

DIFFERENCES IN THE START-UP BEHAVIOR OF CHEMISTRY STUDENTS WITH AND WITHOUT AN IMMIGRATION BACKGROUND: A COMPARISON BETWEEN GERMANY AND POLAND

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ABSTRACT

Entrepreneurs in the chemical industry are predominantly male, and despite more than 20 years of progress in the STEM society, this has not changed. At the same time, a chemistry student in Germany is 54% less likely to start a business than a student in another discipline. The willingness to start a business is also significantly higher in other countries such as Poland, which may be due to cultural influences. However, start-ups are important for the transfer of innovations from the university environment to the chemical industry. Innovations should reshape the chemical industry towards sustainability and transform their respective sectors.

Against this background, we conducted a comparative study among male and female chemistry students with and without an immigration background from all years of study in Germany and Poland to understand motivations, barriers and intentions as well as to identify possible differences between men and women. By selecting students with significant differences in cultural, economic and educational backgrounds, we developed and tested hypotheses on the influence of these factors on the intentions, perceptions, motivations and barriers of the four groups. A statistical random sample of chemistry students from Germany and Poland was included. We differentiated between intrinsic and extrinsic factors. Several significant differences were found between the four groups. Based on the discussed results, we propose approaches for the education of chemistry students and discuss future research approaches.

Keywords: Chempreneurs, Entrepreneurs, Culture, Immigration, Education

INTRODUCTION

Chemical entrepreneurship refers to the commercial application of innovations in chemistry to the market or to potential buyers (Oyeku, et al., 2015). Such ventures, also known as chempreneurs, are characterized by the introduction of new processes, products or procedures that are characterized by the combination of ideas, inventions and dissemination (Wolf, et al., 2021). The technology transfer for innovations takes the form of patents, spin-offs from universities or the founding of their own companies (Wolf, et al., 2022). Due to the far-reaching applications of the chemical industry's products, applications and concepts in everyday life, innovations in the field of chemistry are of crucial importance, especially in the context of global challenges such as health, plant production, energy conversion and storage, water resources and climate change (Confalone, 2014).

The chemical industry makes a significant contribution to gross domestic product in Germany and Poland. In Germany, it accounts for 6.7% of GDP and ranks third in the world behind the USA and China (Federal Ministry for Economic Affairs and Energy, 2017; Rudnicka, 2023). Bridging the gap between science and entrepreneurship is crucial for the chemical industry's ability to grow and survive in both countries (Sachse & Martinez, 2016).

The start-up propensity of migrants in Germany and Poland is of great interest, especially given the growing importance of migrants for the economy in both countries. Current research suggests that migrants are increasingly recognized as important drivers of innovation, growth, and entrepreneurship. Current research suggests that students with a migrant background in Germany have a significantly higher propensity to start a business (Middermann, 2020; Harima, et al., 2021). These findings emphasize the importance of an in-depth study of start-up dynamics among migrants in both countries to better understand the strengths and challenges of this entrepreneurial segment and to develop targeted measures to promote migrant entrepreneurship.

Against this background, this study aims to compare the willingness and activities of migrants in Germany and Poland to start a business. The focus is on the specific challenges, motivations, and barriers that migrants face when it comes to starting a business in the chemical industry. The results should help to deepen the understanding of the dynamics of migrant entrepreneurship and to develop innovative approaches to promote migrant entrepreneurship.

LITERATURE REVIEW

This study is based on the theory of planned behavior (TPB) (Ajzen, 1991; Walther, et al., 2023). According to the TPB, human behavior is determined by three factors and the associated beliefs. The basic model comprises the attitude, the subjective norm and the perceived behavioral control. A positive or negative attitude towards behavior is reflected in the respective aggregates and behavioral beliefs. The effects of the attitude towards the behavior and the subjective norm on the intention are moderated by the perceived behavioral control. In general, the more advantageous the mindset and subjective norm and the greater the perceived control, the stronger a person's control should be over their intention to engage in the behavior in question (Ajzen, 2006).

The basic model is modelled according to the research question and application so that different "relevant behaviors", i.e. target variables or questions, can be investigated, such as entrepreneurial behavior (Boissin, et al., 2009). In this study, the TPB model was supplemented by the variables start-up knowledge, perceived educational support, perceived support from the university/research institute and perceived career opportunities (Cook, et al., 2000; Zapkau, et al., 2015; Roy, et al., 2017). This can also provide fundamental insights for the training of prospective chemists in Germany and Poland (Walther, et al., 2024). The green arrows in Figure 1 therefore indicate factors that have a significant influence in Germany (Walther, et al., 2024).

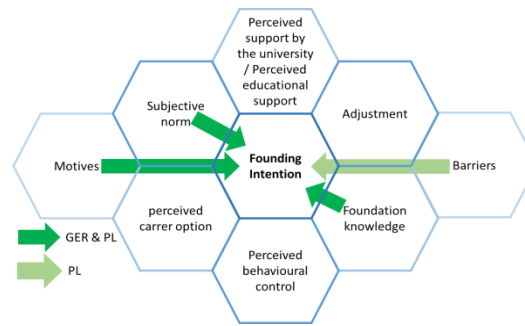


Figure 1

ADAPTED RESEARCH MODEL ACCORDING TO THE THEORY OF PLANNED BEHAVIOR

In addition to regular immigration, there were several large waves of immigration in Germany after the Second World War. From the 1960s, significant immigration took place in West Germany through the recruitment of "guest workers" from southern Europe to meet the economy's growing demand for labor (Oltmer, 2013). Until 1990, immigration between East and West Germany differed fundamentally in terms of the type, volume and countries of origin of migrants due to the respective form of government. In 2021, there were around 11.82 million people with foreign citizenship living in Germany, with Turkey, Poland, Syria, Romania and Italy representing the largest groups (BMIBH, 2023). At 27.3% of the total population and 22.3 million people, the post-migrant society made up more than twice as much as the migrant population in 2021 (BMIBH, 2023).

Studies have shown that migrants in "innovation-driven countries" (predominantly highly developed countries according to the current country categorization in the GEM reports) show a greater willingness to start a business than non-migrants (GERA, et al., 2024). The second generation of migrants in Germany shows a higher propensity to start a business than the first generation, which is attributed to high barriers such as bureaucracy or the length of time it takes to start a business (Leicht, et al., 2017). Another reason for this can often be a lack of language skills and knowledge of the authorities (GERA, et al., 2024).

The relationship between immigration and entrepreneurship is well researched in industrialized countries and can be attributed to the combination of new capital flows and increasing human capital (Fiess, et al., 2010; Li & Zahra, 2012; Siqueira, et al., 2016). A key factor influencing the entrepreneurial success of migrants is education: Asian immigrant entrepreneurs in the USA, for example, have a higher average income than the national average (Fairlie, et al., 2010).

In the context of STEM students, initial qualitative research has already taken place, indicating a strengthening of entrepreneurial self-efficacy and entrepreneurial intentions in the context of a gender-sensitive entrepreneurship and peer mentoring program in Canada (Elliott, et al., 2020). These results are based on the foundations of Ajzen's theory of planned behavior and suggest that the willingness to start a business is strengthened by the perceived attitude and subjective norm (Kolvereid, 1996). For chemistry students in Germany and Poland, social capital

is a significant influencing factor on their start-up behavior in addition to the subjective norm (Walther, et al., 2024).

It should also be noted that female chemistry students in Germany and Poland are significantly less likely to start a business (Walther, et al., 2024). However, Polish students are significantly more likely to start a business than German students (Walther, et al., 2024). Due to the high immigration density of Polish citizens in Germany, which comprises over 2 million people and thus represents the second most common country of origin, the willingness of Polish chemistry students to start a business also influences the general willingness to start a business in Germany (Bund - Länder Demografie Portal, 2024).

In view of the diverse factors influencing the willingness of chemistry students with and without a migrant background to start a business, specific hypotheses emerge that shed light on the potential of the migrant background to explain differences in business start-ups.

Hypothesis No. 1: *Chemistry students with an immigration background are more likely to start a business than students without an immigration background.*

Hypothesis no. 2: *Chemistry students without an immigration background rate the motives lower than their colleagues with an immigration background.*

Hypothesis no. 3: *Chemistry students without an immigration background rate the barriers higher than their colleagues without an immigration background.*

The following hypotheses are aimed at investigating and comparing the behavior and perceptions of chemistry students with and without an immigration background about start-up motives and perceived barriers.

METHODOLOGY

Survey

This study is part of a comparative study of German and Polish chemistry students that examines innovation-oriented technology transfer from the students' perspective. Due to time and cost constraints, a longitudinal design was chosen for our study. The chosen method was a survey with one measurement point (August 2022 - January 2023) to collect prospective and current data using an online questionnaire. Additional questions were added to the questionnaire used in this article. The questionnaire was translated into English, French, Spanish and Polish by specialized staff and then checked for loss of meaning. The target group for the survey was students from the departments of chemistry as well as related fields (biochemistry, analytics, industrial chemistry, process engineering, industrial biology and food chemistry) who were contacted by mail, personally in lectures or via online social media networks like Instagram.

Questions

The questionnaire used in this study is composed of questions from different studies. The questions are divided into demographic factors, the probability of founding or career intentions

and the assumed influencing factors from the TBP with supplemented questions. The questions were asked in the fixed order of demographic questions, external influencing factors, start-up probability and personal influencing factors. After the demographic questions on gender, immigration, nationality and age, participants were excluded due to their student status to obtain the desired data. Subsequently, study-relevant characteristics such as place of study, field of study, intended degree, total duration of study, type of employment or the presence of founders in the environment were recorded and questions were asked to determine the latent constructs. For this, questions from different studies were used, which were adapted to a 6-point Likert scale to force selection. Absolute ignorance (1) to comprehensive knowledge (6) for questions on basic knowledge, or I don't know (0), don't agree at all (1) to completely agree (6) for the others. The probability of founding a company was asked through two different types of questions, on the one hand the probability of founding a company after graduation from very unlikely (1) to very likely (6). An overview with the question categories used, the number of questions, the presence of the answer option "*I don't know*" as well as the question source can be found in Table 1.

Question categories	Number of questions	Answer option "I don't know"	Question source	Addition of own questions
Foundation knowledge	3	no	(Cook, Heath, & Thompson, 2000)	no
Perceived educational support (PES) & Perceived Support of the university (PSU)	10	yes	(Roy, Akhtar, & Das, 2017)	yes
subjective norm (SN)	2	no	(Saeed, Yousafzai, Yani-De-Soriano, & Muffatto, 2015)	no
Founding intention	2	no	(Saeed, Yousafzai, Yani-De-Soriano, & Muffatto, 2015)	no
Perceived Career options (WCO)	6	yes	(Cook, Heath, & Thompson, 2000)	no
Perceived Behavioral control (PBC)	9	yes	(Zapkau, Schwens, Steinmetz, & Kabst, 2015)	no
Self-assessment for the foundation (SF)	3	yes	(Krueger, Reilly, & Carsrud, 2000)	no
Motives for Starting a Business	17	yes	(Pruett, Shinnar, Toney, Llopis, & Fox, 2009), (Solesvik, 2013)	yes
Barriers to Starting a Business	19	yes	(Pruett, Shinnar, Toney, Llopis, & Fox, 2009), (Solesvik, 2013)	yes

Participants

A total of 4,367 people and 120 professors or student representatives were contacted. In February 2023, we received completed questionnaires from 1,287 participants, a response rate of

29.4 %, which is acceptable compared to other web-based studies (Cook, et al., 2000). Before conducting our statistical analyses, we excluded 320 participants due to incomplete data. We also excluded participants who reported that they were not currently a student ($n = 135$) or belonged to another field (such as teaching or electrical engineering) or were studying in another country ($n = 21$). The final sample thus consisted of 811 students, 498 from Germany and 313 from Poland. The students were confronted with the question "Do you have an immigration background" to be able to separate them according to the presence of an immigration background and gender. The average time spent in the questionnaire was 9.25 minutes. A summary of the distribution of study participants can be found in Table 2.

Types: number of...	Number (n)				
total	1,287				
exclude	476				
include	811				
German	498				
SUBGROUPS	GER Immigration Background		PL Immigration Background		
	Yes	No	Yes	No	
Number	116	382	64	249	
Age \pm SD	24,3 \pm 3,68	24,0 \pm 3,10	23,1 \pm 2,79	22,8 \pm 2,85	
Nationality	German	61	360	52	249
	other	55	22	12	0
University Type	Public	103	294	62	248
	Private	13	88	2	1
desired degree	Bachelor	63	199	41	183
	Master	27	99	14	50
	PhD/Doctor	26	84	9	16
income	No income	44	139	31	156
	Part time job	63	218	26	83
	Full time job	9	25	7	10
Social capital	yes	53	151	39	157
	no	63	231	25	92
department	Other	32	141	24	114
	Chemistry	84	237	38	104
	Business Chemistry	0	4	2	31

Statistical Analysis

The statistical analysis was carried out using IBM SPSS Statistics Version 28.0.1. As part of the demographic questions, the students were asked whether they had an "immigration background". According to this factor, we subdivide the answers of the lessons into those with an immigration background and those without for the respective country. Before ANOVA, the data were tested for normal distribution using Shapiro-Wilk tests. Since the data were not normally distributed, the Kruskal-Wallis-Test was used for independent samples, which is a non-parametric alternative to ANOVA. Kruskal-Wallis-Test compares the ranks of the data. The result of an ANOVA analysis is the standardized z-value, which indicates how many standard

deviations the test statistic deviates from the expected value, and the significance level (p-value) determined by the distribution function of the test. The significance level was defined as 5 %. The calculation of the probability of founding a company is based on the percentage of participants who selected founding a company as a career option. The general presentation of the results is in the form of a graph and shows the areas with significant differences. The mean values from one category are given and the significance refers to at least one question from this category. Significant different results are presented in a table which contains the factor, the country, the status via the migration background, the number of "I don't know" statements, the proportion of "I don't know" statements, the sample size (n), the mean, the median, the z-value (z) and the p-value (p). A complete list with all questions is included in the study by (Walther, et al., 2024).

RESULTS

Figure 2 provides an overview of the averaged values of all variable groups of the comparison groups used (students with and without an immigration background from Germany and Poland).

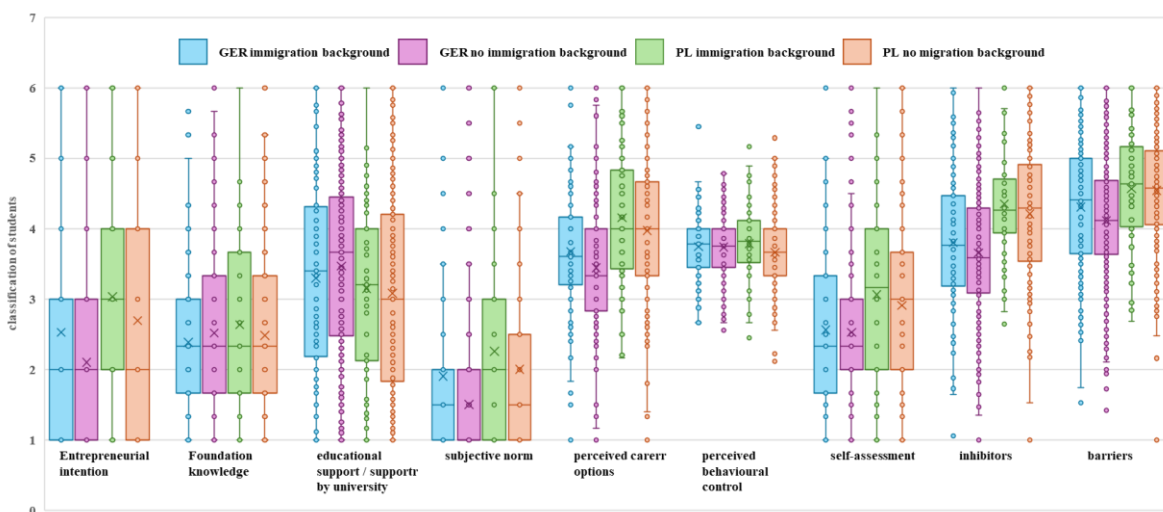


Figure 2
BOXPLOT MEAN PER GROUP AND FACTOR

As Figure 2 suggests, there are differences in all factor groups except for "foundation knowledge", "educational support / support from the university", "perceived behavioral control" and "self-assessment" between students with and without an immigration background. Although there are also differences between the other groups, such as German chemistry students without an immigration background vs. Polish chemistry students with an immigration background, these are not analyzed in more detail below. Although there are differences in all factor groups, these can be attributed to country-specific differences within a culture. For a more detailed analysis of

these differences, we recommend a detailed analysis of country differences (Walther, et al., 2024).

Entrepreneurial Intentions

The analysis of the ANOVA comparisons for the Entrepreneurial Intentions can be found in Table 3.

Question Factors /	Country	Immigrated	n	mean	median	Germany				Poland	
						Immigrated		Not immigrated		Immigrated	
						z	p	z	p	z	p
How likely do you think it is that you will start a business after graduation?	GER	Yes	116	2.5	2						
		No	382	2.1	2	2.738	0.037				
	PL	Yes	64	3	3	-2.303	0.128	-4.808	<0.001		
		No	249	2.7	2	-1.041	1	-0.5001	<0.001	1.723	0.509

Table 3 shows clear differences between the comparison groups. Gender-specific and cultural differences also become clear when comparing immigration status or gender. Here, German female students with a migrant background have an average rating of 2.6 and students without a migrant background have an average rating of 1.9 for willingness to start a business. At the same time, the direct comparison of the genders without an immigration background shows the corresponding significant difference with the higher ratings for men. This leads directly to the conclusion that gender has an influence on the willingness of chemistry students to start a business. This connection has already been postulated for Germany and Poland with a significant effect of men and an up to twice higher willingness to start a business. For chemistry students in Germany, however, no significant influence of an immigration background has so far been postulated (Walther, et al., 2024). This leads directly to the conclusion that the immigration background has an influence on the willingness of chemistry students to start a business. This connection has already been postulated for Germany with a non-significant effect of students with an immigration background and a 30% higher willingness to start a business (Walther, et al., 2024).

The TEA rate serves as the second indicator for assessing the students' willingness to start a business, analyzed by the question of the future career intentions of the participants and the number per respective subgroup. The results of this analysis can be found in Table 4.

Parameter	GER		PL	
	Immigrated	No Immigrated	Immigrated	No Immigrated
n (potential Founder)	15	29	13	45
n (sum)	116	382	64	249
TEA-rate [%]	12.9	7.6	20.3	18.1

The Table 4 shows a higher willingness to start a business among students with an immigration background. At the same time, women with a migrant background are more willing to start a business than their male colleagues, which suggests cultural differences. It is striking that the male participants without an immigration background have a higher TEA rate than the male migrants and that the women with an immigration background have the highest TEA rate. The difference between the genders without an immigration background had already become apparent in the comparison of students by gender, where men also showed a higher willingness to start a business (Walther, et al., 2024).

Factors without significant influence

In a recent study, the variables of the "*start-up knowledge*" group were analysed and it was found that there are no significant differences for chemistry students with or without an immigration background in Germany or Poland. Figure 2, which visualizes the corresponding results, illustrates this finding. These findings indicate that there are no statistically significant differences between the variables analysed in relation to foundation knowledge. This suggests that the factors analysed are similarly pronounced within the group. This also applies to the variables in the "*Perceived educational support (PES) / Perceived support of the university (PSU)*" group. This correlation also applies to the questions from the "*Self-assessment for the foundation (SF)*" variables, for which no significant differences could be identified between the comparison groups in both countries.

Factors with significant influence

The factors with a significant influence include variables from the subjective norm (SN), perceived career options (PCO), perceived behavioral control (PBC), motives for starting a business and barriers to starting a business. The individual variables and the results can be found in Table 5.

Factor group	Question / Factors	Country	Immigrated	I don't know	I don't know %	n	mean	median	Germany				Poland	
									immigrated		not immigrated		immigrated	
									z	p	z	p	z	p
SN	People I care about expect me to start a business after I graduate.	GER	Yes			116	1.7	1						
			No			382	1.3	1	3.422	0.004				
		PL	Yes			64	2.1	1	-2.188	0.172	-5.209	<0.001		
			No			249	1.9	1	-1.919	0.33	-7.103	<0.001	0.892	1
PCO	I can imagine that being an entrepreneur would give me great satisfaction.	GER	Yes	14	12.1	102	3.6	4						
			No	42	11	340	3	3	2.688	0.043				
		PL	Yes	9	14.1	55	4.4	5	-2.629	0.051	-5.114	<0.001		
			No	31	12.4	218	3.8	4	-0.936	1	-4.792	<0.001	2.171	0.18
PBC	Economic security is important to me.	GER	Yes	1	0.9	115	5.2	5						
			No	4	1	378	4.9	5	2.636	0.05				
		PL	Yes	3	4.7	61	5.4	6	-1.125	1	-3.326	0.005		
			No	10	4	239	5.2	6	0.133	1	-3.579	0.002	1.137	1
Motives	...to create something on my own.	GER	Yes	3	2.6	113	5.1	5						
			No	9	2.4	373	4.9	5	2.712	0.04				
		PL	Yes	2	3.1	62	5.2	6	-0.322	1	-2.506	0.073		
			No	2	0.8	247	5.2	6	-0.363	1	-4.053	<0.001	0.079	1
Barriers	...a lack of knowledge of the market.	GER	Yes	6	5,2	110	4,7	5						
			No	29	7,6	353	4,4	5	2.919	0.021				
		PL	Yes	3	4,7	61	5,1	5	-1.259	1	-3.749	0.001		
			No	13	5,2	236	4,8	5	0.094	1	-3.662	0.002	1.475	0.841
	...a lack of support in setting up a business.	GER	Yes	15	12,9	101	4,4	5						
			No	73	19,1	309	4	4	2.712	0.04				
		PL	Yes	4	6,3	60	4,5	5	-0.322	1	-2.35	0.113		
			No	18	7,2	231	4,4	5	-0.363	1	-3.679	0.001	0.08	1

As the results in Table 5 show, there is a significant difference in the variable "People I care about expect me to start a business after I graduate.?" between the women according to their immigration background. This result indicates that women born in Germany perceive a higher pressure on their decisions. Cultural expectations and social support in relation to

entrepreneurship could vary according to cultural backgrounds, exposing immigrants to different expectations and support (Berger, 1991). Thus, differences in the willingness and ability to start a business due to different cultural influences could be observed (Walther, et al., 2024).

In Germany, there was a significant difference between people with an immigration background and those without an immigration background ($z = 2.688$, $p = 0.043$), with those with an immigration background tending to have higher approval ratings. There was also a significant difference between male and female respondents ($z = -5.114$, $p < 0.001$), with male participants tending to give higher approval ratings. In Poland, there was also a significant difference between people with and without an immigration background ($z = -2.629$, $p = 0.051$), with participants with an immigration background tending to have higher approval ratings. In addition, there was a significant difference between male and female respondents ($z = -4.792$, $p < 0.001$), with male participants reporting higher approval ratings. These results indicate that immigration background and gender can have a significant influence on perceived career opportunities in relation to starting a business, particularly in the countries analyzed, Germany and Poland.

The results indicate that German chemistry students with a migrant background gave a significantly higher average rating for the importance of economic security compared to those without a migrant background. In contrast, in Poland there were no significant differences between the two groups in terms of the perceived importance of economic security. These results suggest that immigration background appears to have a more significant impact on perceptions of economic security in Germany than in Poland. The different assessment of economic security can be attributed to cultural differences, for example. These have an effect through the different perception of economic security and thus influence the perceived behavioral control (Yong, 2019).

The results indicate that respondents with an immigration background in Germany expressed significantly higher average ratings for the desire "*to create something on my own*" compared to those without an immigration background. In contrast, no significant differences were observed between the two groups in Poland regarding this desire. This suggests that the motivation to create something independently may be a stronger driving force for individuals with an immigration background in Germany to pursue entrepreneurship compared to non-migrant individuals (Berger, 1991). On balance, the reasons for this can be found in cultural differences, but other factors such as individual abilities, social environment and economic conditions can also be important (Carbonell, et al., 2014)

For the variable "*a lack of knowledge of the market*," the results indicate that respondents without an immigration background in Germany reported a significantly higher average rating for this barrier compared to those with an immigration background. Similarly, in Poland, the non-immigrant group also indicated a higher average rating for this barrier compared to the immigrant group. This suggests that a lack of market knowledge may be perceived as a more significant barrier for non-immigrant individuals in both countries. For the variable "a lack of

support in setting up a business," the results show that in Germany, respondents without an immigration background reported a significantly higher average rating for this barrier compared to those with an immigration background. In Poland, however, no significant differences were observed between the two groups for this barrier. This implies that the lack of support in setting up a business may be perceived as a more substantial obstacle for non-immigrant individuals in Germany, while the perception of this barrier does not significantly differ between immigrant and non-immigrant individuals in Poland. The results highlight the differences in backgrounds depending on country of origin and culture (Falcão, et al., 2024). At the same time, it is possible that cultural differences alone are not sufficient to explain these observations; additional factors such as individual attitudes, political framework conditions and market conditions may also exert an influence (Porfrio, et al., 2016).

DISCUSSION

The present study compared the start-up behaviors of chemistry students with and without an immigration background in Germany and Poland to understand motivations, barriers, and intentions. The results revealed various significant differences between the groups. Based on the findings, the hypotheses can be addressed.

Hypothesis No. 1: *Chemistry students with an immigration background are more inclined to start a business than students without an immigration background. The results suggest that chemistry students with an immigration background in Germany and Poland have a higher inclination to start a business. Particularly, female students with an immigration background exhibit a higher propensity toward entrepreneurship.*

Hypothesis No. 2: *Chemistry students without an immigration background rate motives lower than their counterparts with an immigration background. The data indicate that chemistry students without an immigration background tended to provide lower ratings for certain motivating factors compared to those with an immigration background. This suggests that students without an immigration background may be influenced less by certain motives.*

Hypothesis No. 3: *Chemistry students without an immigration background rate barriers higher than their counterparts with an immigration background. The results show that chemistry students without an immigration background in Germany tended to perceive higher barriers to entrepreneurship compared to students with an immigration background. In Poland, no significant differences in these barriers were observed.*

Our study shows significant differences in the propensity to start a business. Polish chemistry students with a migrant background are the most likely to start their own business. Education is seen as an important factor that strengthens and develops the intrinsic aspects of students (Walther, et al., 2024). We consider entrepreneurial education as a positive contribution within education in terms of subject-specific know-how and an improved entrepreneurial attitude, as for example in Barringer, Jones & Neubaum (2005). Against this background, we consider additional offers and references to further career opportunities, depending on immigration background, as an opportunity for students. In this context, it is necessary to expand existing support programs, whereby networks can serve as catalysts (Castello & Di Bernardino,

2017). In addition, the introduction of a cooperative innovation strategy, such as that implemented by Fresenius University of Applied Sciences under the name PANDA, is recommended (Wolf, et al., 2021). In this way, students not only learn the theoretical basics, but also the practical perspectives on starting a business, which can break down possible barriers and build up start-up knowledge. A combination with other subjects is conceivable from which students can benefit, such as marketing or advertising (Elliott, et al., 2020; Ghafar, 2019).

Limiting factors or possible sources of error in this study are the small number of participants with an immigration background and the non-representative nature of the survey. A possible influencing factor on the survey results could be the regional focus of the participating students. For future research purposes, a more representative survey with more participants is recommended. In addition, the use of further statistical analysis methods such as ordinal regression analysis would be conceivable. For further studies, the use of other countries for comparison purposes is recommended. When implementing entrepreneurial education among chemistry students, it is advisable to utilize the findings from this study. The experienced role models can be utilized and further developed. In general, however, it is advisable to further investigate the effects after the implementation of a semester or year and to make any necessary adjustments to teaching. Gradual implementation, for example as part of a Plan-Do-Check-Act cycle, would be helpful here to integrate the circumstances and changed starting situations of the respective students into the program and thus ensure optimal use of potential and skills.

SUMMARY

The present study compared the start-up behaviors of chemistry students with and without an immigration background in Germany and Poland to understand motivations, barriers and intentions. The results showed several significant differences between the groups that can be considered about the hypotheses. The results suggest that chemistry students with a migrant background, especially in Germany, have a higher propensity to start a business. This suggests that the immigration background has an influence on the propensity to start a business. The chemistry students without an immigration background tended to give lower ratings for certain motivating factors. This suggests that students without an immigration background may have different motivating factors for starting a business. This could be due to the different cultural and socio-economic influences that the two groups are exposed to.

The results suggest that chemistry students without an immigration background in Germany tend to perceive higher barriers to starting a business. This suggests that non-migrant students may perceive greater barriers to starting a business. This could be due to structural, social or cultural differences that affect their perceptions of starting a business. These findings raise important questions and help to deepen the understanding of the dynamics of migrant entrepreneurship and the factors that influence business creation. To further explore the complexity of these issues, qualitative studies could be utilized to further investigate the individual experiences, attitudes and motivations of immigrant and non-immigrant chemistry

students. Furthermore, the results of the study offer insights into potential inequalities and challenges in entrepreneurship of chemistry students with and without an immigration background. Possible approaches to promote entrepreneurship could focus on identifying and addressing specific barriers and providing targeted support measures for different groups.

In summary, the results of this study provide important insights into the differences in start-up behavior of chemistry students with and without an immigration background in Germany and Poland. They provide a basis for further research and could help to develop targeted measures to promote student entrepreneurship and deepen understanding of the dynamics of immigrant entrepreneurship.

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