Digital Start-up Success: How Formal Education and Academic Diversity Impact New Digital Ventures' Performance

Ferdinand Mittermeier
University of Bamberg
Ferdinand.mittermeier@uni-bamberg.de

Cedric Fabian Pöppinghaus
Frankfurt School of Finance & Management
cedric.poeppinghaus@gmail.com

Daniel Beimborn
University of Bamberg
Daniel.beimborn@uni-bamberg.de

Abstract

Factors affecting the creation, growth, and survival of new businesses are of great interest to entrepreneurs, policymakers, and academics and have been studied for a long time. While the importance of work experience is constantly emphasized, the benefits of formal education are often questioned in practice. This study discusses the impact of founders' academic background and diversity on the success of digital startups. By analyzing 519 digital start-ups and 1,038 founders, we show that the ranking of the universities the founders graduated from and the quantitativeness of the founders' majors both contribute to the funding success of digital start-ups. In contrast to previous literature, we were not able to confirm that diversity, measured in the distance between the rankings of two majors, has a significant impact on the success of digital start-ups. The findings enhance our understanding regarding the importance of general human capital in the digital age.

Keywords: Digital start-up, academic background, academic diversity, funding success

1. Introduction

"Find your one thing and do that one thing better than anyone else" (Jason Goldberg, Founder of Fab.com and Simple Token). What Jason Goldberg is describing is a common theme among motivational books like 'The ONE Thing' by Keller and Papasan (2012) and has also been picked up by magazines such as Inc. (Hoffman, 2012). For future founders of digital start-ups, that might mean studying computer sciences, then building on those skills to become an expert in the digital field and ultimately founding a successful digital start-up. Indeed, human capital, i.e., the knowledge, work experience and subjective skills of founders, has been shown to play an important role in product innovation and the creation and survival of start-ups (Marvel et al., 2020). It helps founders to tackle typical challenges along the entrepreneurial process, such as new knowledge creation, opportunity identification and exploitation, or resource acquisition (Reese et al., 2021). It is therefore not surprising that human capital is one of the first aspects investors look at before financing a new start-up (Unger et al., 2011). Since digital start-ups are a driving force for economic development and sources of innovation and new employment, researchers and policy-makers are also interested in understanding and supporting their development and survival (Ratzinger et al., 2018).

However, while the role of prior entrepreneurial, management and industry experience seems indispensable (Hashai & Zahra, 2022), the need for formal education is often questioned in practice, especially in the digital economy (Forbes, 2020). This is partly due to the successes of companies such as Facebook, Apple and Microsoft, whose founders do not hold university degrees. Moreover, previous studies on formal education already show that it only significantly affects the *initiation* of entrepreneurship, but not the *success* of it (Davidsson & Honig, 2003). In contrast, very early studies on human capital in the digital economy show that business and technical knowledge can enhance the performance of start-ups (Kollmann, 2006).

According to Ratzinger et al. (2018), these inconsistencies in the literature are due to the shift in researchers' focus from individual founders to entrepreneurial teams. Multiple founders operating as a team are more likely to bring the multidisciplinary digital-related and managerial skills needed to develop a digital startup. This suggests that in knowledge-based industries such as in the digital economy, it is the venture team rather than the individual entrepreneur that drives the new venture creation process. However, initial research focusing on the team level shows that most high-tech ventures have a strong tendency towards homophily even though diversity in terms of experience and background in the team seems to be the more beneficial option (Browder et al., 2019). In contrast, other

URI: https://hdl.handle.net/10125/103214
978-0-9981331-6-4

studies claim that it is not conclusively proven that different educational levels and backgrounds of team members have significant positive or negative effects (Zhou & Rosini, 2015). The trend towards homogeneous teams that share a common cognition indicates that it is not competence but trust and familiarity, and thus the social network of a founder, that primarily influences team formation (Ratzinger et al., 2018). In the context of digitalization, this could be beneficial, as academic connections. i.e. a subnetwork of the founder's social network, have shown to be crucial in recruiting technical human capital (Zane & DeCarolis, 2021). Such resources are very likely to meet the requirements of the digital economy and are therefore desirable (Kollmann, 2006). The impact of academic diversity, particularly in the context of the digital economy, therefore appears less conclusive.

The focus of this paper is on the analysis of the formal education of founders of digital startups. In particular, we examine the impact of digital-related degrees (i.e., more quantitatively oriented majors) of founders and the academic diversity of founding teams (i.e., the diversity in academic education) on the funding success of digital start-ups. Our research question is therefore:

What is the impact of founders' academic background and founder teams' academic diversity on digital start-up success?

We proceed as follows: First, we outline the related research regarding the two core constructs of this study, i.e. the founders' academic background and founding teams' academic diversity. Based on this, we derive our hypotheses. In this context, we also address the question of whether there are differences in impact of degrees from top-ranked universities compared to universities with lower rankings. By using data from Crunchbase and LinkedIn, we test the relationships between the academic background and diversity of founders and the funding performance of 519 digital start-ups. At the end, our findings will be discussed and mirrored against existing literature.

2. Related research and hypothesis development

2.1. Capital of start-up founders

When talking about start-up success, one must understand the factors contributing to both success and failure. When it comes to failure, managerial literature offers a plethora of reasons. However, over the years and across different sources, the same three main reasons seem to recur: the failed start-up had an insufficient product-market-fit, ran out of cash, or did not have the right team with the respective skillset (Feinleib, 2011; Pride, 2018). The academic literature has long addressed these issues mainly focusing on the initial resource base of the individual founder, i.e. his/her human, social, and financial capital (Linder et al., 2020). The former can be distinguished between general (founder's education) and specific (managerial, entrepreneurial, or industry experience) human capital and describes *what a founder knows* (Unger et al., 2011). Social capital depicts those resources that are "embedded in a social structure which are accessed and/or mobilized in purposive action" (Lin, 1999, p. 35). It results out of investments in social relations and therefore describes *whom a founder knows*. Since it can be transformed into other forms of resources, financial capital depicts a generic type of asset (Ratzinger et al., 2018). Given that not every founder is lucky enough to be equipped with sufficient financial resources right at the beginning and just about every new start-up has to raise money eventually, the financial capital very often describes the outcome rather than an influencing factor. Hence, we focus on the former two types especially in the context of academia. Education has been shown to have the most direct impact on human capital and is therefore considered one of the most important investments in this type of resource. This, and the fact that the academic network has been found to have a positive impact on the success of start-ups (Nann et al., 2010; Zane & DeCarolis, 2021), gives universities a special role in generating general human and social capital and makes it an interesting object of study. Since the digital economy requires a multidisciplinary skill set, which is difficult to obtain at an individual level (Ratzinger et al., 2018), we further analyze the academic diversity of founding teams and its impact on the funding success of digital start-ups.

2.2. Founders' academic background

Scholars have long been focusing on founders' background and its impact on the performance of start-ups. Bruderl et al. (1992), for instance, surveyed over 1800 business founders in Germany and found that the background of the founders has a significant impact on the failure rate of start-ups. More specifically, the study showed that more years of academic and professional experience decrease the chance of a failed business and most importantly industry-relevant work experience has a very significant impact on the survival of a new business. However, work experience does not have a linearly positive correlation with survival chances. After about 25 years, a tipping point is reached and the survival rate starts to decrease. Studying 48 start-ups in Korea, Jo and Lee (1996) found a

clear relation between academic and professional experience relevant to the start-up's industry and product and the success of the start-up in terms of both growth and profitability. Researching the team characteristics that are most important for venture capital decision making, Franke et al. (2008) suggest that the three most important aspects are industry experience, leadership experience and educational background. Other studies argue that the factors that improve the ability to get funded include the founders' academic backgrounds as well as their managerial skills. However, there are differences between what factors attract funding and what factors contribute significantly to the survival of a start-up. While the technical skills seem to play no significant role in attracting investors, they are one of the key factors for the chances of survival (Gimmon & Levie, 2010). Not surprisingly, technical and digital human capital, in particular, appear to become more important in times of digitalization (Grimpe et al., 2022). The literature further suggests that the start-up's performance depends on whether the founders' skills match the specific requirements of an industry (Kollmann, 2006). Therefore, it can be assumed that a more digital-related background is more appropriate for performing in the digital economy and therefore affects the funding success of digital start-ups. 'Digital-related' comprises the "knowledge, skills, and abilities of individuals regarding digital technologies such as software coding, artificial intelligence (AI), or machine learning", acquired through formal education, i.e., more quantitatively oriented majors (Grimpe et al., 2022, p. 1). Initial studies already show that a higher technical or business education increases the probability of achieving specific investment milestones (Ratzinger et al., 2018). Hence, we argue:

H1: *In digital start-ups, founders with digital-related majors found more successful start-ups than those with non-digital majors.*

Prior studies generalized higher education and therefore neglected the impact of specific universities (Ratzinger et al., 2018). However, top-tier universities like Harvard, Stanford, and MIT seem to produce the most Unicorn founders, especially in the digital age. Hence, it might not be the degree itself but the reputation of the university that appears to matter (Kawohl & Grumbach, 2018). Linder et al. (2020) argue that it takes the right combination of social, human, and financial capital to ensure the survival of a new venture. Since top-tier universities have the greatest output on graduate founders that raised at least one million USD in funding for their start-ups (Glasner, 2017), they appear to contribute to those critical factors at most, i.e., through access to funding, access to entrepreneurs, and access to an entrepreneurial ecosystem (Nag, 2020). Especially the academic connections are often highlighted as reasons for studying at such universities (Macosko, 2022). Nann et al. (2010) utilized the German professional online network XING for analyzing the effects of alumni networks on start-up success. Founders from universities where alumni are staying more connected with each other and a larger share of the professional networks of the universities' alumni is made up by other alumni are more successful than others. From an individual point of view, it was found that the more connections founders had to alumni from their university, the more successful their start-up was. It can thus be assumed that top-tier universities not only promote the development of digital human capital, but are also relevant for the establishment of a corresponding social network of a founder, which in turn has an impact on the funding success of a new digital venture. This brings us to our second hypothesis:

H2: *In digital start-ups, founders from highly ranked universities are more successful than those from lower-ranked universities.*

2.3. Academic diversity

As outlined above, the importance of founder characteristics for the success of start-ups has been established in numerous studies. In terms of diversity, experience and academic diversity are of particular interest. "As human capital has an influence on performance at an individual level (Martin et al., 2013), the composition of the founding team is arguably influential upon the performance of the start-up" (Ratzinger et al., 2018, p. 763). Hence, we are not only interested in diversity on an individual level but also in the context of founding teams. Rizy et al. (2011) surveyed 321 executives about the impact of diversity on their company. The opinion of the majority of participants suggests that diversity in terms of experiences, perspectives, and backgrounds is significant for the companies' innovation capabilities and thus for the business's success. Other studies suggest that the sharedness of entrepreneurial competencies among team members can be beneficial for start-up performance, while management competencies should be concentrated in one person (Reese et al., 2021). Vogel et al. (2014) studied the influence of different team diversity factors on the decision of a venture capital firm to invest. They found that a diverse team in terms of academic background and level of education affects VC-firms' investment decisions positively. Academic diversity is also confirmed to positively contribute to the start-up's ability to secure funding in a study by Franke et al. (2008). According to them, academically diverse teams are "strongly preferred over teams where all members have an engineering background or a management

background" (Franke et al., 2008, p. 478). In the context of digital start-ups, the literature further suggests that a heterogeneous team configuration in terms of different types of higher education is more likely to meet the specific requirements of the digital economy (Ratzinger et al., 2018). In this vein, we propose:

H3a: *In digital start-ups, the more academically diverse the team is in terms of the majors studied, the more successful the start-up will be.*

H3b: *In digital start-ups, the more academically diverse the team is in terms of the university attended, the more successful the start-up will be.*

3. Research methodology

3.1. Data collection

For the data collection, two main sources were used: Crunchbase and LinkedIn. Crunchbase is a start-up database including data about funding and background information on the founders. While Crunchbase is relying to some extent on its community data input, it does have a dedicated team and machine learning implemented to ensure data accuracy (Crunchbase, 2022). LinkedIn is the world's leading professional social network with over 774 million members around the world (LinkedIn, 2022). The majority of founders are present on LinkedIn and most of them present information about their academic background in their profile.

On Crunchbase, we drew data about start-ups from the following categories: software, apps, IT, data and analytics, internet services, and artificial intelligence. Only start-ups headquartered in the US with exactly two founders were considered. Additionally, the two founders both had to have at least one degree from a US four-year university or graduate university. In order to avoid survivorship-bias, we considered both active and closed start-ups. Finally, yet importantly, only start-ups with at least a funding sum of USD 100,000 were included. Before data cleaning, this export included 629 companies.

The information about the academic background of the founders was either taken directly from Crunchbase or, when incomplete, from LinkedIn. When neither Crunchbase nor LinkedIn had the required information, alternative sources were used (e.g., start-up's website, the founder's official website, forbes.com). We considered up to two university degrees for each founder. If a founder had studied both outside the US and inside the US, only the degree from the US university was captured. If a founder held more than two degrees, the earliest two were entered. The level of education – whether the degree received was a Bachelor, Master or PHD – was not collected and does not influence the analysis of this study. Double degrees, e.g., two Bachelor's degrees in different subjects, were treated the same way as major and minors, as one combined degree. Those start-ups, for which we could not find sufficient information about their founders' academic backgrounds, were skipped from the original data set, leading to our final sample with 519 start-ups and 1,038 founders.

3.2. Operationalization

To operationalize the dependent variable, i.e., success, we divided the total funding sum by the years of active funding. This method was preferred over the total funding sum to remove preferences for older start-ups that had collected huge funding over a long period and a negative bias towards young start-ups that had only begun to receive funding. Based on the deciles of this annual funding sum distribution, ventures were categorized into ten success categories.

For H1, the different majors needed to be operationalized. The goal for the score was to determine how quantitative and thus how digital-related each major is. This score is based on published data about the Graduate Record Examinations (GRE) scores. The GRE is a standardized test designed to measure basic cognitive abilities, such as quantitative reasoning or critical thinking, and is required for admission to graduate schools. The Educational Testing Service published the mean scores for GRE test takers between 1 July 2013 and 30 June 2016 for the quantitative section of the test. This section is scored on a scale of 130-170, with 170 being the best possible score. The mean scores were available for seven groups of majors: life sciences, physical sciences, engineering, social & behavioral sciences, humanities & arts, education and business. The GRE report also included a list of majors classified under the different groups. These classifications were used as a basis to manually assign the different majors observed through Crunchbase and LinkedIn to a major group. Afterwards, the normalized mean score for the quantitative section of the respective major group was assigned (Table 1). Because majors with a quantitative focus, such as engineering and physical sciences, value these scores the most and also can report higher average scores, we used the quantitative section of the GRE score as an indicator of the 'quantitativeness' of the majors.

In order to analyze H2, we used the US News National Universities Ranking and the Leiden Ranking, which include 231 and 177 US universities, respectively. For universities not considered in the ranking, the lowest possible score of 0 was assigned. For the analysis, three average university scores were created:

the average of the university scores for the first founder, the average of the university scores for the second founder, and the average of the average university scores of both founders. If a founder only attended one university and thus only had one university score, that score was used as the average. The same was done for the major scores to analyze H1.

Table 1: Normalized Quant score per major group

Major Group	Exemplary Majors	Quant Score
Engineering	Electrical, Software, and Mechanical Engineering	1
Physical Sciences	Computer Sciences, Chemistry, Mathematics	0,9
Business	Accounting, Banking, Management	0,4
Life Sciences	Biology, Nursing, Medicine	0,2
Social & Behavioral Sciences	Political Sciences, Anthropology, Law	0,2
Humanities & Arts	Philosophy, History, Literature	0,1
Education	Elementary, Administration, Early Childhood	0

Finally, for H3 we calculated two separate diversity scores in order to avoid losing information in a combined diversity score. The university diversity and the major diversity were scored separately. Both are calculated as the absolute value of the distance between two scores. Based on this calculation, major and university diversity scores were generated for each founder on an individual basis. This was supposed to cover potential diversity within the academic background of one founder. The university diversity of a founder is the absolute difference of her first and second university score. The diversity is automatically zero if the founder only has one university score. The same was done to create the major diversity of a founder. Additionally, a team university diversity and a team major diversity score were calculated using the absolute distance of both founders' average university scores and major scores respectively.

As controls, we used gender, age and gender diversity, and the age span on a team level, respectively. Furthermore, we used the following control variables: (1) founding year of the start-up, (2) a founder location score, based on three rankings of start-up friendliness in the particular state where the founders' universities are located (including aspects like start-up activity, the survival rate of businesses, access to capital and the labor market), (3) and a start-up location score (same ranking-based scoring for the venture's headquarter location). The first ranking is '2017's Best & Worst States to Start a Business' by WalletHub (Bernardo, 2017). The second ranking is 'The Best and Worst States to Start a Business' by gobank-ingrates.com (Csiszar, 2017). The final ranking is 'Best States to Start a Business – Definitive Ranking of All 50 States' by Waring (2017). The average score for each state out of the three included rankings was then normalized and used as the location score. The location score was then assigned to each of the founders' universities based on the US state they are located in. Subsequently, an average for the location scores of each founders' university location scores was calculated. If only one score was available, it was used as the average. As a last step of the university location score, an average university location score for the founding team was calculated.

Finally, to allow for the analysis of the potential impact of the headquarter location, a location score was assigned to every start-up based on the state of its headquarter. The headquarter location score utilized the same scores as the university location score.

To control for multicollinearity, we checked both the correlations among independent variables and VIFs[1] and did not find any problematic indications.

3.3. Descriptive statistics

On average, the start-ups were active in funding activities for 4.29 years and collected almost USD 27 billion. This corresponds to an average funding sum of over USD 51 million and a median funding sum of USD 9 million per start-up. The minimum funding matches the applied filter at USD 100,000 and the maximum funding collected was over USD 6 billion. About half of the start-ups collected less than USD 9 million, while about 20% collected more than USD 44 million. The bottom 10% collected under USD 500,000 and the top 10% collected over USD 87 million each. On average, about $7.5 million was raised per year, with a minimum of $25,000 and a maximum of about $452 million. About half of the start-ups collected more than USD 2.5 million per year.

The average age of the founders in our sample is 45.56 years. The average age difference within a start-up is 5.66 years. 10.40 % are female, the rest are male. Over 17% of the founders attended Stanford for their first degree. The second place goes to Harvard (8.38%). About 46% of founders did not pursue a second degree at a US university. From those that did pursue a second degree, the same universities dominate. In terms of the percentage of total funding raised by graduates of each university in this data set, Stanford

[1] Absolute values of all but two correlation coefficients were below 0.1 (-0.69 and 0.38 were the exceptions). All VIFs were below 2. Correlation table has not been included due to page restrictions but can be provided upon request.

dominates by an even larger margin, with 25.12% of funding raised by Stanford graduates. Graduates from the Rochester Institute of Technology collected the highest funding per founder. In terms of the second degree, once again, Stanford dominates regarding the percentage of the total funding sum (26%). Graduates from Santa Clara University achieved the highest funding per founder. The average university score of all founders is 0.76, with a minimum of 0 and a maximum score of 1. Over 70% of founders have an average university score of over 0.71. Hence, the majority of founders went to highly ranked universities.

Computer sciences are the most common first major (19%) with very high margins followed by economics (7%) and electrical engineering (6%). Founders studying computer sciences collected the highest percentage of total funding. Founders who graduated with a degree in electrical engineering achieved the highest total funding collected per founder. From those founders that did pursue a second degree, a vast majority took part in a MBA program (30%), with another high percentage of founders getting a degree in computer sciences (16%). MBA graduates, followed by computer sciences and electrical engineering collected the highest percentage of total funding. Founders who studied electrical engineering, followed by software product management and business, achieved the highest amount per founder.

Examining the major groups for the first major, the most common group is physical sciences followed by engineering and social & behavioral sciences. Among those founders that pursued a second degree, business ranks as the most common major group, followed by physical sciences and engineering. The founders in this sample have an average major score of 0.61, with a minimum score of 0.05 and a maximum score of 1. Over half of the founders have a major score of at least 0.65 and over 40% of founders have a major score of at least 0.9. 10% of founders have a major score of 1. This data shows that the founders of digital start-ups typically study majors with higher quantitative scores, like computer sciences.

The average university diversity per founder is 0.1, ranging from 0 to 0.99. Over 60% of founders have a university diversity score of 0, only 10% have a score of greater or equal than 0.42. The average major diversity per founder is 0.11 while values range from 0 to 1. Over 70% of founders have a major diversity score of 0, 10% have a score of 0.5 or higher.

4. Results

The team university diversity is on average 0.235 with a minimum of 0 and a maximum of 0.995. About half of the teams have a score under 0.12 and about 20% over 0.47. The most common university diversity score is 0 (13.68%). When plotting the university diversity with the success indicator very dispersed data results, which indicates a slightly negative correlation between diversity and the per-year funding. The team major diversity is on average 0.291, with a minimum value of 0 and a maximum of 0.9. The most common team major diversity is 0 (22.16%) followed by 0.1 (13.87%) and 0.7 (6.74%). When plotting the average success indicator per start-up with the respective team major diversity score a clearly negative trend can be identified. Hence, the higher the team major diversity, the lower the per year funding. Both team diversity scores show that in general, the level of diversity between the two founders is not very high. Additionally, a trend can be identified for both team diversities, linking increasing diversity with decreasing success.

The average team university score is 0.76, with a minimum of 0 and a maximum score of 0.995. Over 70% of start-ups have a score of 0.5 or greater. Thus, most founding teams have an academic background at highly ranked universities. When plotting the team university score with the success indicator, a clearly positive trend can be seen: The higher the university score, the higher the per-year funding amount.

The average team major score is 0.61, with a minimum value of 0.075 and a maximum value of 1. The most common score is 0.9 (9.25%), followed by 0.55 (8.48%) and 0.65 (6.94%). Almost 70% of start-ups have a team major score of over 0.5. This means that, most founding teams have a background in quantitative majors. When plotting the scores with the success indicator, a positive trend becomes clear: the higher the major score, the higher the per-year funding.

The highest average success indicator is achieved by founders studying physical sciences (0.5), followed by engineering (0.45). The lowest scores comes from those studying education (0.1) or life sciences (0.35). Engineering students collected the highest percentage of the total funding sum, followed by physical sciences. Engineering also ranks first in average total funding per founder, followed by humanities & arts. Those who studied physical sciences (0.54) as a second major have the highest average success indicator, followed by engineering (0.47) and business (0.45). The lowest one is again held by those who studied life sciences (0.29) and education (0.21). Founders with a degree in engineering as their second major group collected the greatest percentage of total funding, followed by physical sciences with life sciences and education placing last. Engineering graduates also collected on average the most funding per founder.

The average university location score of the founders is 0.55 with a minimum score of 0 and a maximum score of 1. For about 50% of the founders the

score is greater than 0.46. When plotting the university location score with the success indicator no clear relation can be observed between the two. There appears to be very little explanatory value from the university location score on the success indicator. The headquarter location score for the start-ups is 0.525 on average, with a minimum score of 0.037 and a maximum score of 1. Over 60% of start-ups have a score of 0.45 or smaller. About 20% of start-ups have a score of 0.71 or greater. When plotting the score with the success indicator a very slightly positive trend can be seen.

Reported in Table 2 are the effects, which quantify the relationship between the determinants and the per year funding sum on an individual level, i.e. regression R1. Both the university score and the major score have a positive and very significant relationship with the success indicator. Additionally, both the headquarter location score and the founding year have a highly significant negative correlation with the success indicator. However, neither the university diversity score nor the major diversity score have any significance. The same applies to the founder's university location. While the gender has a weakly significant impact, age does not appear to have any effect.

Table 2: Results of R1 on individual founders

Coefficients:	*Estimate*	*Std. Error*	*T value*	*Pr(<|t|)*	*Signif.*
α	19.847102	3.842522	5.165	2.88e-07	***
UscoreAvg	0.137569	0.032839	4.189	3.04e-05	***
MscoreAvg	0.082071	0.027340	3.002	0.002748	**
UDiversity	-0.052372	0.038546	-1.359	0.174549	
MDiversity	0.020147	0.040004	0.504	0.614640	
UGeoScoreAvg	0.032691	0.039412	0.829	0.407022	
HQGeoScore	-0.146707	0.040777	-3.598	0.000336	***
FoundingYear	-0.009722	0.001901	-5.114	3.77e-07	***
FAge	0.001401	0.001107	1.266	0.205897	
FGender	-0.048226	0.028827	-1.673	0.094650	.

*Signif. Codes: 0 = '***'; 0.001 = '**'; 0.01 = '*'; 0.05 = '.'; 0.1 = ' '; 1*

The results for R1 suggest that on an individual founder basis there is a positive relationship between attending a highly ranked university, studying a highly quantitative major, and the start-up succeeding. The results also show that there is no relationship between a founder having a diverse academic background, e.g., having studied at a highly ranked and a low ranked university or having studied a highly quantitative major and a low quantitative major. The negative relations with the founding year and the headquarter location score and the success indicator show that older start-ups perform better than those that were founded in newer years and start-ups with headquarters in lower-ranked locations have more success.

The second regression (R2) confirms the findings of R1 on a team basis (Table 3). Both the average university score as well as the average major score of the founding team have a positive, significant relationship with the success variable. The founding year has a highly significant, negative effect and the headquarter location score a lower significant negative relation with the success indicator. The average university location score of the founders and the major diversity score of the team have no significant impact on the success indicator. The team university diversity score has a weakly significant, positive impact on the funding success.

Table 3: Results of R2 based on founding team

Coefficients:	*Estimate*	*Std. Error*	*T value*	*Pr(<|t|)*	*Signif.*
α	20.890585	5.018944	4.162	3.70e-05	***
TeamUDiversity	0.106440	0.058905	1.807	0.0714	.
TeamMDiversity	-0.014076	0.044553	-0.316	0.7522	
TeamUscoreAvg	0.354855	0.076797	4.621	4.85e-06	***
TeamMscoreAvg	0.116215	0.048582	2.392	0.0171	*
TeamUGeoScoreAvg	0.082937	0.069845	1.187	0.2356	
HQGeoScore	-0.137734	0.059375	-2.320	0.0207	*
FoundingYear	-0.010335	0.002496	-4.140	4.06e-05	***
AgeSpan	0.002214	0.001749	1.266	0.2061	
GenderDiversity	-0.080574	0.046854	-1.720	0.0861	.

*Signif. Codes: 0 = '***'; 0.001 = '**'; 0.01 = '*'; 0.05 = '.'; 0.1 = ' '; 1*

The results of R2 show that the same relations found on an individual basis also largely hold true on a team basis. There is a positive correlation between founding teams attending highly ranked universities and studying more quantitative majors and the success indicator. However, diversity in terms of universities attended appears to have only a weakly impact. For the other variables, the results of the team analysis are also consistent with the results of the individual founders.

Summarizing the regression results, both H1 and H2 can be supported. Even after accounting for different measures of control, both the major score and the university score have significant impacts on the success indicator. Start-ups with founders from top-tier universities outperform those that graduated from lower-ranked universities in success measured by collected funding. Those start-ups whose founders studied a more quantitative major outperform those of less quantitative majors. The majority of founders studied something like computer sciences or engineering – both having the highest major scores –, which seems logical for being successful with a digital start-up. However, based on the results, H3a cannot be confirmed. No sufficient proof could be found that founders individually or as a team having high diversity scores in terms of the majors studied has any significant impact on the start-up's success. In contrast, we found a weakly significant, positive effect of diversity in terms of the universities the founders attended on the funding success of start-ups. Hence, H3b can be supported.

5. Discussion and implications

The aim of this study was to shed light on the impact of founders' academic background and academic diversity on the success of digital start-ups. While some previous research did not observe a correlation between education and success (Davidsson & Honig, 2003), this study suggests, that the academic background especially in terms of digital-related majors influences the funding success of digital start-ups. However, while some studies emphasize the importance of a balanced skills profile (Browder et al., 2019) we further found that diversity at both the individual and team level does not seem to be as important. Hence, these results are more in line with the findings of Zhou and Rosini (2015) and Kollmann (2006) who argue that there might be a negative correlation between academic diversity and success.

The results show that start-up teams where both founders attended top-tier universities and graduated with highly quantitative majors outperform more academically diverse teams or those teams where the founders went to lower-ranked universities and studied less quantitative majors. Thus, the assumption that start-ups in the digital economy benefit more from digital human capital can be confirmed. By showing that technical competence is relevant to both the long-term survival and the funding success of a digital start-up, we add to the existing literature on human capital in the context of technology start-ups (Gimmon & Levie, 2010). The importance of top-tier universities for the successful funding of a start-up, as evidenced by Glasner (2017) and Nag (2020), can also be confirmed. This underscores the important role of universities in the digital economy, a role that has often been questioned in the past (Ratzinger et al., 2018).

Considering the findings, the weakly significance of academic diversity for the success of digital start-ups seems obvious. If one assumes that it is better for the success of a start-up if the founders attend highly ranked universities and graduate with a degree in a highly quantitative field of study, then diversity cannot be positive. This is in contrast to previous literature that suggest that a diverse team specifically with both managerial and technical background can be beneficial (Franke et al., 2008). A possible interpretation of this circumstance could be that it may be more important for co-founders to have a similar background and the relevant technical skills to enable a coherent focus on getting the business off the ground. Complementary skills could then later be brought into the team in form of the first employees. Hence we add new perspectives to previous literature on team formation, which largely assumes that team members should play largely complementary roles (Rizy et al., 2011).

However, by looking at the descriptive analysis it becomes apparent that there are certain universities that founders of digital start-ups prefer. The founders of this dataset attended proportionally more top-tier universities. However, even among those universities, certain universities seem particularly popular. Stanford with 17.5% and Harvard with over 8% are highly overrepresented. Both universities embrace entrepreneurship in their respective centers for entrepreneurship, the Center for Entrepreneurial Studies[2] (Stanford) and the Arthur Rock Center for Entrepreneurship[3] (Harvard). This indicates that those universities may also integrate entrepreneurial courses within the digital-related majors. Since we do not have detailed data regarding the majors' specific contents, we cannot estimate the degree of entrepreneurial education. Nevertheless, since previous studies show that entrepreneurial education is an important factor in increasing an entrepreneur's confidence in participating in high-growth ventures, it is reasonable to assume that prospective founders will choose a university that offers such training (Tan & Ng, 2006).

In general, the results suggest that pairing teams of two founders from top-tier universities who studied something like computer science or electrical engineering generates the most successful digital start-ups, which is interesting for prospective founders. The results of this study may be relevant not only to founders' decisions about what and where to study, but also to the selection of co-founders. Aspiring founders who want the best chance of getting funding for their digital venture should take a highly quantitative course at a prestigious university like Stanford. When founding their start-up, they should look for a co-founder with a similar academic background, perhaps another alumnus from their university. Universities can use this information to specifically promote their computer sciences and electrical engineering programs among aspiring founders. In addition, universities can play an important role in matching future co-founders.

Investing in start-ups with founders who earned a digital-related degree also seems to be a lucrative investment for VC-firms because only 29 of the start-ups in this sample are marked as closed. Since they are still operational or were bought, they are or were in some way successful. However, more research should be conducted on the actual financial performance of these start-ups.

[2] https://www.gsb.stanford.edu/experience/about/centers-institutes/ces

[3] https://entrepreneurship.hbs.edu/Pages/default.aspx

7. Limitations and future research

The present study is based on a sample exclusively consisting of digital US-start-ups. Therefore, these results may not be applicable to different types of start-ups or start-ups in other countries. Furthermore, while Crunchbase employs a dedicated team and applies machine learning to ensure a high level of accuracy, it still includes a lot of user-generated content about the start-ups and their founders (Batra, 2017). No matter the level of control, user-generated content always places the data quality at risk. In this vein, also the accuracy of the information collected through LinkedIn could also be brought into question.

During the manual data collection of the founders' academic background, other limitations arose. First, only two degrees were considered in the model. A number of founders finished more than two degrees, which gets lost in this dataset. Second, only degrees from US universities were considered. Some founders earned degrees in the US and then one or more additional degrees at universities outside the US. In addition, the level of education was not included in our analysis. We have taken our cue from the earlier literature that has questioned educational level as a measure of human capital because it reduces the multi-faceted concept to a single measure (Klomp, 2013). Moreover, research related to digital startups "confirms the importance of specific human capital configurations as opposed to an overall high level of human capital in the digital sector" (Ratzinger et al., 2018, p. 774). However, various other confounding factors limit our results. For instance, we only focused on majors, while neglecting minors. Furthermore, we did not controlled for job experience. Even if we included the years of experience through the founder's graduation and the start-ups' foundation year, we do not include industry specific job experience.

Next, given the left skewed distributions of university and major diversity scores, we excluded the 60% and 70% of founders with diversity scores of 0 and ran the regressions again. The results remained structurally equivalent.

Additionally, the quantification of qualitative variables presents limitations. In order to make data analysis and regressions possible, the qualitative information about the universities attended as well as the majors studied were quantified. It is not completely transparent how exactly the classification schemes we used build the respective ranking. Since the classification by the GRE was not sufficient to cover the multitude of different majors the founders studied, 331 majors had to be further added and assigned to the different major groups. Furthermore, automatically assigning universities that are not included in the US News ranking the lowest possible score of 0 might not be accurately assessing the relative value of the universities. Finally, it must be said that the GRE score is only one indicator of the quantitative orientation of a major. We used this indicator to measure level and diversity of (quantitativeness of) the majors studied. However, this value only indicates the average scores of applicants in terms of their quantitative competence and does not measure the quantitative nature of the program.

Beside those limitations, the analysis of the results open opportunities for future research. One aspect that could be further examined would be what exactly it is about the top-tier universities that make founders more successful. It could be a multitude of reasons and this study does not provide a solution. Furthermore, it would also be interesting to analyze more specifically what majors drive digital start-up success. Our findings allow an educated guess that more quantitatively orientated majors are an important pillar. However, since the major score was built based on major categories and not on individual majors it was not possible to provide a conclusive answer to the question of what majors matter the most. Given the results regarding the impact of academic diversity on start-up success, future research could come up with alternative measures of diversity and confirm or reject the findings of this study. This would offer important insight on whether or not the results can be robust across different measures of diversity, and whether academic diversity of founders truly is not significant for digital start-up success. Finally, since collected funding was applied as measure of success, the implications of the results for investors are very limited. Future research could attempt to employ an alternative success measure based on the financial performance of a start-up. This would provide insights into the actual long-term success of a start-up and be of high value to investors.

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