentials can enhance employability, indicating a partially substitutional signaling function, while this is not the case for digital micro-credentials. These findings suggest that in strongly institutionalized labor markets such as Germany, employers continue to prioritize established (micro-)qualifications over emerging digital forms. At the same time, this is evidence against a digital divide in terms of outcomes.

Keywords

Micro-credentials, digital badges, continuing education and training, recruitment, choice experiment, Germany

1 Introduction

Rapid economic transformations continue to reshape labor markets, altering occupational tasks and creating continuous pressure on workers to reskill. As a result, continuing education and training has become ever more important for workers' employability and firms' productivity (OECD, 2025). While many of these learning activities for adults are still in a traditional in-person format, online formats such as Massive Open Online Courses (MOOCs) and Webinars are becoming ever more important (Karger et al., 2024). Particularly in MOOCs, digital "micro-credentials" are used to certify knowledge acquisition (Varadarajan et al., 2023). Their promise lies in offering flexible opportunities for lifelong learning and the possibility to signal acquired skills to employers. Yet, their actual labor market value remains contested, as causal evidence on their impact on labor market outcomes remains scarce (but see: Castaño-Muñoz & Rodrigues, 2021; Kässi & Lehdonvirta, 2024; Rivas et al., 2020). In this article, we provide novel causal evidence about the returns to digital micro-credentials by assessing their impact on hiring probabilities in a survey experiment.

Previous research showed that the labor market value of continuing education and training among adults depends on the certificates earned. When adults graduate from courses that lead to a formal degree, i.e. a degree that is officially recognized in the national qualifications framework, they usually earn higher wages afterwards and are generally regarded as more employable (Kosyakova & Bills, 2021). Participation in courses without recognized credentials on the other hand leads to much lower or even a lack of returns (Ehlert, 2017; Görlitz, 2011; Pischke, 2001). Nevertheless, studies showed that such "non-formal" courses lead to lower chances to become unemployed (Ebner & Ehlert, 2018; Picchio & van Ours, 2013) and higher chances to be hired (Schimke, 2023).

Micro-credentials fall in between the common distinction between "formal" and "non-formal" continuing education. According to a recent definition by the EU Commission, micro-credentials are "[...] the record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes will have been assessed against transparent and clearly defined criteria." (Council of the European Union, 2022). While they are usually not officially recognized, the issuers of micro-credentials aim to achieve a high level of trustworthiness. Clearly, micro-credentials are not completely novel – many commercial and public learning providers have issued certificates for continuing training participation for a long time. Yet those certificates were often not universally recognized. Recently, some European countries, such as Denmark and France, have begun to include micro-credentials into their national qualifications framework. In these countries, several micro-credentials can be combined to achieve a formal degree (Cedefop, 2023). Policy makers have identified micro-credentials as a possibility to increase the flexibility of the adult education system by certifying even short learning activities.

While policy makers are still debating how to implement micro-credentials, there has been a massive growth in the use of digital micro-credentials in MOOCs, especially in higher education (Gibson et al., 2015). Such digital micro-credentials, also known as "digital badges", are digital credentials awarded after digital learning activities, often containing metadata about the acquired skills and the provider. They are designed to be presented online on websites and social media profiles. Digital micro-credentials have been subject to much research recently. The focus of this research has been mainly on the effect on learner motivation (e.g.: Cheng et al., 2023; Roy & Clark, 2019; Schürmann & Quaiser-Pohl, 2022).

Beyond the effects on learners, little is known about the labor market value of digital micro-credentials and digital badges. Most of the previous findings rely on qualitative studies of employers, who describe their perception of the potential and limitations of micro-credentials (Gauthier, 2020; Goglio et al., 2022; Goglio & Bertolini, 2021; Rosendale, 2017). Yet, while these studies illuminate interesting mechanisms that link micro-credentials to labor market outcomes, the results cannot be generalized. To our best knowledge, only three empirical studies have so far applied quantitative approaches that allow for a causal assessment of the effects of digital micro-credentials on labor market outcomes (Castaño-Muñoz & Rodrigues, 2021; Kässi & Lehdonvirta, 2024; Rivas et al., 2020). However, their studies are all confined to specific groups or segments of the labor market, as we will detail in the literature overview in section 2.

It is important to note that none of the previous studies on the labor market outcomes of digital micro-credentials included a comparison to similar "offline" micro-credentials from in-person courses. We argue that such a comparison is important to assess the implications of digitalization in continuing education for social inequality. By comparing digital and in-person micro-credentials, we can analyze whether a "third-level" digital divide exists in the outcomes of digital micro-credentials (Matzat & van Ingen, 2020; van Dijk, 2020). If the value of digital micro-credentials is higher compared to offline micro-credentials, digitalization of continuing education and trainig increases inequality. If the value of digital micro-credentials is lower than the value of offline courses, digital inequalities are reduced. In this sense, the recognition of digital micro-credentials could have significant implications: it may either deepen the third-level digital divide by penalizing non-digital learners, or, conversely, contribute to reducing educational and labor market disparities by providing equally or even higher rewarded offline pathways to skill acquisition.

Another blind spot in the literature so far is the content of certification with regards to the labor market outcomes of digital micro-credentials. Micro-credentials can certify a wide variety of results. Sometimes they are awarded for mere participation in a course, sometimes tests or assessments of learned skills are required. This information is likely to affect labor market outcomes, as employers will probably take it into account when hiring.

Furthermore, digital micro-credentials can be acquired from a wide variety of providers, ranging from major companies such as Google and Amazon to prestigious universities such as Harvard and Cornell. MOOC platforms like Coursera and EdX usually offer courses and micro-credentials from a wide range of providers. The hiring value of digital micro-credentials presumably depends on the extent to which employers trust the issuing organizations. It is so far unknown whether large companies or universities are considered as more trustworthy in this regard.

Finally, research has not examined which types of workers may benefit from digital micro-credentials. We argue that the effect may differ depending on initial educational attainment. Theoretically, continuing education and training may be complements or substitutes (Wolbers, 2005). Complementarity means that the effect of micro-credentials should be larger among those individuals with higher or better matching initial credentials, since their value in the labor market depends on this. Substitution on the other hand implies that a lack of (matching) educational credentials can be offset by micro-credentials. This also has important repercussions for social inequality, as it determines whether digital micro-credentials can be a means for less educated individuals to catch up.

Based on these considerations, we pose three related research questions:

RQ1: Does the effect of micro-credentials on the hiring probability among adults differ between digital and in-person micro-credentials?

RQ2: Does the effect of digital micro-credentials depend on the provider of the course?

RQ3: Are digital micro-credentials complements or substitutes of initial formal education and work experience?

The German labor market is a particularly instructive case for analyzing the value of digital micro-credentials because the institutional setup and societal factors make strong effects unlikely. First, Germany is characterized by a high degree of institutional coordination and a strong emphasis on formal qualifications on the labor market (Allmendinger, 1989), resulting in distinct patterns of credentialism (Collins, 1979) and closure (Weeden, 2002). The highly regulated formal vocational education system is complemented by a decentralized and complex continuing training system with a variety of different commercial and public providers (OECD, 2021). The term "micro-credentials" is not well known, especially among employers. Yet, comparable "non-formal" certificates from in-person continuing education and training courses, which resemble micro-credentials, are quite common (Haseloff, 2023). In addition, digitalization of the economy and society is only average in international comparison (IMD, 2024).

Using a preregistered experimental design, we test whether digital micro-credentials improve employment opportunities, how employers perceive different micro-credential attributes, and whether these certificates complement or substitute formal qualifications and work experience. In doing so, the paper contributes to several important debates. First, we add to the literature on digital micro-credentials by providing an assessment of their labor market effect. Second, we contribute to digital divide research by analyzing the outcomes of digital technology use. Third, our results also provide evidence for the literature on the returns to education and training by analyzing how new forms of certification interact with established credentials in recruitment decisions. Finally, our results are highly policy relevant and can supply policy makers with important insights for the implementation of micro-credentials.

2 Previous empirical findings

While there is a large literature on the effect of formal degrees, work experience, and continuing training on hiring probabilities (Di Stasio, 2014; Humburg & van der Velden, 2015; Neugebauer et al., 2025; Piopiunik et al., 2020; Schimke, 2023; Van Belle et al., 2018), comparatively little is known about the effect of digital micro-credentials or digital badges. Most of the previous findings rely on qualitative studies (Gauthier, 2020; Goglio et al., 2022; Goglio & Bertolini, 2021; Rosendale, 2017), and the recent literature reviews are mainly based on these studies (Bruguera et al., 2025; Thi Ngoc Ha et al., 2024; Varadarajan et al., 2023). One of the main results from these studies is that employers are primarily interested to learn about the competencies certificate holders possess (Varadarajan et al., 2023) in order to identify suitable candidates for their vacancies. Yet, it is difficult to generalize these findings. Beyond this, there are a few quantitative studies showing that learning online and attaining a digital micro-credential is associated with better labor market outcomes (Eynon & Malmberg, 2021; Yeyati et al., 2025). Most studies on the effectiveness of digital micro-credentials in recruitment so far rely on self-assessments by applicants or employers (Alasmari, 2024; Gauthier, 2020; Thi Ngoc Ha et al., 2024). For example, Coursera, one of the most important commercial providers of micro-credentials, claims that 85% of employers in a global survey prefer candidates with micro-credentials over those without

(Coursera, 2025). However, this information may be biased, and it is difficult to recover causal effects from this kind of data.

To our best knowledge, only three empirical studies have so far applied causal approaches that allow for an unbiased assessment of the effects of digital micro-credentials on labor market outcomes. First, Kässi and Lehdonvirta (2024) analyzed data from more than 46,000 workers on an online labor platform to examine the effects of digital micro-credentials on employment probability and earnings. Their findings show that completing micro-credentials increases both the likelihood of obtaining projects and the monetary value of those projects. However, the added value of micro-credentials decreases with growing work experience, suggesting a partly substitutional relationship between professional experience and micro-credentials at least within the gig economy. The underlying mechanism appears to be primarily signaling rather than human capital based, as micro-credentials seem to reduce employers' uncertainty about applicants' abilities rather than enhancing actual productivity. Second, Rivas et al. (2020) conducted two vignette experiments with approximately 1,900 respondents in the United States to examine the hiring value of MOOCs for workers with varying levels of experience, as well as their relative value compared to traditional degrees. Their results suggest that MOOCs increase the likelihood of being hired, and this effect does not significantly decline with greater work experience. However, compared to traditional degrees, MOOCs are perceived as substantially less valuable. Key limitations of their approach were (1) that the hiring task was indirect as respondents were asked to "assist a friend in hiring a freelance[r]" (Rivas et al., 2020, p. 4), (2) the experimentally varied dimensions are very low increasing the risk of inflated effects, (3) and the majority of respondents reported that they are not typically involved in real hiring decisions. Third, Castaño-Muñoz and Rodrigues (2021) applied a quasi-experimental design to examine the effects of participation in MOOCs on employment stability and wages. Although their study relies on a relatively small sample (n = 346) and focuses on a distinct target group – of whom approximately 90% hold higher education degrees – the results indicate that workers who participated in MOOCs were significantly more likely to remain employed but did not see a raise in wages.

Related literature also examined the hiring value of digital formal credentials, such as a B.A. from an online college. In a correspondence study, Lennon (2021) found that the employer callback rate for applicants with formal online degrees is significantly reduced by 7.6 percentage points compared to traditional in-person degrees (15.9%). Although the underlying mechanism cannot be identified in this study, it seems reasonable that it is due to signaling, as learning outcomes appear to be comparable between online and in-person learning (Figlio et al., 2013). Another study by Deming et al. (2016) also found reduced callback rates for online B.A. degrees compared to traditional degrees from public institutions in a field experiment.

Overall, previous research suggests that while digital micro-credentials have the potential to serve as meaningful labor market signals, empirical evidence on their actual hiring value remains scarce and fragmented. Most existing studies rely on self-reported perceptions or qualitative insights, and the few quantitative approaches available either focus on very specific labor market segments, rely on small non-representative samples or study other dependent variables. None of the studies, however, compared digital micro-credentials to their analog equivalents. Such a comparison is so far only available for formal degrees.

3 Theory and Hypotheses

Our hypotheses about the labor market value of digital micro-credentials are based on signaling and screening theory (Arrow, 1973; Spence, 1973). This approach posits that employers use observable signals such as qualifications, references, and certificates to assess the productivity of applicants. It evolved as a critique of human capital theory (Becker, 1975), which assumes perfectly informed employers who choose employees directly on the basis of productivity. Signaling and screening theory are based on the observation that hiring decisions are typically made under conditions of uncertainty. Especially in the initial stages of recruitment, employers have limited information about applicants' actual performance or job fit. Thus, employers use signals to determine which applicant can be trained most efficiently to match the requirements (Thurow, 1975).

Digital micro-credentials and micro-credentials from in-person courses may be signals that employers use to assess the productivity of employees in the sense of signaling and screening theory. In the initial formulations of the theories and in most applications, the signals consist of school degrees or higher education certificates (Bills, 2003). Yet, the literature on continuous training also took up this notion and theorized that certificates earned from training courses may also be signals used by employers (Dieckhoff, 2007; Ehlert, 2017; Schimke, 2023).

Based on signaling and screening theory, we assume that Digital micro-credentials and micro-credentials from in-person courses are signals that employers use to screen applicants. If these micro-credentials signal skills, we expect that the hiring probabilities of applicants with both digital and in-person micro-credentials are higher than those without. The two first preregistered hypotheses[1] that we aim to test in this study are therefore:

H1: The selection probability of profiles with digital micro-credentials exceeds that of profiles without.

H2: The selection probability of profiles with a micro-credential from an in-person course exceeds that of profiles without.

Due to missing previous empirical findings (see section 2), we expect no difference in the recruitment value for the direct comparison between digital and in-person certificates.

The labor market value of micro-credentials may furthermore differ due to the information they contain about the learning process and the competencies acquired. While some certificates merely confirm course participation, others provide more differentiated documentation, including the detailed course syllabus and skills taught. For employers, the informational depth of a credential is crucial, as it affects their ability to evaluate a candidate's suitability and reduce uncertainty about their productivity (Arrow, 1973; Spence, 1973; Thurow, 1975). Following signaling theory (Spence, 1973), we assume that both digital and offline micro-credentials are more credible if their acquisition is tied to individual ability rather than mere participation. We therefore hypothesize that both digital and offline micro-credentials have stronger hiring effects when they require passing a final exam before being awarded.

[1] See https://osf.io/5z4ky for the preregistered hypotheses. Note that we changed the ordering and numbering of the hypotheses in this study to improve readability. Also, we changed the terminology slightly to remain coherent. The substantial content and direction of the hypotheses was not changed through these edits.

H3: The selection probability of profiles with digital micro-credentials is higher if the course certification includes a final examination and not just a certificate of attendance.

H4: The selection probability of profiles with a micro-credential from an in-person course is higher if the course certification includes a final examination and not just a certificate of attendance.

Beyond this, both digital and in-person micro-credentials may also differ in their signaling value because of the trustworthiness of the providers. Credentials awarded by providers embedded in the formal education system, such as universities, are likely subject to regulatory oversight and quality assurance. In contrast, certificates from commercial providers may lack standardized evaluation criteria. It is therefore plausible that employers trust more in digital and offline micro-credentials from universities. We thus assume that micro-credentials yield stronger hiring effects when issued by institutions affiliated with higher education rather than commercial providers.

H5: The selection probability of profiles with digital micro-credentials is higher if the certifying institution is a university rather than a commercial provider.

H6: The selection probability of profiles with a micro-credential from an in-person course is higher if the certifying institution is a university rather than a commercial provider.

In addition to the characteristics of the micro-credentials themselves, their signaling value might be different for applicants with different qualification profiles. Employers' initial selection decisions are based on a variety of information in the application documents, like educational credentials or professional experience. All these sources serve to reduce the employer's uncertainty about the applicant's productivity and can therefore be regarded as partially interchangeable information (Arrow, 1973; Spence, 1973). Digital and offline micro-credentials could thus reduce mismatches between the educational requirements of the job and the formal education of the applicants. These mismatches may be vertical, i.e. formal education is lower than required, or horizontal, i.e. the field of education does not fit the job (Verhaest et al., 2017).

On the vertical dimension, we expect that the effects of digital and in-person micro-credentials are larger among applicants with lower formal education. This is because micro-credentials may enhance the perceived skill level. We therefore formulate two more hypotheses about the interaction between formal education and digital and offline micro-credentials.

H7: The hiring value of a digital micro-credential is higher if the profile has a bachelor's degree (in comparison to a master's degree).

H8: The hiring value of a micro-credential from an in-person course is higher if the profile has a bachelor's degree (in comparison to a master's degree).

Additionally, digital and in-person micro-credentials may be particularly valuable for candidates whose formal education is horizontally mismatched with the job offer. In such cases, they can serve as substitute signals, demonstrating occupation-specific knowledge that formal degrees do not cover. Conversely, micro-credentials may offer limited additional value for applicants whose academic background closely matches the job, as core competencies are assumed to be covered within the study program itself. We therefore hypothesize that the positive hiring effects of digital and offline micro-credentials are larger for applicants whose field of study does not match the target occupation.

H9: The hiring value of a digital micro-credential is higher if the field of study is mismatched with the occupation (in comparison with a good match).

H10: The hiring value of a micro-credential from an in-person course is higher if the field of study is mismatched with the occupation (in comparison with a good match).

4 Methods and data

4.1 Sampling procedure

This experimental study is pre-registered (https://osf.io/5z4ky) and is based on a discrete choice experiment (DCE) (Street & Burgess, 2007) conducted in 2025. The sample consists of human resources (HR) professionals in Germany who make hiring decisions in one of 24 systematically selected occupations. These occupations cover professions with a high share of university educated workers in key segments of the German labor market.[2]

We recruited HR professionals for the experiment via job advertisements posted on Germany's Federal Employment Agency website between October 2024 and January 2025. First, we acquired a sample of job ads in the selected occupations using a stratified random sampling approach. From each job ad, we extracted the email address that applicants should use to apply. After accounting for duplicate entries, the final target sample comprised 8,586 contacts. In February 2025, the selected HR professionals were invited by email to participate. Following a one-month field period, which included a reminder email after two weeks, a total of 1,380 individuals participated in the experiment and completed an additional survey, corresponding to a response rate of 16.0%. Participants were informed in advance that the experiment would include three decision-making scenarios, each involving the review of three brief applicant profiles, and would take approximately five minutes to complete. After the experimental module, respondents answered a very short questionnaire about their personal background and work context.

4.2 Experimental design

Each survey participant evaluated three independent hiring scenarios, selecting the most suitable candidate from three options with an additional opt-out alternative (see Fig. A1 in the appendix). The selection question read: "Which applicant is most likely to possess the skills required for the advertised position?" The presentation of the profiles is modelled after written CVs and each systematically varies eight experimental factors in total (see Tab. 1). Two factors refer to formal educational credentials, varying the vertical (bachelor's and master's degree) and horizontal match (field of study). Similarly, two factors provide information on the quantity and match of previous work experience. The fifth experimental factor determines whether the fictitious applicant has completed continuing education and acquired a micro-credential, including whether the course was attended in-person or online. The last three attributes depend on the previous factor and vary only if continuing education has been attended. Based on these factors, various attributes of micro-credentials are contrasted, including the certifying institution, course volume and type of certificate.

[2] We furthermore selected both regulated (closed) and unregulated (open) professions (Weeden, 2002) that span the entire automation susceptibility spectrum (Dengler & Matthes, 2018). We do not use this variance in the analyses.

Table 1. Vignette design.

Factors	Levels
Educational qualifications # (1)	0=Bachelor's degree; 1=Master's degree
Match of the field of study (2)	0=<Related match>; 1=<Exact match>
Work experience (3)	0=1 year; 1=3 years; 2=5 years
Match of the work experience (4)	0=<Related match>; 1=<Exact match>
Micro-credential (5)	0=None; 1=<In-person>; 2=<Online>
Certifying institution * (6)	0=<Commercial provider>; 1=<University>
Course volume * (7)	0=40 hours; 1=80 hours
Type of certificate * (8)	0=Certificate of attendance; 1=Certificate, incl. final exam

<> Placeholder for dynamic information.
* Conditional factors and levels if the factor "Micro-credential" takes value 1 or 2.
# In the profession „Physician" Master's degree and state examination are contrasted.

To provide recruiters with realistic applicant profiles that closely resemble typical applications for the 24 target occupations, we selected related fields of study, related occupations for prior work experience, and related digital and in-person micro-credentials. These occupation-specific elements were derived from the BERUFENET database[3], the German equivalent of the U.S. O*NET, hosted by the German Federal Employment Agency. This database provides detailed information on all occupations regarding tasks, working conditions, required educational qualifications, related professions, and continuing education opportunities for professional adaptation.

To ensure sufficient variation in applicant qualifications, three occupation-specific options were included for both the 'related field of study' (see Tab. A.1) and 'related work experience' (see Tab. A.2) attributes. Within each choice set, these items were drawn randomly without replacement to guarantee uniqueness. Consequently, the reported estimates for these factors (see Section 5) represent averages across the three variations. A similar approach was applied to capture a broader range of relevant micro-credentials within each occupation (see Tab. A.3). Regarding micro-credential providers, variation was introduced independently of the occupation. Based on our assessment of relevant market shares of the providers, the in-person courses were offered by German institutions, while online courses were provided by major international providers. All providers were chosen to reflect institutions with a broad scope of offerings and general importance on the market for continuing training.[4] The names of the providers we used are listed in Table A.4 in the appendix.

[3] https://web.arbeitsagentur.de/berufenet/

[4] However, it cannot be ensured that all occupation-specific courses are actually offered by each provider. Given the high fragmentation of the German vocational education and training market, recruiters likely lacked complete market knowledge.

To broaden the scope of the experiment, the content of digital and in-person micro-credentials were not identical. This decision could potentially bias results if course format and course content are correlated. To address this concern, all 144 courses were independently coded by two experts according to whether they provided occupation- or industry-specific versus transferable skills. The coding showed high intercoder reliability (r=0.80) and only a small to moderate correlation between course format and content (r=0.22), indicating that micro-credentials leading to occupation- or industry-specific skills were more likely to appear as online courses. This could lead to an overestimation of the effects of digital micro-credentials compared to in-person courses.

Profiles are drawn from a full factorial set of 576 possible combinations of the experimentally varied attributes ($6^2 \times 3^2$). The DCE is constructed by combining these profiles into sets of three vignettes, resulting in a choice set universe $\binom{576}{3} = \frac{576!}{3!\cdot(576-3)!}$ = 31,684,800. In order to obtain a feasible research design, the choice set universe is reduced to a design with 162 sets ($D_{Bayesian}$-Error = 0.0297) using the coordinate exchange algorithm from the 'idefix' package in R (Traets et al., 2020).[5] This procedure creates a valid fractional design by ensuring orthogonality, balance of factor levels and minimal overlap of attributes within a set (Huber & Zwerina, 1996). The finally selected choice sets are divided into 54 blocks, with respondents randomly assigned to one block, and the profiles within the choice sets presented in randomized order.

4.3 Survey module

After completing the three selection scenarios, the questionnaire included a module collecting additional information on the recruiters, such as their professional experience and the size of their employing organization. Two questions were implemented to validate the a priori defined relatedness of the experimental factors regarding educational and work experience matches: respondents were asked to directly select the field of study and professional experience that best fit their job advertisement. The results largely support the pre-defined distinction in favor of the exact matches and can be found in the appendix (see Tab. A5 and A6).

Additionally, two questions captured perceptions of micro-credentials. First, respondents rated whether they trust that applicants with a micro-credential from a certain provider possess the skills indicated by the course title on a 7-point scale. Each respondent evaluated one randomly drawn in-person provider and one online provider they had encountered in the selection scenarios. Second, all respondents were asked whether they had received applications with digital micro-credentials from massive open online courses (MOOCs) attached in the past 12 months.

[5] The experimental factors were effect-coded for the design. The construction of the DCE design relies on assumptions about parameter estimates (prior distributions), which the experiment aims to refine. For the initial design generation, we used very conservative priors. Specifically, we assumed slightly higher selection probabilities for applicants with higher educational degrees, better field of study matches, as well as more and better-matched work experience. In addition, we expected an even smaller positive effect of additional continuing education certificates. Finally, we assumed a very low likelihood that employers would choose the opt-out alternative.

4.4 Methods

We conduct the analyses using conditional logit models to estimate the effects of micro-credentials on hiring decisions (Chamberlain, 1980). The data were structured in long format, with one observation per alternative within each choice set and a binary indicator for whether the alternative was chosen.

The probability that respondent i chooses alternative j in choice set t is given by

$$P(Y_{ijt} = 1 \mid C_{it}) = \frac{\exp(V_{ijt})}{\sum_{k \in C_{it}} \exp(V_{ikt})},$$

where C_{it} is the set of available alternatives and V_{ijt} is the systematic component of utility. In the baseline model,

$$V_{ijt} = X_{ijt}\beta,$$

with X_{ijt} representing the profile attributes.

The no-choice option was modeled as an additional alternative-specific indicator. Because each respondent completed multiple choice tasks, standard errors were clustered at the respondent level.

In further analyses we also included respondent-level variables from the survey module. Since these variables do not vary across alternatives within a choice set, they cannot be estimated as main effects in a conditional logit model. We therefore modeled heterogeneity through interactions between respondent-level characteristics Z_i and alternative-specific attributes:

$$V_{ijt} = X_{ijt}\beta + (X_{ijt} \times Z_i)\gamma.$$

In conditional logit models, coefficients indicate how strongly an attribute affects the latent utility of an alternative relative to the other alternatives in the same choice set. Positive coefficients imply that an attribute increases the likelihood that a profile is chosen, whereas negative coefficients imply that it decreases this likelihood. The estimates should therefore be interpreted comparatively within a given choice situation rather than as unconditional individual-level probabilities. To facilitate the interpretation of the results, we computed marginal-effect-based summaries, interpreted as changes in the modeled probability of choosing an alternative within a given choice set.

4.5 Sample statistics

The survey sample comprises 1,380 respondents in total. A large share (97%) indicated that recruitment tasks are part of their position. Respondents represent firms of varying sizes, with 28% employed in small firms (up to 50 employees), 43% in medium-sized firms (51–500 employees), and 30% in large firms (more than 500 employees). Regarding professional experience, 46% reported less than 10 years, 28% between 10 and 20 years, and 26% more than 20 years of work experience.

When asked about exposure to applications containing digital micro-credentials from Massive Open Online Courses (MOOCs), 14% reported having received such applications in the past 12 months, while 52% had not, and 34% stated they were unfamiliar with them.

Tab 2. Sample descriptives for the respondents.

Variables	Distribution
Information on the respondents	
Firm size	
Up to 50 employees	0.280
51 to 500 employees	0.425
501 and more employees	0.295
Hiring tasks in your position?	
Yes	0.970
No	0.030
Professional experience	
Less than 10 years	0.464
10 to less than 20 years	0.280
20 years and more	0.256
Received applications with certificates from massive open online courses (MOOCs) attached in the last 12 months?	
Yes	0.142
No	0.523
I don't know what that is	0.335
$N_{respondents}$	1,380

During the collection of contact information, data on both the occupational background of recruiters and, where available, the federal state of the company's location were recorded. These variables allow an assessment of potential sampling bias between the targeted and actual respondent groups. The occupational distribution differs significantly between the targeted and realized samples ($\chi^2(23)=51.0$, $p=0.001$) and is mainly driven by an overrepresentation of recruiters hiring social workers and psychologists and a simultaneous underrepresentation of automotive engineers and heads of production/manufacturing. In contrast, no systematic bias was found with respect to the geographic distribution across federal states in Germany and the few records from Switzerland and Austria ($\chi^2(17)=20.4$, $p=0.256$).

5 Results

5.1 Hiring value of micro-credentials

As shown in Figure 1, micro-credentials from in-person courses significantly increase the selection probability, whereas micro-credentials from online courses have no significant effect. Micro-credentials from in-person courses increase the probability that employers will select a candidate in a choice set by 5.5 percentage points compared to candidates with no micro-credentials. This evidence supports Hypothesis 1. On the other hand, digital micro-credentials do not lead to higher selection probabilities, which leads us to reject Hypothesis 2. In fact, employers treated candidate profiles without any micro-credentials almost exactly like those with digital micro-credentials. Correspondingly, the difference

between the two types of micro-credentials is statistically significant ($p<0.001$), indicating that German employers value micro-credentials from in-person courses much more than those from digital MOOCs. This clearly contradicts our theoretically derived expectation that digital and in-person micro-credentials would have the same effect.

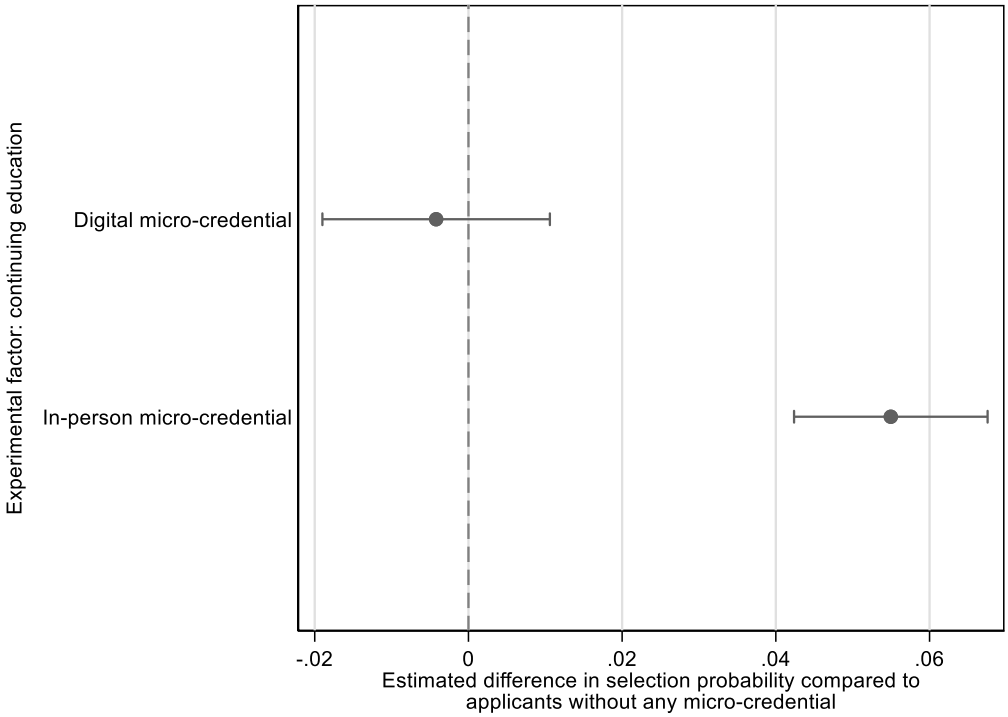


Figure 1: The effect of digital and in-person micro-credentials on selection probability. Reference category: no micro-credential. Results from a conditional logit model.

Turning to the trust-enhancing attributes of micro-credentials, Figure 2 shows that these factors mainly affect in-person micro-credentials. We find that digital micro-credentials have no effect on hiring probabilities, regardless of whether they have been issued by universities or involved exams. For in-person courses, on the other hand, we find that university-issued micro-credentials improve selection probability significantly by about 4 percentage points ($p<0.001$) compared to commercial providers. These results support Hypothesis 6, which predicted a larger effect for in-person micro-credentials issued by universities, but contradict a similar effect for digital micro-credentials as described in Hypothesis 5. The results in Figure 2 thus suggest that universities are only viewed as trust-enhancing if the micro-credential is awarded after an in-person course. Going beyond statistically significant coefficients, there is also a tendency towards positive effects of exams for digital micro-credentials and commercial in-person courses. In general, however, exams do not seem to influence recruiters much. This is contrary to our expectations in Hypotheses 3 and 4.

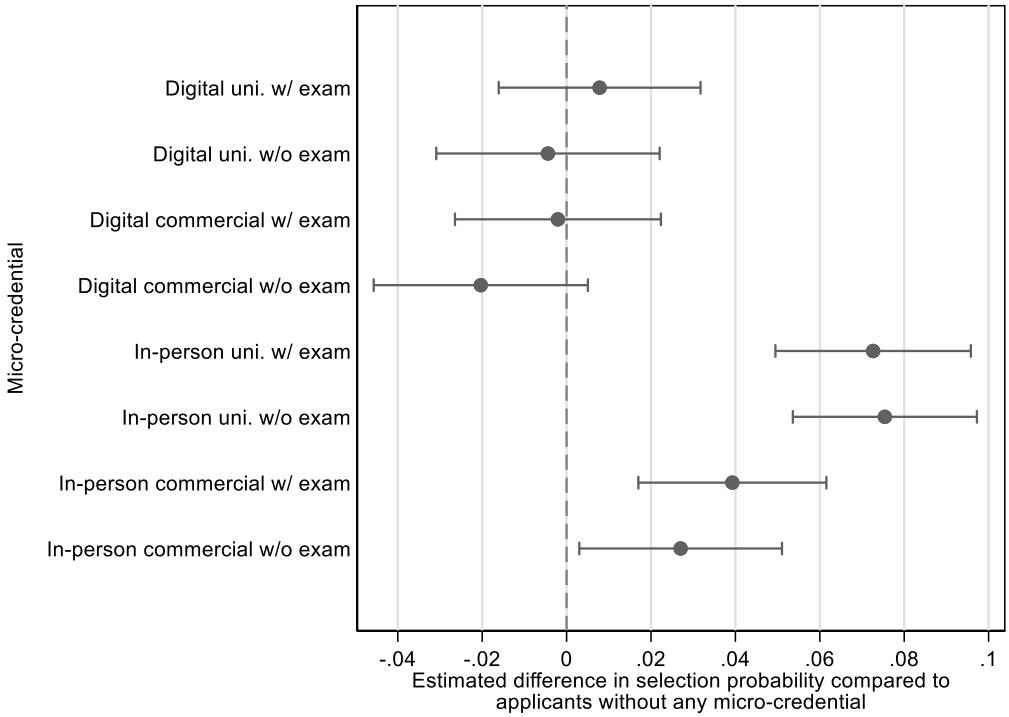


Figure 2: The effect of digital and in-person micro-credentials on selection probability by providers and exams. Reference category: no micro-credential. Results from a conditional logit model

5.2 Moderating effects of different qualification signals on the hiring value of micro-credentials

Figure 3 shows that micro-credentials are (if anything) complements rather than substitutes to formal degrees. For both digital and in-person micro-credentials, we find no difference in the impact between applicants with different formal education backgrounds. This is evidence against our Hypotheses 7 and 8, predicting larger effects among candidates with bachelor's degrees. Thus, micro-credentials play a complementary role and improve chances for both educational groups similarly. This also implies that micro-credentials do not close the gap in selection probabilities between candidates with bachelor's degrees and those with master's degrees.

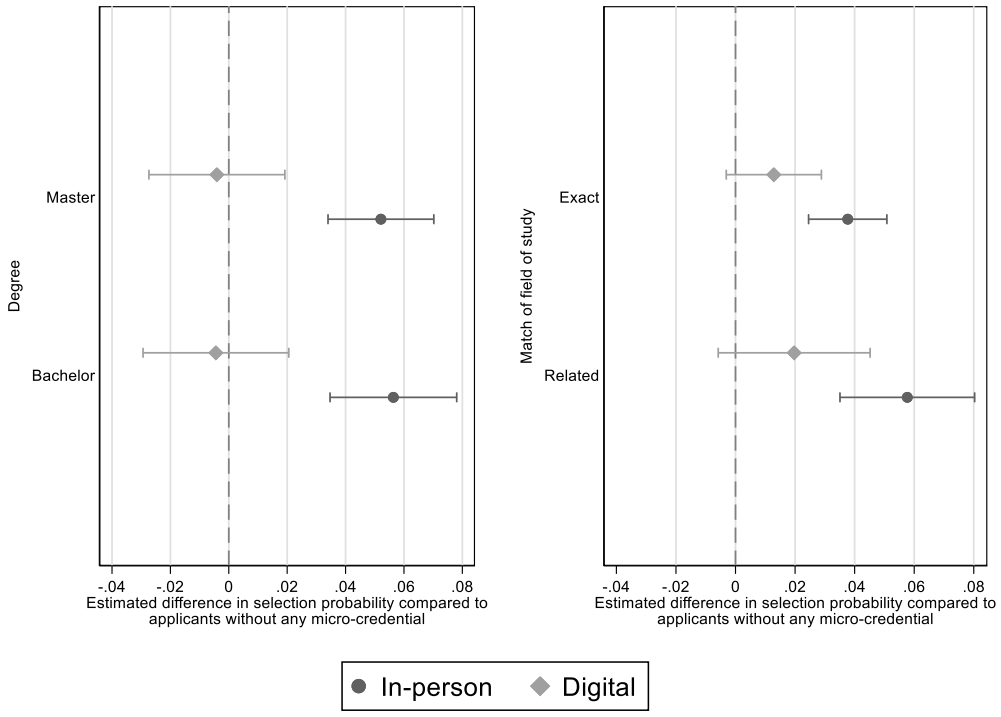


Figure 3: The effect of digital and in-person micro-credentials on selection probability by vertical and horizontal educational match of the vignette. Reference category: no micro-credential. Results from a conditional logit model

We do, however, find some evidence for substitutive effects in the case of horizontal mismatches in Figure 3. The effect of micro-credentials is larger for those with a mismatch between field of study and the target occupation. For in-person courses, this difference is statistically significant ($p<0.001$) and amounts to about 2 percentage points. This speaks in favor of Hypothesis 10. We also observe a slight increase in the effect of digital micro-credentials, but neither the difference nor the effect for mismatched vignettes is statistically significant, mirroring our initial results. Thus, Hypothesis 9 has to be rejected.

We find further evidence for a substitutive role of in-person micro-credentials when we consider the amount and the horizontal match of work experience. The results are depicted in Figures A.2 and A.3 in the appendix. Micro-credentials from in-person courses have a lower effect when applicants have more experience and the experience is in the same field as the job offer. Once again, we found no such patterns for digital micro-credentials. Taken together, these findings provide strong evidence that in-person micro-credentials can compensate for disadvantages resulting from horizontal mismatches and lack of experience, but digital micro-credentials cannot.

6 Heterogeneity analyses

A possible explanation for the average null effect of digital micro-credentials may be recruiters' limited experience with such qualifications in past hiring situations. For instance, Alasmari (2024) indicates a positive but insignificant correlation between recruiter familiarity and prioritizing applicants with MOOC certificates. In our survey, we find that most German recruiters are not familiar with digital micro-credentials. One third of respondents reported that they did not know what MOOCs are, and an additional 52% indicated that they had not received any applications with a MOOC certificate in the past 12 months. Only 14% had encountered applications with references to MOOCs. This mirrors qualitative findings from Germany (Haseloff, 2023). To examine whether this relative inexperience drives our results, we included this indicator in an additional moderation analysis.

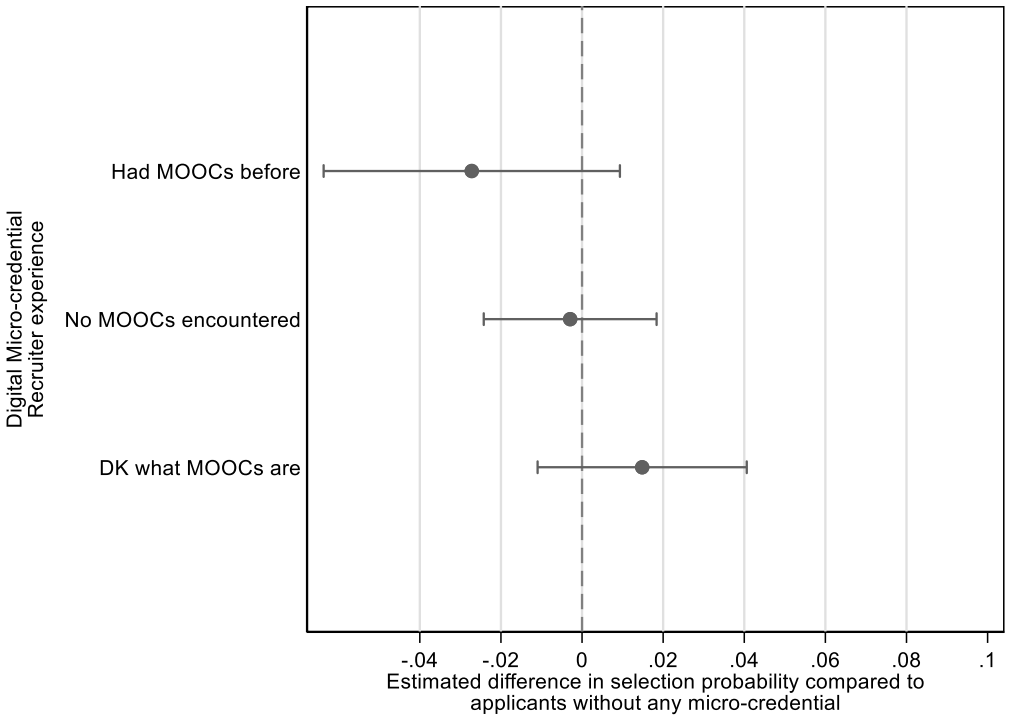


Figure 4: The effect of digital micro-credentials on selection probability by recruiter's experience with MOOCS. Reference category: no micro-credential. Results from a conditional logit model

The perceived hiring value of digital micro-credentials appears largely independent of recruiters' prior experience with applications including MOOCs, as depicted in Figure 5. Interestingly, although not statistically significant, the analysis even indicates a relative disadvantage in the small group of respondents who had previously encountered MOOCs in application documents. This finding suggests that skepticism may persist even among more experienced recruiters, pointing to concerns about whether participation in digital training actually translates into the acquisition of the proposed skills.

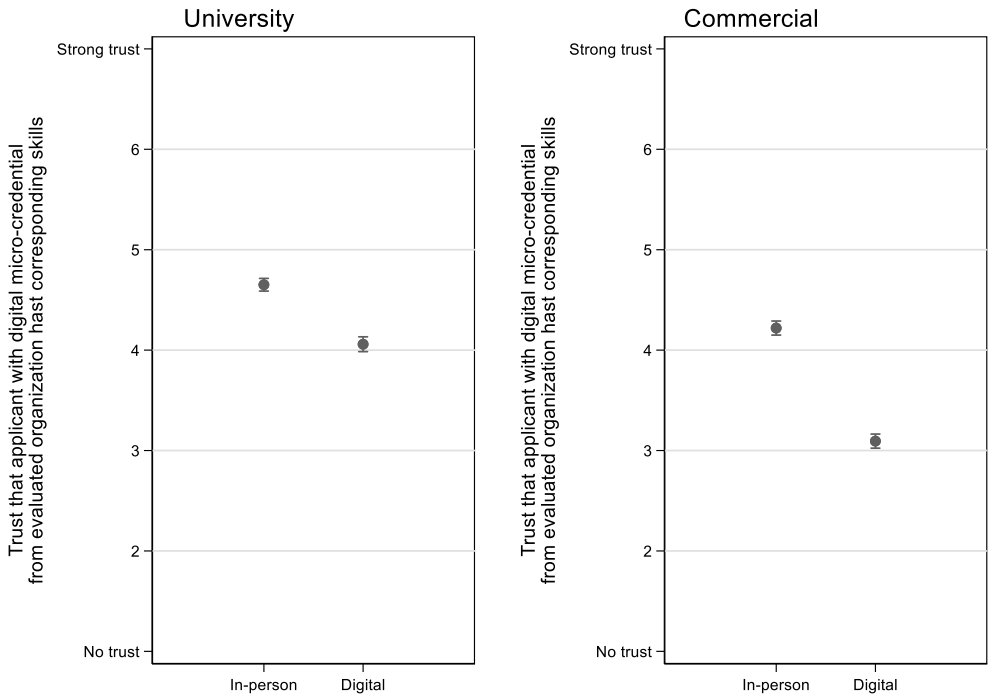


Figure 5: Recruiter's average trust in evaluated organizations by digital and in-person as well as university and commercial providers.

A second explanation of the non-existent effect for digital micro-credentials may be that employers trust less in them as credible signals for skills. As described in Section 4.3, we asked each respondent to indicate how confident they were that completing a course from the micro-credential providers featured in the recruitment scenarios would equip applicants with the skills specified in the course title. Figure 5 graphs the recruiters' evaluations of the providers by teaching format and type of organization. The results show that recruiters trust less in digital micro-credentials. This is even more pronounced for digital micro-credentials from commercial organizations, where we find a difference of one point on a seven-point scale. Universities, on the other hand, are regarded as more trustworthy by the recruiters. Yet, in-person commercial providers are about on the same level as online universities, reflecting the generally lower trust in digital micro-credentials.

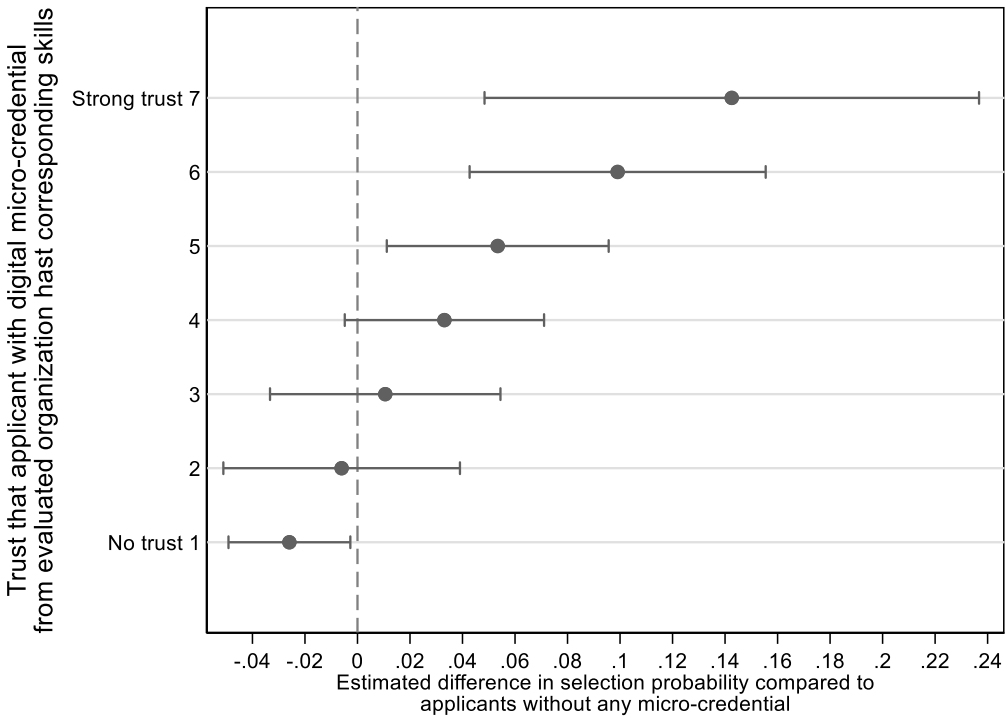


Figure 6: The effect of digital micro-credentials on selection probability by recruiter's trust in evaluated organization. Reference category: no micro-credential. Results from a conditional logit model

Figure 6 shows that trust in online providers is associated with higher valuation of candidates who hold the corresponding micro-credentials. If recruiters rate their trust digital micro-credentials as three or lower on the 7-point scale, the previously described non-significant effect is replicated. However, those who rate digital micro-credentials as more trustworthy are also more likely to select candidates with such credentials. Compared to the averages shown in Figure 5, this suggests that if recruiters rate online providers as similarly trustworthy as in-person providers, digital micro-credentials would also have a positive effect on selection probabilities. This supports in the expectation that providers' trustworthiness plays a central role in the hiring value of micro-credentials.

7 Discussion

In this study, we examined the recruitment value of online versus in-person micro-credentials, using a survey experiment in which recruiters selected candidates with randomly varied characteristics. The analysis of the data revealed three main findings. First, we found a pronounced advantage of micro-credentials from in-person continuing training formats over digital micro-credentials. Across all models, certificates from in-person courses consistently increased applicants' hiring chances, while digital micro-credentials provided no advantages compared to candidates without any micro-credential. Second, we found significant differences in the effects between providers of micro-credentials. Certificates issued by higher education institutions are held in higher regard than commercial providers. This indicates that the credibility of micro-credentials depends not only on their content but also on the institutional context. Third, the analyses provide strong evidence that the value of micro-credentials depends on the applicants' broader qualification profile. With respect to formal education, micro-credentials function as complements, since both Bachelor's- and Master's-level applicants benefited

similarly from additional certificates. By contrast, micro-credentials acted as substitutes with respect to field of study and professional experience. They were most valuable when academic or professional backgrounds did not closely match the target occupation.

These findings challenge optimistic perspectives that portray digital micro-credentials as effective instruments for individual career advancement (coursera, 2025; Yeyati et al., 2025). Also, our results could not replicate the positive effects of digital micro-credentials for workers on online platforms that earlier studies with causal research designs have found (Kässi & Lehdonvirta, 2024; Rivas et al., 2020). Our results are in line with those by Castaño-Muñoz and Rodrigues (2021), who found no evidence for career advancement resulting from participation in MOOCs among a sample of participants from mostly Spanish-speaking countries. We interpret these differing results as evidence that the effect of digital micro-credentials depends on the context in which they are acquired. Beyond the literature on digital micro-credentials and MOOCs, our findings are in line with studies showing lower returns to formal degrees from online institutions compared to formal degrees from regular colleges (Deming et al., 2016; Lennon, 2021).

The nonexistent effect of digital micro-credentials in our study points to employer skepticism regarding their credibility as signals for actual skills in structured labor markets such as Germany. This is consistent with earlier findings from France looking at the perception of MOOCs by employers (Dussarps, 2018). However, our findings that in-person micro-credentials increase hiring chances show that such credentials can have a signaling value. Further analyses indicate that the distinction between online and in-person micro-credentials can be attributed to recruiters' trust in the skill signals of micro-credentials. Here, online providers score significantly lower. These findings align with previous qualitative research, highlighting the importance of provider reputation as a key facilitator of micro-credential recognition (Thi Ngoc Ha et al., 2024). However, final exams as trust-building devices did not produce robust effects, suggesting that formal assessment alone does not resolve doubts about online learning outcomes. Although the underlying mechanisms cannot be conclusively determined, a plausible explanation might be that employers view online learning as offering fewer opportunities to apply acquired knowledge in the real world, a limitation that appears particularly relevant in the context of soft skills (Alasmari, 2024; Bruguera et al., 2025). Another possible and related mechanism is the concern that micro-credentials lack social interaction and therefore social skill development is missing in these programs (Yılık, 2021).

The larger effects of in-person micro-credentials compared to online formats counteract concerns that the "digital divide" increases social inequality, at least for the time being (Matzat & van Ingen, 2020; van Dijk, 2020). Recent scholarship on the digital divide has pointed to the growing importance of outcomes related to the use of digital media and tools (DiMaggio & Bonikowski, 2008). If online activities such as job search or banking yield larger returns than corresponding offline activities, social inequality may rise, since not everyone has online access or the required digital skills. In this case, however, we find the opposite: online learners are worse off than those who attend in-person continuing training. Thus, we find no evidence for an increasing digital divide due to digital micro-credentials. Our data rather point to a penalty for online learners in Germany.

The complementarity with formal education and substitution with respect to experience further highlights the context-dependence of micro-credentials. They may extend the credential portfolio of highly educated applicants, while also offering compensatory value for those with less occupation-specific experience. This duality suggests that micro-credentials cannot be conceptualized solely as either complements or substitutes, but rather as context-dependent signals whose value is determined by

their interaction with other qualifications. From a theoretical perspective, micro-credentials reduce uncertainty only when other productivity-related signals are missing.

The results carry several implications for policy makers as well as employees. For policy makers, the limited hiring value of digital micro-credentials calls into question strategies that present digital short courses as a universal solution to reskilling challenges. While online formats increase accessibility, their weaker labor market recognition seems to be strongly driven by a lack of employer trust, at least in the German context. Policy initiatives should therefore focus not only on expanding supply, but also on building employer trust through quality standards, accreditation frameworks, and stronger involvement of established institutions such as universities.

For individual workers, the results of this study also carry several implications. Although digital micro-credentials offer a comparatively low-cost and flexible opportunity for skill development, their current labor market signaling value remains negligible or at best limited in Germany. Recruiters assign higher credibility to in-person credentials, suggesting that workers who rely on online continuing training may face disadvantages in hiring situations. The findings also emphasize the role of providers' reputation and perceived trustworthiness, implying that the choice of training platform matters for the recognition of acquired skills.

This study, like any empirical investigation, has several limitations. First and foremost, its focus on the German labor market must be acknowledged, as Germany's institutionalized pathways, strong credentialism, and high vocational specificity of formal certificates may amplify skepticism toward new forms of lifelong learning certification (Haseloff, 2023). This may explain why we find no effect of digital micro-credentials. Higher returns may be expected in countries with less standardized higher and vocational education systems (Allmendinger, 1989). In such settings, formal schooling focusses more on general skills, while specific skills are acquired on the job. Consequently, micro-credentials may be a complement to work experience (Kässi & Lehdonvirta, 2024). Also, we only provide a snapshot of the situation in 2025 and it may be that German employers in the future may be more open to digital micro-credentials as they become more well known.

Although a unified understanding of the concept of micro-credentials is still lacking and substantial cross-country differences persist (Gamage & Dehideniya, 2025), much of the relevant academic literature refers to the frameworks proposed by the Council of the European Union (2022) or UNESCO (2022). The experimental variation of micro-credential attributes in this study was likewise derived from the mandatory elements outlined in these recommendations. However, one limitation of this approach is the absence of information on essential micro-credential components specifically designed to enhance broader recognition, such as clearly defined learning outcomes or the type of quality assurance applied (Council of the European Union, 2022). While the influence of both attributes may be partially reflected in the information conveyed through the course title and provider, they should be explicitly incorporated in future research, as the perceived quality and recognition of a micro-credential largely depend on these features (Gamage & Dehideniya, 2025; Tamoliune et al., 2023; Varadarajan et al., 2023).

Given our methods, one issue may be that our experimental findings do not resemble "real world" behavior. A frequently raised criticism of these vignette experiments concerns the hypothetical nature of the selection decisions, which raises questions about the external validity of the results (Forster & Neugebauer, 2024). One strategy to enhance external validity in this study lies in the deliberate selection of respondents. The experiment specifically targets HR professionals who are regularly involved in reviewing applications and are therefore expected to possess the relevant expertise and decision

heuristics for evaluating CVs. Moreover, we relied on a comprehensive database of occupations, tasks, and typical continuing training content (BERUFE.NET) to construct credible vignettes. Crucially, we provide the recruiters with three vignettes to choose from, enabling us to emulate a typical decision-making situation they face. For many recruiters, this situation was arguably hypothetical, as they were unfamiliar with digital micro-credentials. Still, we argue that this effectively captures the signaling value of micro-credentials relative to other applicant characteristics.

While this study provides evidence that perceived efficacy and trust in online learning play a central role, future work could employ experimental designs that more directly capture employers' skill expectations and the perceived applicability of online-acquired competencies. Given our findings about the context dependence of micro-credentials, it would be valuable to test whether the patterns observed here generalize across different occupational fields, levels of qualification, and national contexts, or whether there are systematic differences. Further research should also investigate whether employer skepticism toward digital micro-credentials diminishes over time as digital formats become more widespread and quality assurance mechanisms improve, as intended in the policies regarding micro-credentialing.

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Appendix

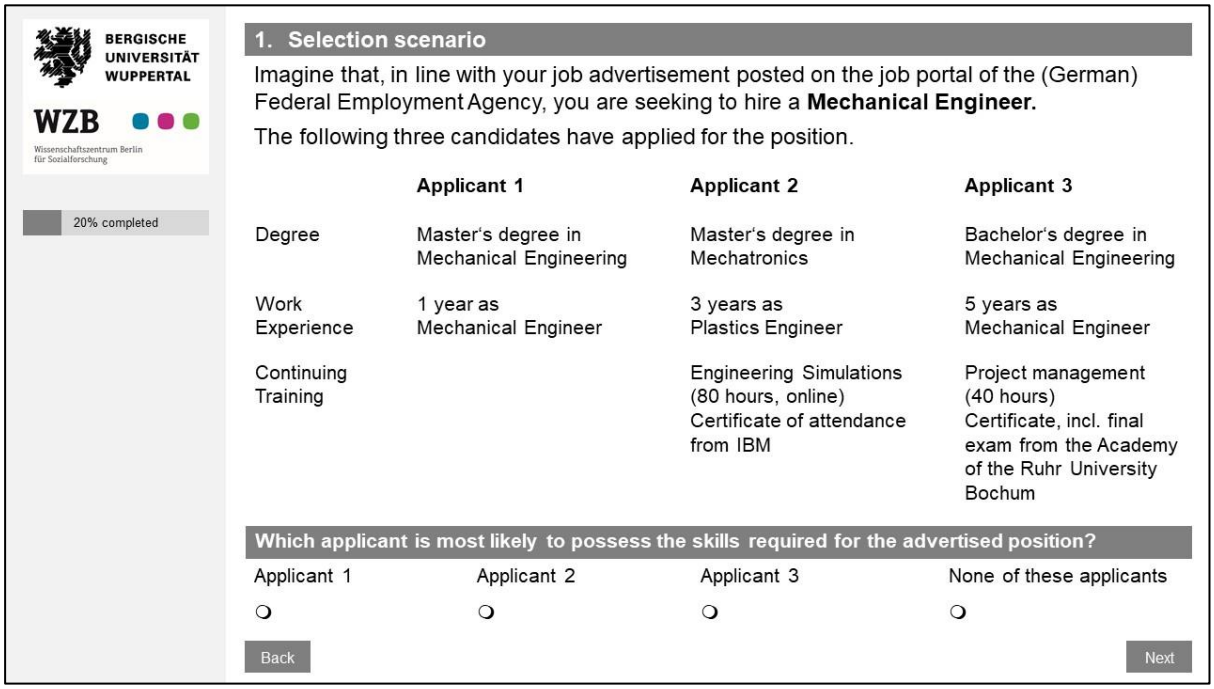


Figure A1. Example decision scenario in the version for mechanical engineers.

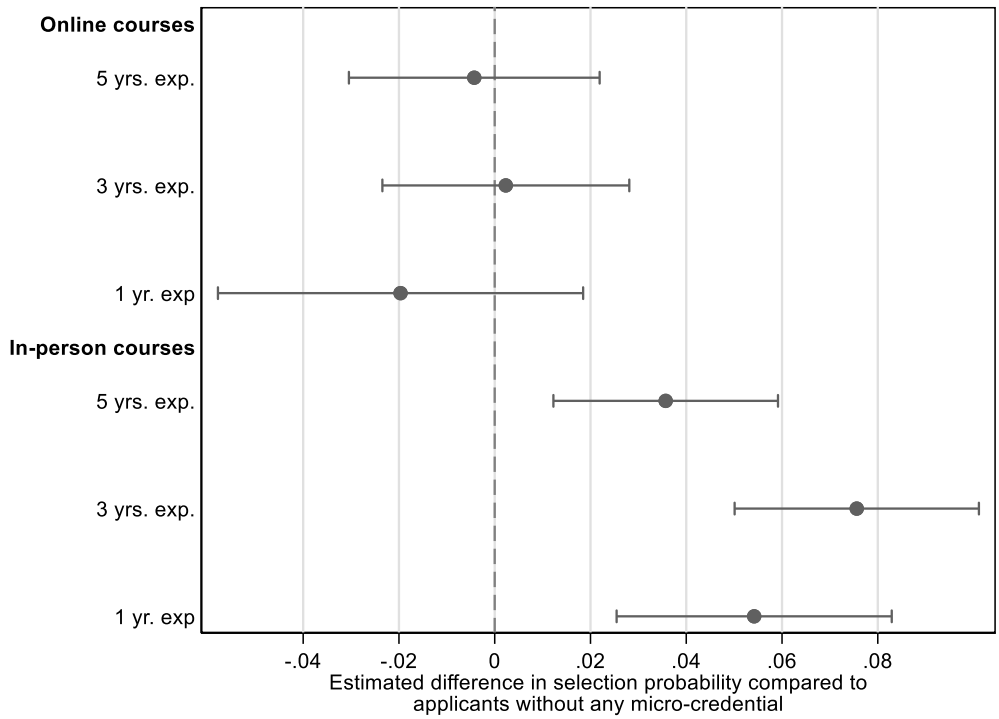


Figure A2. The effect of digital and in-person micro-credentials on selection probability by job experience. Reference category: no micro-credential. Results from a conditional logit model

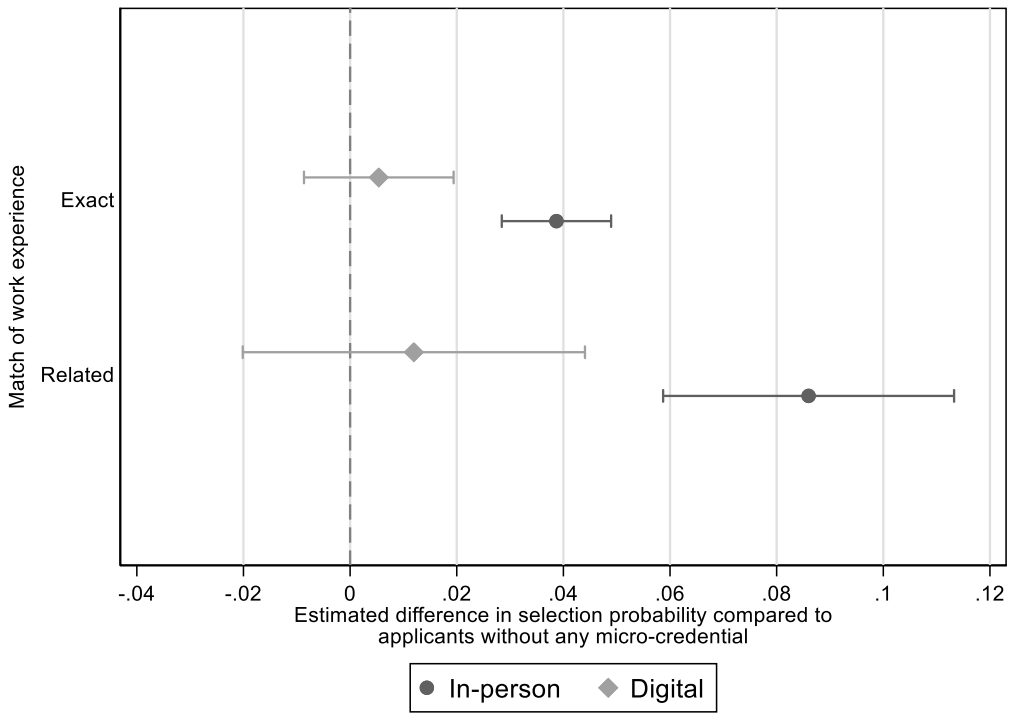


Figure A3. The effect of digital and in-person micro-credentials on selection probability by match of work experience. Reference category: no micro-credential. Results from a conditional logit model

Table A1. Occupation-specific information of the “match of the field of study”-factor.

Occupation	Exact match	Related match (1)	Related match (2)	Related match (3)
Mechanical Engineer	Mechanical Engineering	Automotive Engineering	Plastics Engineering	Mechatronics
Automotive Engineer	Automotive Engineering	Mechanical Engineering	Manufacturing and Materials Engineering	Mechatronics
Automation Engineer	Automation Technology and Robotics	Electrical Engineering	Mechatronics	Mechanical Engineering
Energy Engineer	Energy Engineering	Automation Technology and Robotics	Mechatronics	Mechanical Engineering
Electrical Engineer	Electrical Engineering	Mechatronics and Automotive Engineering	Energy Engineering	Mechanical Engineering
Project Engineer	International Project Engineering	Industrial Engineering	Automation Technology and Robotics	Mechanical Engineering
Head of Production/ Manufacturing	Industrial Engineering	Mechanical Engineering	Industrial Management	Mechatronics
Civil Engineer	Civil Engineering	Energy, Building and Environmental Engineering	Building Services Engineering and Energy Management	Urban and Regional Planning
Architect	Architecture	Civil Engineering	Building Services Engineering and Energy Management	Urban and Regional Planning
Computer Scientist	Computer Science	Mathematics	Computational and Data Science	Information and Communication Technology
IT Consultant	Business Informatics	Economics	Computer Science	Management Consulting
IT Manager	Computer Science and IT Management	Business Informatics	Information and Communication Technology	Computer Science
Software Developer	Software Engineering	Business Informatics	Computer Science	IT Engineering
Supply Chain Manager	Supply Chain Management	Industrial Management	Trade Management	Economics
Sales Engineer	Sales Engineering	Business Informatics	Industrial Engineering	Marketing and Sales Management
Head of Sales	Marketing and Sales Management	Service Management	Business Administration	Trade Management
Management Consultant	Industrial Engineering	Social and Communication Sciences	Social Sciences	Psychology
Business Economist	Business Administration	Social Sciences	Economics	Industrial Engineering
HR Specialist	Human Resource Management	Social and Communication Sciences	Communication, Multimedia and Market Management	Psychology
Controller	Controlling and Finance	Insurance Management	Business Administration	Social Sciences
Physician	Human Medicine	Human Medicine	Human Medicine	Human Medicine
Psychologist	Psychology	Business Psychology	Clinical Psychology	Personnel and Communication Psychology
Social Worker	Social Work	Education	Educational Science	Psychology
Business Economist – Marketing	Business Administration	Service Management	Economics	Social Sciences

Table A2. Occupation-specific information of the “match of the work experience”-factor.

Occupation	Exact match	Related match (1)	Related match (2)	Related match (3)
Mechanical Engineer	Mechanical Engineer	Automotive Engineer	Plastics Engineer	Mechatronics Engineer
Automotive Engineer	Automotive Engineer	Mechanical Engineer	Automation Engineer	Mechatronics Engineer
Automation Engineer	Automation Engineer	Electrical Engineer	Mechatronics Engineer	Mechanical Engineer
Energy Engineer	Energy Engineer	Automation Engineer	Mechatronics Engineer	Mechanical Engineer
Electrical Engineer	Electrical Engineer	Automotive Engineer	Energy Engineer	Mechanical Engineer
Project Engineer	Project Engineer	Industrial Engineer	Automation Engineer	Mechanical Engineer
Head of Production/ Manufacturing	Head of Production/ Manufacturing	Mechanical Engineer	Industrial Business Economist	Mechatronics Engineer
Civil Engineer	Civil Engineer	Supply Engineer	Building Services Engineer / Facility Manager	Urban and Regional Planner
Architect	Architect	Civil Engineer	Building Services Engineer / Facility Manager	Urban and Regional Planner
Computer Scientist	Computer Scientist	Mathematician	Software Developer	Data Scientist
IT Consultant	IT Consultant	Management Consultant	Application Engineer/Manager	Business Economist
IT Manager	IT Manager	Business Informatics Specialist	Computer Scientist	Technical Informatics Engineer
Software Developer	Software Developer	Data Engineer	Business Informatics Specialist	Computer Scientist
Supply Chain Manager	Supply Chain Manager	Industrial Business Economist	Business Economist for Trade	Business Economist for Corporate Management and Administration
Sales Engineer	Sales Engineer	Application Engineer/ Manager	Industrial Engineer	Sales Consultant
Head of Sales	Head of Sales	Business Economist for Service Management	Business Economist	Management Consultant
Management Consultant	Management Consultant	Business Economist	Personnel Developer	Employer Branding Manager
Business Economist	Business Economist	Management Consultant	Industrial Engineer	Economist
HR Specialist	HR Specialist	Business Economist	Personnel Developer	Employer Branding Manager
Controller	Controller	Insurance Business Economist	Business Economist	Business Economist
Physician	Physician	Physician	Staff Doctor	Staff Doctor
Psychologist	Psychologist	Business Psychologist	Clinical Psychologist	Communications Psychologist
Social Worker	Social Worker	Educator/Pedagogue	Psychologist	Educational Consultant
Business Economist - Marketing	Business Economist - Marketing	Business Economist for Service Management	Economist	Management Consultant

Table A3. Occupation-specific information of the “micro-credential”-factor.

Occupation	In-person course (1)	In-person course (2)	In-person course (3)	Online course (1)	Online course (2)	Online course (3)
Mechanical Engineer	CAD 2D/3D FEM Applications	Project Management	Communication and Employee Leadership	Engineering Simulations	3D Printing and Additive Manufacturing	Operations Management
Automotive Engineer	CAD 2D/3D FEM Applications	Project Management	Communication and Employee Leadership	Electric Vehicles and Mobility	Integrating Sensors and Motors	Self-Driving Cars
Automation Engineer	CAD 2D/3D FEM Applications	Project Management	Communication and Employee Leadership	3D Printing and Additive Manufacturing	Foundations of IoT Systems and Industrial Automation	Management in Engineering
Energy Engineer	CAD 2D/3D FEM Applications	Project Management	Communication and Employee Leadership	Sustainable Energy	Practitioner's Approach to Power Distribution & Automation	Generation, Transmission and Protection of Power Systems
Electrical Engineer	CAD 2D/3D FEM Applications	Project Management	Mechatronic Systems	Semiconductor Packaging	Optical Technology	Operations Management
Project Engineer	CAD 2D/3D FEM Applications	Process and Quality Management	Communication and Employee Leadership	Operations Management	Engineering Simulations	Effective Communication in Groups
Head of Production/ Manufacturing	Customer Relationship Management (CRM)	Project Management	Communication and Employee Leadership	Operations Management	Supply Chain Logistics	Lean Production
Civil Engineer	CAD 2D/3D FEM Applications	Project Management	Communication and Employee Leadership	Management of Smart Urban Infrastructures	Future of the Construction Industry	Electrical-Based Non-Destructive Testing and Sensing
Architect	CAD 2D/3D FEM Applications	Project Management	Communication and Employee Leadership	Sustainable Design Practices in Building Design	Design of Ventilation & Air Conditioning Systems for Buildings	AI in Architectural Design
Computer Scientist	Big Data Engineering	IT Project Management and Artificial Intelligence	Communication and Employee Leadership	Configuration Management and the Cloud	Relational Database Administration (RDB)	Applied Local Large Language Models
IT Consultant	Customer Relationship Management (CRM)	IT Project Management and Artificial Intelligence	Communication and Employee Leadership	Applying AI in Practice	Introduction to Blockchain	Audit of Information Systems, Controls and Assurance
IT Manager	Customer Relationship Management (CRM)	IT Project Management and Artificial Intelligence	IT Law	Cybersecurity Fundamentals	Introduction to Blockchain	Cloud Computing Law
Software Developer	Big Data Engineering	IT Project Management and Artificial Intelligence	Chat GPT & Coding	Life Cycle of Software Development	Introduction to Machine Learning	Business Considerations for Edge Computing

Supply Chain Manager	Risk Controlling	Project Management	Agile Organizational Management	AI and Gen-AI for Supply Chain Management	Sustainable Supply Chain Management	Operations Management
Sales Engineer	Customer Relationship Management (CRM)	Project Management	Communication and Employee Leadership	Data-Driven Marketing	Communication Strategies for the Virtual Age	Operations Management
Head of Sales	Customer Relationship Management (CRM)	Project Management	Communication and Employee Leadership	Sales Management	Listening to Lead in Today's Workspaces	Fundamentals of Digital Marketing
Management Consultant	Strategic Business Planning	Project Management	Design Thinking	Digital Business Strategy	Agile Process, Project, and Program Controls	Managing Conflicts on Projects with Cultural and Emotional Intelligence
Business Economist	Customer Relationship Management (CRM)	Project Management	Communication and Employee Leadership	Business Intelligence and Data Analytics	Predictive Analytics	Risk Management
HR Specialist	Systemic Organizational Development	Project Management	Employer Branding	Digital Transformation in HR	Negotiation & Conflict Management	Generative AI for Human Resources (HR) Professionals
Controller	Fundamentals of Innovation Management	Project Management	Communication and Employee Leadership	Basics of Business Intelligence	Predictive Analytics	Data Analysis and Presentation Skills
Physician	Stress Management	Medical Technology and Pharmaceutical Industry	Communication and Employee Leadership	AI in Healthcare	Business of Health Care	Patient Safety
Psychologist	Coaching Techniques and Interventions	Conflict Management and Mediation	Communication and Employee Leadership	Performance and Motivation at Work	Existential Well-being Counseling	Virtual Care with Presence
Social Worker	Coaching Techniques and Interventions	Conflict Management and Mediation	Communication and Employee Leadership	Design Thinking for Social Innovation	Improving Mental Health and Suicide Prevention in Young Adults	Virtual Care with Presence
Business Economist – Marketing	Customer Relationship Management (CRM)	Project Management	Strategic Marketing	Leveraging Customer Insights and Data	Business Intelligence and Data Analytics	Corporate Brand and Reputation

Table A4. Evaluating the a priori classification of the “field of study match”.

Occupation	**“Exact“ match**	**“Related“ match (1)**	**“Related“ match (2)**	**“Related“ match (3)**
Mechanical Engineer	86%	3%	3%	8%
Automotive Engineer	76%	18%	0%	6%
Automation Engineer	61%	33%	6%	0%
Energy Engineer	89%	0%	11%	0%
Electrical Engineer	90%	3%	3%	3%
Project Engineer	24%	21%	12%	42%
Head of Production/ Manufacturing	24%	42%	29%	5%
Civil Engineer	94%	3%	2%	2%
Architect	77%	19%	3%	1%
Computer Scientist	81%	0%	5%	14%
IT Consultant	72%	0%	27%	2%
IT Manager	70%	12%	12%	7%
Software Developer	60%	3%	33%	3%
Supply Chain Manager	88%	0%	0%	12%
Sales Engineer	73%	4%	11%	11%
Head of Sales	70%	6%	17%	8%
Management Consultant	62%	28%	2%	9%
Business Economist	91%	4%	0%	4%
HR Specialist	92%	3%	0%	5%
Controller	90%	0%	10%	0%
Physician	-	-	-	-
Psychologist	62%	1%	35%	3%
Social Worker	94%	5%	1%	1%
Business Economist – Marketing	88%	9%	0%	3%
Total	**77%**	**8%**	**10%**	**5%**

Note: The experimental module of the survey was followed by an empirical evaluation of the a priori defined field of study-classification. For this purpose, each respondent was confronted with all 4 possible degree programs in a simple selection question and asked which of the field of studies best matched the advertised position.

Table A5. Evaluating the a priori classification of the “work experience match”.

Occupation	“Exact“ match	“Related“ match (1)	“Related“ match (2)	“Related“ match (3)
Mechanical Engineer	89%	6%	3%	3%
Automotive Engineer	88%	12%	0%	0%
Automation Engineer	89%	11%	0%	0%
Energy Engineer	89%	4%	7%	0%
Electrical Engineer	86%	0%	10%	3%
Project Engineer	64%	0%	12%	24%
Head of Production/ Manufacturing	100%	0%	0%	0%
Civil Engineer	92%	2%	3%	3%
Architect	77%	16%	5%	1%
Computer Scientist	77%	0%	17%	7%
IT Consultant	52%	14%	34%	0%
IT Manager	78%	8%	8%	5%
Software Developer	94%	3%	0%	3%
Supply Chain Manager	96%	0%	4%	0%
Sales Engineer	80%	5%	2%	14%
Head of Sales	96%	4%	0%	0%
Management Consultant	85%	13%	0%	2%
Business Economist	84%	10%	4%	1%
HR Specialist	90%	0%	8%	2%
Controller	100%	0%	0%	0%

Physician	21%	21%	42%	16%
Psychologist	62%	0%	33%	5%
Social Worker	82%	12%	3%	3%
Business Economist – Marketing	100%	0%	0%	0%
Total	**82%**	**6%**	**8%**	**3%**

Note: The experimental module of the survey was followed by an empirical evaluation of the a priori defined field of study-classification. For this purpose, each respondent was confronted with all 4 possible degree programs in a simple selection question and asked which of the field of studies best matched the advertised position.

Tab. A6. Sample descriptives for the vignettes.

Variables	Sample distribution
Information on the vignettes	
Vignette selection probability	0.309
Educational qualifications	
Bachelor	0.460
Master	0.540
Match of the field of study	
Related match	0.499
Exact match	0.501
Work experience	
1 year	0.334
3 years	0.333
5 years	0.333
Match of the work experience	
Related match	0.507
Exact match	0.493
Certificate of continuing education	
None	0.347
Further training	0.340
MOOC	0.313
Certifying institution *	
Commercial provider	0.506
University	0.494
Course volume *	
40 hours	0.536
80 hours	0.464
Type of certificate *	
Certificate of attendance	0.495
Certificate, incl. final exam	0.505
$N_{vignettes}$	12,048
$N_{vignettes\ with\ certificate\ of\ continuing\ education}$	7,868
* Distribution for the conditional factors and their levels. Information in the vignettes provided if the factor "Certificate of continuing education" takes the value "further training" or "MOOC".	