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# **Improving Entrepreneurs' Digital Skills and Firms' Digital Competencies through Business Apps Training: A Study of Small Firms**

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## **Abstract:**

The lack of awareness of digital services and outcomes is a concern in business environments since small firms need to improve their digital competencies. The present exploratory study investigated whether business apps training was associated with entrepreneurs' and firms' digital advancements. The business apps training was offered to migrant entrepreneurs running small firms in Athens (Greece) over three months, with data collected before and after the training. The analysis revealed that business apps training was positively associated with entrepreneurs' attitudes toward technology, willingness to change (relating to technology/skills/operations), and internet/digital skills, as well as increased use of business apps. Moreover, the training was positively associated with firms' digital competencies related to communication, networking, social media, customer relationship management, payments, accounting and finance, and project management operations. Furthermore, the business apps training was positively associated with migrant entrepreneurs' integration into Greek society. Given the increased number of migrants in Europe, factors that positively impact their entrepreneurship and integration merit consideration. The study provides researchers with a systematic method for evaluating the association between business app training and entrepreneurs' and firms' digital advancements.

**Keywords:** Training; Entrepreneurs; Small Firms; Business Apps; Digital Skills; Digital Competencies; Artificial Intelligence; Integration

**JEL Classification:** M53; L26; O31; O33

## 1. Introduction

Digital skills are envisioned as traits that enable firms to exploit opportunities provided by information communications technologies (ICTs), thereby ensuring more efficient performance and exploring new ways of conducting business [1]. Digital transformation is the use of new technologies to facilitate business improvements and enhance customer experience [2]. Moreover, this needs to evolve according to the ability to take advantage of new technologies and adjust according to the market circumstances [3-4]. Digital competencies are regarded as the ability to understand and express by making analytical, productive and creative use of ICTs and social software to transform information into knowledge, operations and services [5-7].

In Europe, small and medium firms need to improve their digital competencies [8-9] but the lack of awareness of digital services and outcomes is a concern in business environments [10-12]. Small and medium firms risk their competitiveness, growth and profitability if they fail to embrace digital transformation [13-14], often renouncing digital initiatives because they are unaware of how to incorporate them into their operations [11, 15]. The main reason why small and medium firms experience a digital divide is not the lack of access to digital technology rather the firm's lack of relevant knowledge and education [10-11, 15]. Since digital competencies and transformation are perceived as crucial lifelong learning and development challenges [8-9], universities and research centres should support firms in developing their competencies toward digital skills and transformation [3], as e-learners that require digital knowledge are proactive learners and tend to make good use of what they learn [3].

The present study focused on small firms run by migrant entrepreneurs in the capital city of Greece, Athens. An exploratory study [16] was conducted to examine whether online training on business apps could boost entrepreneurs' positive attitudes toward technology, willingness to change (relating to technology/skills/operations) and internet/digital skills. Moreover, the study assessed whether online training could increase firms' use of business apps and digital competencies. Furthermore, the study examined whether business apps training is associated with societal integration for migrant entrepreneurs. In 2021, the research team of the Faculty of Business and Law of Anglia Ruskin University (Cambridge Campus) offered a three-month online session on business apps to interested migrant entrepreneurs. The business apps were grouped into nine categories including communication, networking, payments and project management, with data collected before and after the training.

Although research on the business apps training payoffs is scarce, some studies have approached topics related to the present study's objectives. There is evidence that internet skills training can act as a catalyst to convince small and medium firms to adopt ICTs, boosting the general level of digital skills among trainees [3, 17, 18]. Moreover, studies found that small and medium firms use apps to drive learning, innovation and transformation, allowing them to promote sense opportunities and sustain

competitive advantages [19]. The technical characteristics of business apps can boost outcomes since small and medium firms invested in advanced technologies and experienced operational efficiencies [19]. Importantly, entrepreneurship and vocational training targeting migrant populations can bring positive externalities ranging from societal integration [20-21] to personal development and empowerment [22].

The present study contributes to the literature as there is a lack of adequate research on business apps training payoffs. First, the study addresses the gap by systematically assessing a few unexamined but contemporary questions in the ICTs area such as whether business apps training is associated with entrepreneurs' internet/digital skills and adoption of business apps. The study synthesises theoretical and empirical frameworks to propose six novel hypotheses on business apps training payoffs. Such a specification is missing in the empirical and theoretical ICTs literature and the implications of each hypothesis might be of interest to policymakers and firms.

Second, a new scale is developed to capture firms' digital competencies related to nine operations including communication, social media, payments and project management. The proposed framework quantifies whether the business apps training can be associated with firms' digital competencies and the practical implication of such an assessment might be useful for apps developers and firms. The OECD [23] evaluated the importance of quantitative scales that summarise patterns, examine policies and progress in business phenomena, providing insights for app developers, firms and policymakers. The study indicates that given the massive contribution of small and medium firms to economies' performance, ways that boost entrepreneurs' skills and small firms' digital competencies can provide critical insights [24-25]. Similarly, strategies that facilitate migrants' entrepreneurship should be of interest to policymakers and firms, as small firms run by migrants drive economic growth and innovation [26]. In Greece, the increasing number of migrant firms reflects a business reality that has become increasingly more common since 2000. Indeed, in the capital city of Greece, Athens, migrant entrepreneurial activity is part of the urban landscape, as well as an organic aspect of daily city life [27].

Third, the present study examined whether the business apps training is associated with migrant entrepreneurs' integration into Greek society. Given the increased number of migrants in Europe, factors that positively impact their integration merit consideration [28]. Migration can be a positive experience for both migrants and natives [28] as migrant entrepreneurship can inject new dynamism into an economy and be an effective tool for economic development [20-22]. Finally, the study provided empirical evaluations through a longitudinal data set, with panel data capturing unobserved heterogeneity and spurious relations [29]. In the ICTs literature, longitudinal evaluations are limited [19], hence, the present study aims to offer better-informed evaluations.

This paper is structured as follows: section 2 presents the study hypotheses, section 3 describes firms' recruitment to business apps training, the data collection and the context of the business apps training, section 4 details how business apps were identified and screened, section 5 describes the tasks

per business apps, section 6 presents the study variables and scales with descriptive statistics provided in section 7, then, section 8 presents the estimates and section 9 is the discussion with the limitations and future research provided in section 10.

## **2. Theoretical framework**

Small and medium firms are often short of resources including capital and budget [13, 30] therefore requiring coping strategies to develop resources for innovative projects [14]. Small and medium firms have invested in an increasing number of activities to develop and explore the potential of ICTs by adopting technology-enabled tools and networks to monitor how core technologies and markets are changing [11, 19].

The human capital framework in facilitating the adoption of ICTs has long been highlighted in the literature [31]. The implementation and beneficial exploitation ICTs require specific knowledge and skills that firms can primarily obtain through education and training [32]. However, the absence of studies on business apps training payoffs for small firms exposes a rhetoric versus reality argument of whether relevant training is critical to firms' strategies and payoffs.

The limited studies have found that internet skills training, such as training on the latest audio and visual computer equipment, business apps and basic Web design skills, can raise awareness of ICTs among small and medium firms, helping break down the barriers toward technology [17]. Internet skills training can act as a catalyst to convince small and medium firms to adopt ICTs and promote the general level of digital skills among trainees [17]. Indeed, trainees reported being inspired, prompted and encouraged by the training to go digital [17].

Online training on automation and innovation in small and medium firms can increase the motivation and flexibility of staff who want to improve their digital skills and lifelong learning, as well as increase the quality of vocational training related to industrial automation systems [18]. Similarly, training on digital transformation in such firms, aiming to enhance decision-making capability at both a strategic and tactical level, can bring favourable evaluations among trainees in relation to the concepts, principles, methodologies, and tools taught in the training [3].

The study hypotheses are as follows:

***Hypothesis 1.*** *Business apps training is associated with positive attitudes toward technology for small firm entrepreneurs.*

***Hypothesis 2.*** *Business apps training is associated with a willingness to change (relating to technology/skills/operations) for small firm entrepreneurs.*

***Hypothesis 3.*** *Business apps training is associated with better internet/digital skills for small firm entrepreneurs.*

***Hypothesis 4.*** *Business apps training is associated with the increased use of business apps in small firms.*

Business apps are utilised by firms to support their business operations in areas such as sales and marketing, data analytics, credit evaluations, and risk assessments [33-35]. Studies indicate that small and medium firms can use common and inexpensive apps, such as social media and online fora, to drive learning, innovation and transformation, allowing them to quickly sense opportunities in their industries, validate their ideas, and deploy resources to rapidly innovate and sustain competitive advantages [24]. Digital competencies are perceived as a critical goal for individuals and firms [9] and are approached through a vector of concepts such as knowledge, skills, attitudes, as well as the confident, critical and creative use of ICTs to achieve goals related to work, employability, problem-solving, learning, inclusion and/or participation in society [5-7].

In the present study, driven by the human capital framework [31], business apps training can allow small firms to observe, assess and utilise business apps and/or advanced technology to facilitate critical operations, such as finding and engaging with the right customers, improving customer retention, experience and purchases [19, 34, 36]. Moreover, business apps training can help small firms to observe, assess and utilise business apps and/or advanced technology to initiate routines to offer real-time pricing and predict cash flow [19, 33-34]. In addition, business apps training can help small firms to observe, assess and utilise business apps and/or advanced technology to enhance operational systems and management [19, 37-38].

Digital competence consists of the ability of firms to adopt and use new or existing ICTs to analyse, select and critically evaluate digital information to investigate and solve business-oriented problems and develop a collaborative knowledge body while engaging in organisational practices [39]. The present study suggests that business apps training can enable firms to observe, assess, and adopt business apps and/or advanced technology to create, extend, modify and boost their digital competencies by leveraging technology to meet new demands, move at speed to pivot business operations and boost efficiency [19, 24, 38-41].

The study hypothesizes that:

***Hypothesis 5. Business apps training is associated with increased digital competencies for small firms.***

A final consideration in the present study is whether business apps training is associated with migrant entrepreneurs' societal integration. The few studies in the literature indicate that active labour market programmes, such as training in working life skills and vocational training for migrants can boost their societal integration [20]. Similarly, training in areas of digital literacy, e.g., the use of computers and software, can boost the societal integration of migrants [21]. In addition, entrepreneurship training for migrants can support their integration into society, as well as personal development and empowerment [22].

The recent increase in migration in Europe has driven researchers to develop specialised apps aiming to facilitate migrants' needs [42]. Migrants use mobile apps to learn a language, access

occupational and employment opportunities, as well as maintain and build social networks [42]. In the present study, it is indicated that business apps training could facilitate migrants' integration through the acquisition of digital skills that support their human, social and informational capabilities [42]. In host countries, better access to information, services, and recourses through advanced technology can facilitate migrants' societal integration [42].

The study hypothesizes that:

***Hypothesis 6. Business apps training is associated with societal integration for migrant entrepreneurs running small firms.***

Given the limited studies in the literature examining business apps training payoffs, the present study should be treated as exploratory research [16] aiming to offer insights into the underexamined thematic in the ICTs domain. The study synthesises theoretical frameworks and empirical evidence to propose six novel hypotheses on business apps training payoffs. Such a thematic has not been identified in the empirical and theoretical ICTs literature and forms the study's key contribution. The theoretical framework is shown in Figure 1.

**[Figure 1]**

### **3. Recruitment of firms, data collection and training context**

#### *3.1 Recruitment of firms and data collection*

In Greece, there is an unequal distribution of the access to, use of and opportunities offered by ICTs for migrant populations [43]. The present study focused on migrant entrepreneurs, evaluating the impact of business apps training on marginalised populations. In Greece, migrants including entrepreneurs, experience racism and societal exclusions that affect their socioeconomic experiences [27, 44].

Google search was used to identify migrant communities in Athens between October and December 2020. These communities were emailed an invitation to participate in the study and provided with information regarding the nature of the study to offer online digital training, free of charge, to migrant entrepreneurs running small firms in Athens. Potential participants were required to have a PC, a smartphone, and access to the most utilised app for e-meetings (which is available free of charge). Instructions on how to install the e-meetings app were provided and it was indicated that the training would be in Greek. The research team has accumulated experience of collaborating with migrant communities in Greece for research purposes [42, 44-45].

Migrant entrepreneurs confirmed their participation by providing written informed consent and completing an e-questionnaire between January and February 2021. This preliminary data collection before the digital training intervention was designated wave 1. The participants had to provide their email addresses to receive instructions for the training and were informed that e-materials and follow-up e-

questionnaires would be forwarded to their email. Participants were free to withdraw from the training and the follow-up data gathering at any time.

The online training took place between February and April 2021 in four online training sessions, each was approximately three hours. During and after the training sessions, four additional e-meetings (drop-in e-sessions) were offered to address any queries. Throughout the training, the participants had the opportunity to submit questions and the research team offered further instructions and insights. The follow-up e-survey was conducted between May and June 2021 (wave 2).

The study data set consisted of two waves, a preliminary data collection before the business apps training and a follow-up data collection upon completion of the training. The participants were aware that the sessions were not recorded and that the research team was interested to collect aggregate data, hence ensuring anonymity. Moreover, it was mentioned that the research team did not have any financial incentive and was not affiliated with the business app developers, so there were no conflicts of interest. The study followed the usual procedures for securing ethics approval and ensuring the anonymity of the participants. The contact details of the university's ethics committee were provided to the participants. At the end of the training, no complaint was raised.

### *3.2 Business apps training context*

The business apps identified aimed to optimise day-to-day firms' processes, streamline operations and extend business functionality and productivity.

In session one, the research team presented communication and networking apps, session two covered social media and customer relationship management apps, session three presented payments and accounting/finance apps and session four presented managing inventory, team, time and project management apps. Each session was structured to:

- (i) offer an introduction of the relevance of each thematic in the business context;
- (ii) present the series of tasks that each app could offer and handle;
- (iii) present technical information on how to download and install each app;
- (iv) offer a manual-oriented presentation on how to use each app; and
- (v) practice with examples to showcase how each app works.

The research team provided the participants with examples to practise after each session and participants had the opportunity to discuss their performance and issues during the drop-in e-sessions. At the end of each session, an email was forwarded to the participants to provide feedback on the delivery and in particular, to rate the context, clarity, usefulness and practicality of the session. The evaluation forms indicated the participants' satisfaction.



#### 4. Identifying and screening apps

The Google Play Store was utilised to identify business apps in Greece in 2020/21. The apps were grouped into nine categories:

- (i) communication;
- (ii) networking;
- (iii) social media;
- (iv) customer relationship management;
- (v) payments;
- (vi) accounting and finance;
- (vii) managing inventory;
- (viii) team and time management; and
- (ix) project management.

The top three ranked apps based on app performance and users' reviews were selected in each category, with priority given to free apps. In those categories in which free apps did not make the top three, the top-ranked paid apps were selected. The total sample consisted of 27 apps, six of which (22.2%) were not free of charge. The cost of the paid apps was ranged from €5 to €30 per month. In all categories, the apps could run on both smartphones and a PC.

Apart from the Google Play Store ranking, the research team re-assessed the top three apps per category based on the protocol of Martin et al. [46] consisting of five steps:

- (i) identify all potentially relevant apps;
- (ii) remove light or old versions of each app;
- (iii) identify the main functional requirements and exclude all apps that do not offer this functionality;
- (iv) identify all secondary requirements; and
- (v) construct tasks to test the main functional requirements using each of the methods below: key-stroke level-oriented modelling [47] and usability heuristic evaluation [48].

Two IT and business personnel at Anglia Ruskin University (Cambridge Campus) and the University of Cambridge assessed each app.

Step one required the selection of appropriate keywords for each app to search the app stores and step two indicates that after compiling the results obtained from step one, any light or old versions of other apps should be removed because these versions could contain less functionality than the full or newer version [46]. Google Play Store's ranking per business app for 2020/2021 in Greece satisfied these first two steps.

Step three involved identifying whether the screened apps offered the main functional requirements required for a given category [46] by assessing the descriptions of each app in the online

app store. For instance, in the case of communication apps, the apps under consideration should offer internal and external e-interaction and e-information sharing. In each business category, the top three Google Play Store apps provided the required functional requirements.

The fourth step identified all the secondary functionality of the apps [46], thereby realising the full range of functionality offered by competing apps. The research team compared the top three ranked apps and created a list with the functional similarities, differences and unique features per app based on the app descriptions in the Google Play Store.

In step five, the 27 apps underwent keystroke level-oriented modelling [47] and usability heuristic evaluation [48]. Regarding the keystroke level-oriented modelling [47], the number of interactions to complete tasks was used to measure app efficiency [46], as shown in Appendix A. Given that this study focused on the most favourable business apps per category, that is, the top-ranked in the Google Play Store (based on their performance), it is not surprising that the identified apps demonstrated comparable levels of efficiency based on the number of interactions.

To conduct the usability heuristic evaluation, the apps were assessed based on Nielsen's [49] five-point severity ranking scale in the following eight heuristic categories:

- (i) visibility of system status and losability/findability of the device;
- (ii) match between system and the real world;
- (iii) consistency and mapping;
- (iv) good ergonomics and minimalist design;
- (v) ease of input, screen readability and glanceability;
- (vi) flexibility, efficiency of use and personalization;
- (vii) aesthetic, privacy and social conventions; and
- (viii) realistic error management.

Appendix A shows that there was no major usability problem or usability catastrophe for the 27 apps. The usability of the aforementioned apps was also verified by the users' reviews ranking on the Google Play Store, demonstrating low levels of usability problems.

During the first online session, the participants were informed of how the research team selected and screened the apps.

## **5. Business apps operations**

As the identified business apps can be used for a wide variety of tasks, the following operations per business category were examined during the usability heuristic evaluation [48].

- Communication apps were assessed on internal and external e-interactions and e-information sharing processes.

- Networking apps were evaluated based on tasks relating to sending updates on the go, adding new connections, recruiting new hires, following inspirational companies and individuals and considering competitors' strategies.
- Social media apps were assessed on processes related to planning, promoting and monitoring projects by connecting directly with social channels.
- Customer relationship management apps were evaluated on tasks related to managing customer profiles by sending marketing and outreach messages and maintaining and developing points-based rewards programmes.
- Payments apps were examined on tasks related to reviewing business analytics data, monitoring selling items and processing credit cards, checks, and invoices.
- Accounting and finance apps were evaluated on tasks relating to organising bookkeeping processes, including invoicing, expenses, and payroll.
- Managing inventory apps were assessed on tasks relating to creating product catalogues, tracking and managing stock and sales and making purchase orders.
- Team and time management apps were evaluated on processes related to managing payroll and benefits, calculating and filing payroll taxes, tracking team availability, sick days and vacation time and overseeing employees' performance.
- Project management apps were assessed on tasks related to managing projects, work-flows, and deadlines across alternative business tasks.

## 6. Variables and scales

The e-surveys included questions on the firms' sector of operation, years of operation, number of employees and the ownership of the business premise, as well as the entrepreneurs' demographic characteristics (age, gender, continent of origin, higher education degree, years in Greece). The main independent variable of interest is the so-called 'Business Apps Training' that captures two time periods, before the intervention (i.e., training) and after the intervention.

The Positive Attitudes Toward Technology scale [50] was employed to test **hypothesis 1**. This scale captured entrepreneurs' attitudes toward the use of technology and consisted of six items examining whether it is important to keep up with the latest trends in technology scored using a five-point Likert scale ranging from "Strongly agree" to "Strongly disagree", with higher scores implying higher positive attitudes toward technology [50].

The Willingness to Change scale [51] was used to examine **hypothesis 2**. This scale measured the level at which entrepreneurs were keen to accept changes in their firm over the next two years and consisted of three items capturing whether entrepreneurs were keen to accept an increase in the level of technology/computers, skills and responsibility involved in their operations scored using a seven-point

Likert scale ranging from “Definitely” to “Definitely not”, with higher scores suggesting a higher level of innovative changes in firms [51].

The Internet Skills scale [52] was used to assess **hypothesis 3**. The scale captured entrepreneurs’ internet/digital skills and consisted of 35 items covering aspects such as whether individuals know how to “download and install apps to their mobile device”, “keep track of the costs of mobile app use”, “adjust privacy settings”, and “change who they share content with”, with responses scored via a five-point Likert scale ranging from “Not at all true of me” to “Very true of me”, with higher scores indicating increasing levels of internet/digital skills [52].

Moreover, a new scale entitled Business Apps in Use was developed to capture whether entrepreneurs used business apps in their firms’ operations to examine **hypothesis 4**. The scale consists of nine items and entrepreneurs had to indicate whether they utilised business apps through their P/C or mobile to facilitate their operations. The apps covered services related to communication, networking, social media engagement, customer relationship management; payments, accounting and finance, managing inventory, team and time management, and project management and the responses were scored using a six-point Likert scale ranging from “Very frequently” to “Never”, with higher scores indicating increasing levels of business apps usage.

A further scale entitled Digital Competencies was developed to measure entrepreneurs’ reflection on the level of their firm’s digital competency in communication, networking, social media, customer relationship management, payments, accounting and finance, managing inventory, team and time management, and project management to assess **hypothesis 5**. The questions were: ‘*Indicate the level of your firm digital competency in the following categories: (i) communication operations in relation to internal and external e-interactions and e-information sharing processes, (ii) networking operations in relation to sending updates on the go, adding new connections, recruiting new hires, following inspirational companies and individuals, and considering competitors strategies, (iii) social media engagement in relation to planning, promoting and monitoring projects by connecting directly with social channels, (iv) customer relationship management in relation to managing customer profiles by sending marketing and outreach messages and maintaining and developing points-based rewards programmes, (v) payment services in relation to reviewing business analytics data, monitoring selling items and processing credit cards, checks, and invoices, (vi) accounting and finance services in relation to organising bookkeeping processes, including invoicing, expenses, and payroll, (vii) inventory operations in relation to creating product catalogues, tracking and managing stock and sales, and making purchase orders, (viii) team and time management services in relation to managing payroll and benefits, calculating and filing payroll taxes, tracking team availability, sick days and vacation time and overseeing employees’ performance, and (ix) project management services in relation to managing projects, workflows, and deadlines across alternative business tasks.*’ A five-point Likert scale ranging

from “Very strong” to “Very weak” was utilised to capture responses per category, with higher scores suggesting higher levels of digital competencies.

Finally, the Ethnosizer scale [53] was used to examine **hypothesis 6**. This scale captured the level of migrants’ integration in Greece and included five questions regarding the entrepreneurs’ devotion to Greece and commitment to the culture of their origin by combining information on language, cultural habits, self-identification, social interaction, and future citizenship plans. A five-point Likert scale ranging from “Strongly agree” to “Strongly disagree” was utilised, with higher scores indicating increasing levels of migrant integration.

## 7. Descriptive statistics

Table 1 presents the descriptive statistics of the sample of 89 observations, with 48 firms completing the e-survey in wave 1 (i.e., before the business app training) and 41 firms providing follow-up information in wave 2 (i.e., after the business app training). Based on Table 1, and regarding the entrepreneurs’ profile, 83.3% were male with a mean age of 34.7 years, and 12.5% had a higher education degree. Most migrants (47.9%) were from Africa, followed by Asia (29.1%) and had resided in Greece for a mean of 9.6 years. The mean years of the firms’ operation were 4.1 years with an average of 3.5 employees and 4.1 of the entrepreneurs owned the firm’s premises. Regarding the sector of operation, most were involved in trade, followed by hospitality and services.

[Table 1]

Table 2 presents Cronbach’s alpha coefficients, with the Internet Skills scale ( $\alpha=0.86$ ), and the Digital Competencies scale ( $\alpha=0.79$ ) surpassing the Cronbach’s alpha threshold ( $\alpha=0.7$ ), indicating internal consistency [54]. The Business Apps in Use scale ( $\alpha=0.67$ ) and the Positive Attitudes Toward Technology scale ( $\alpha=0.59$ ) demonstrate acceptable levels, whereas the Firms’ Willingness to Change (relating to technology/skills/operations) scale ( $\alpha=0.53$ ), and the Integration (Ethnosizer) scale ( $\alpha=0.52$ ) were weak. The assigned patterns are expected given the number of items per scale [54].

[Table 2]

Table 3 presents outcomes before and after the business apps training, showing that entrepreneurs had a more positive attitude toward technology (2.7 versus 2.5,  $p<0.05$ ), increased willingness to change (technology/skills/operations) (3 versus 2.6,  $p<0.05$ ), higher levels of internet/digital skills (2.3 versus 2.0,  $p<0.01$ ) and utilised more business apps for their operations after the training (1.6 versus 1.2,  $p<0.01$ ). Moreover, there is an increase in firms’ digital competencies (2 versus 1.3,  $p<0.01$ ) after the training, with entrepreneurs feeling more integrated into Greek society after the training (2.4 versus 2.1,  $p<0.01$ ).

[Table 3]

Table 4 provides insights on firms' digital competencies per category before and after the training, showing improved digital competencies in seven cases out of nine, that is, related to communication (2 versus 1.2,  $p < 0.01$ ), networking (1.8 versus 1,  $p < 0.01$ ), social media (1.9 versus 1.2,  $p < 0.01$ ), customer relationship management (1.9 versus 0.9,  $p < 0.01$ ), payments (2 versus 1.3,  $p < 0.01$ ), accounting and finance (1.9 versus 1.1,  $p < 0.05$ ) and project management (1.8 versus 1.3,  $p < 0.05$ ).

[Table 4]

Table 5 presents the correlation coefficients between the business apps training and the study scales, showing that the training positively correlated with entrepreneurs' positive attitudes toward technology ( $r = 0.2$ ,  $p < 0.05$ ), willingness to change (technology/skills/operations) ( $r = 0.2$ ,  $p < 0.05$ ), internet/digital skills ( $r = 0.3$ ,  $p < 0.01$ ), business apps in use ( $r = 0.2$ ,  $p < 0.01$ ), digital competencies ( $r = 0.4$ ,  $p < 0.01$ ) and integration (Ethnosizer) ( $r = 0.3$ ,  $p < 0.01$ ).

[Table 5]

## 8. Estimates

### 8.1 Hypotheses testing

Table 6 presents the random effects and fixed effects estimates [55] to examine whether the business apps training is associated with entrepreneurs' positive attitudes toward technology (H1), willingness to change (technology/skills/operations) (H2), level of internet/digital skills (H3), and business apps in use (H4). Bell et al. [56] indicate that random effect models provide everything that fixed effect models provide and more, making it the superior method for most practitioners, thus are often used as a starting point for multilevel analyses. It is acknowledged that given the longitudinal nature of the data, panel specifications are more appropriate than cross-sectional specifications and omitted factors may be correlated with key predictors in random effects models, while fixed effects models could remove omitted variable bias [55-57].

The random effects models incorporate information relating to firms' sector of operation, years of operation, number of employees, ownership of the business premise, as well as entrepreneurs' age, gender, continent of origin, higher education degree and years in Greece. The fixed effects models do not incorporate the aforementioned covariates because they are time-invariant [58]. In all cases, robust standard errors are reported [58].

Model I presents the random effects estimates, showing that the business apps training is associated with increased positive attitudes toward technology for entrepreneurs ( $b = 0.267$ ,  $p < 0.01$  or 4.6%), that is, the training increased entrepreneurs' positive attitudes toward technology by 4.6%.

**Hypothesis 1** can be accepted. Model II's fixed effects specification confirms Model I's outputs ( $b = 0.272$ ,  $p < 0.01$  or 4.7%).

Model III provides the random effects estimates showing that the business apps training is associated with increased willingness to change (technology/skills/operations) for entrepreneurs ( $b=0.361$ ,  $p<0.01$  or 5.8%), thus **hypothesis 2** can be accepted. Comparable results are found ( $b=0.365$ ,  $p<0.01$  or 5.9%) in Model IV employing fixed effects modelling.

Model V reports the random effects estimates showing that the business apps training is associated with increased internet/digital skills for entrepreneurs ( $b=0.332$ ,  $p<0.01$  or 6.9%), therefore **hypothesis 3** can be accepted. The fixed effects estimates indicate a similar pattern ( $b=0.339$ ,  $p<0.01$  or 7.1%) in Model VI.

Model VII presents the random effects estimates showing that the business apps training is associated with increased business apps in use for firms ( $b=0.486$ ,  $p<0.01$  or 15.4%), thus **hypothesis 4** can be accepted. The fixed effects outcomes in Model VIII verify Model VII's pattern ( $b=0.493$ ,  $p<0.01$  or 15.8%).

[Table 6]

Table 7 adopts the same estimation strategy as Table 6, with Model I reporting the random effects estimates showing that the business apps training is associated with increased firms' digital competencies ( $b=0.650$ ,  $p<0.01$  or 17.7%), therefore **hypothesis 5** can be accepted. Model II adopts a fixed effects specification and estimates similar patterns ( $b=0.647$ ,  $p<0.01$  or 17.7%).

Model III shows the random effects estimates showing that the business apps training is associated with increased entrepreneurs' integration (Ethnosizer) into Greek society ( $b=0.402$ ,  $p<0.01$  or 8.1%), therefore **hypothesis 6** can be accepted. The fixed effects outcomes in Model IV indicate comparable results ( $b=0.404$ ,  $p<0.01$  or 8.1%).

[Table 7]

## 8.2 Missing values

In Tables 6 and 7, if observations from firms that only participated in the first survey but did not participate in the second survey are excluded from the analysis ( $n=7$ ), then qualitative comparable results are estimated. For instance, random effects estimates indicate that the business apps training is associated with increased positive attitudes toward technology for entrepreneurs ( $b=0.272$ ,  $p<0.01$  or 5.1%), willingness to change (technology/skills/operations) for entrepreneurs ( $b=0.365$ ,  $p<0.01$  or 6.4%), internet/digital skills for entrepreneurs ( $b=0.339$ ,  $p<0.01$  or 7.7%), business apps in use ( $b=0.493$ ,  $p<0.01$  or 17.2%), and firms' digital competencies ( $b=0.647$ ,  $p<0.01$  or 18.9). In addition, random effects estimates suggest that business apps training is associated with increased entrepreneurs' integration (Ethnosizer) into Greek society ( $b=0.404$ ,  $p<0.01$  or 8.8%) and in all cases, the fixed effects estimates indicate similar patterns, hence, **hypotheses 1 to 6** can be accepted and attrition does not affect the direction of the outcomes in this study.

### 8.3 Business apps training and firms' digital competencies per category

Appendix B presents associations between the business apps training and firms' digital competencies per category and adopts the same estimation strategy as Table 6. The random effects models indicate that the business apps training is positively associated with digital competencies related to communication (Model I;  $b=0.838$ ,  $p<0.01$  or 24.3%), networking (Model III;  $b=0.823$ ,  $p<0.01$  or 26.6%), social media (Model V;  $b=0.708$ ,  $p<0.01$  or 20.6%), customer relationship management (Model VII;  $b=0.927$ ,  $p<0.01$  or 30.5%) and payments (Model IX;  $b=0.777$ ,  $p<0.01$  or 21.3%). The relevant fixed effects estimates in Models II, IV, VI, VIII, and X reveal comparable outcomes.

Appendix C presents additional associations between the business apps training and digital competencies per category, with the random effects models showing that the business apps training is positively associated with digital competencies related to accounting and finance (Model I;  $b=0.753$ ,  $p<0.01$  or 22.9%), and project management (Model VII;  $b=0.588$ ,  $p<0.01$  or 16.9%). The fixed effects estimates (in Models II, and VIII) found comparable results.

### 8.4 Business apps aided by AI and firms' digital competencies

The study assesses whether business apps aided by artificial intelligence (AI) are associated with increased digital competencies for firms. To test the research question, the minimum level of AI features per app considered in the AI category was as in Drydakis [42], '*at least one AI system related to the search engine and text analytics; cloud computing; data ingestion; deep learning; quantum computing; voice including speech recognition; predictive text; pronunciation and translation; location and mapping; automated chat, simple and repetitive tasks; virtual communication including individual engagement without any human involvement.*' Random effects estimates indicate that AI is positively associated with firms' digital competencies ( $b=0.354$ ,  $p<0.05$  or 10.1%). Moreover, fixed effects outcomes suggest a comparable pattern ( $b=0.681$ ,  $p<0.01$  or 19.5%).

## 9. Discussion and implications

This empirical evaluation revealed that the business apps training was positively associated with entrepreneurs' attitudes toward technology, willingness to change (relating to technology/skills/operations), internet/digital skills, as well as increased use of business apps. Moreover, the estimates showed that the business apps training was positively associated with small firms' digital competencies related to communication, networking, social media, customer relationship management, payments, accounting and finance, and project management operations. The estimates were robust across different estimation strategies and were not sensitive to attrition.

The present study contributed to the literature in various ways, presenting a systematic method to evaluate the association between business apps training and entrepreneurs' and firms' digital



advancements. Six hypotheses were generated to form a framework to assess business apps training's payoffs; a specialisation missing from the literature. Moreover, a new scale (entitled Digital Competencies scale) was developed to assess the association between business apps training and firms' digital competencies. The scale demonstrated internal validity and quantified entrepreneurs' reflections on their firms' level of digital competencies in nine domains. Given the contemporary interest in digital competencies, the proposed scale captures relevant patterns and adds to the empirical domain. The same holds for a further scale developed in this study capturing firms' use of business apps.

This study has several implications as follows. For small and medium firms to boost their effectiveness and competitiveness, they might need to consider embracing digital transformation [13-14] but may lack the knowledge necessary to do so [10-12]. Based on the study findings, business apps training boosted entrepreneurs' internet/digital skills related to communication and sharing, creation of content and knowledge, and technical operation abilities in line with the scant literature indicating that internet training can raise awareness of ICTs among small and medium firms, boost the general level of digital skills among trainees and increase the motivation and flexibility of staff who want to improve their digital skills and lifelong learning [3, 17-18].

If business apps training can be envisioned as a demonstration of best practices that increase entrepreneurs' digital skills and boost firms' digital competencies, this can enable firms to better define strategies and develop abilities to navigate new opportunities to innovate [19]. The literature indicates that digital skills allow entrepreneurs to form, extend and modify their firms' digital competencies and build strategic assets helping them to enhance competitive positions [59-61]. This can be done by leveraging technology to meet new opportunities, move at speed to pivot operations and boost efficiency [19]. Business apps training could increase entrepreneurs' digital literacy enabling them to better perform tasks in digital environments and to easily and effectively access the wide range of knowledge embedded in the digital environment [59-61]. In the present study, the examined business apps were evaluated to allow small and medium firms to engage with external communities to run and validate business ideas, uncover industry patterns, develop processes and products, as well as monitor market changes [19, 24]. Digital transformation and the use of business apps promote firms' digital competencies enabling entrepreneurs to identify new opportunities or adapt systems to boost performance [4-7, 32, 59-61]. For firms, the capacity to absorb and/or create knowledge and business systems is a determining factor of continual improvement and financial performance [19, 24, 59-61]. Business apps training can enable small and medium firms to explore new opportunities by adopting technology-enabled tools to monitor how core technologies and environments are changing [19, 32]. Consequently, digital training and the adoption of new technologies can be envisioned as a critical strategy of business competency that could determine the direction and sustainability of small and medium firms [19, 24, 25, 59-61]. In this study, the estimated patterns related to business apps training payoffs and digital competencies are shown in **Figure 2**.

## [Figure 2]

Policymakers' actions, such as developing a flexible design for digital education and training for small and medium firms, for both employers and employees, at low or no cost could address the growing needs of digital literacy [10-14]. Studies recommend that policymakers should promote the construction of infrastructure and reduce tax laws to stimulate firms to provide IT training programmes to employees [62]. Digital training for small and medium firms should be flexible, with practical content to enable direct action [32].

The present study found that firms that implemented AI in their digital operations through the utilisation of the examined business apps experienced positive payoffs in terms of digital competencies. Business apps aided by AI can boost firms' digital competencies due to advanced abilities related to information management, problem-solving and decision-making. The literature indicates that digital technologies aided by AI have transformed the nature and scope of entrepreneurial activity in small and medium firms [38], with AI apps allowing firms to better predict markets and inform financial and planning leading to increased performance [19]. AI leads to advanced customer services and increased customer purchases and operational efficiency [40], helping small and medium firms in marketing and sales platforms to increase the number of customers and profitability [34]. Moreover, AI facilitates virtual communication to improve sales, customer services and satisfaction [37], helping small and medium firms in data analytics to recognise and analyse risks controls, offer credit evaluations, and risk strategies [41]. AI apps enabled small and medium firms to reduce business risks associated with the adverse business environment of the COVID-19 pandemic [19]. The generativity of AI can represent a method of achieving productivity benefits and represent a critical innovation tool by which small and medium firms

The present study also revealed that business app training was associated with migrant entrepreneurs' integration into Greek society, confirming the limited international patterns indicating that digital literacy, working life skills, vocational and entrepreneurship training for migrants can boost their societal integration, personal development and empowerment [20-22]. Although in Greece, and especially in the capital city, migrant entrepreneurship is a significant activity [27], studies assessing whether migrant entrepreneurship can promote their integration into society are scarce. Given that migrants are perceived to be entrepreneurial, contributing to economic growth and innovation [26-27, 43] ways that positively affect their entrepreneurial activity should be of interest to policymakers. Similarly, factors that affect migrant entrepreneurs' integration in host countries merit consideration. Drydakis [42] found that communication and information apps (the so-called M-Integration apps) support and enhance migrants' human, social and informational capabilities, which are associated with increased levels of societal integration. M-Integration apps boost migrants' opportunities to exercise their agency and enhance their participation in society, thereby control over their circumstances [42].

In addition, the more integrated migrants are in a host country, the higher their net economic and fiscal contribution to the host economy [45]. Moreover, integrated migrants may be important for the attitudes of the natives toward newcomers [28, 45]. As migrants gain information about the functioning of the new environment and invest in human and social capital in the host culture, their labour market outcomes, entrepreneurship and income could be increased [28, 45].

Despite the considerable volume of research on ICTs [4, 7], there is a lack of studies on business apps training payoffs, both internationally and in Greece. Greece presents a particular important case for research on this subject matter as the economy has experienced a massive economic recession since 2010 [31], faced an increased migrant population [42], as well as the adverse socioeconomic effects of the COVID-19 pandemic [19]. In Greece, policymakers and researchers have emphasised the crucial role that ICTs can play in the country's attempt to boost small and medium firms' entrepreneurship, recover from economic recessions, and integrate migrant populations into society [32, 42-43].

Although the present study focused on migrant entrepreneurs, the main outcome of this study, i.e., business apps training increasing the likelihood of boosting entrepreneurs' internet/digital skills and firms' digital competencies, might also apply to Greek entrepreneurs. The ultimate goal of each firm, regardless of ethnic background, is to boost effectiveness and productivity [19, 62-63]. ICTs are perceived as an essential tool in enhancing the competitiveness of a country's economy and it is commonly accepted that advanced technology can have significant effects on firms' productivity of firms [63]. Given the challenges entrepreneurs have experienced in the last decade in Greece, digital training might allow small and medium firms to interact and integrate new ICTs in their operations [1, 31] and exploit innovative technology opportunities [4, 7, 10].

## **10. Limitations and future research**

The present study focused on migrant small firms in the capital city of Greece, so the magnitude of the estimates may not be generalisable to entrepreneurs running medium and large firms or firms operating in rural areas. Future studies should evaluate larger firms as well as native entrepreneurs' experiences and compare training payoffs between natives and migrants. Whether business apps training shall be more beneficial to migrant entrepreneurs cannot be addressed without comparing their experiences against the experiences of native populations.

Moreover, whether business apps training affects firms' turnover and other long-run performance indicators was not examined and requires an informative data set and longitudinal evaluation. It is also important to examine how entrepreneurs' gender moderates the relationships under examination. Furthermore, observations from additional firms are needed to allow training payoffs comparisons per entrepreneurs' and firms' digital literacy level, firms' economic performance, size and years of operation. In addition, a sector-oriented evaluation could bring further insights.

This study was conducted during the COVID-19 pandemic and it has been reported that advanced technology and utilisation of AI apps reduced business risks caused by the COVID-19 pandemic [19], so new studies should be conducted post-COVID-19 to determine whether the magnitude of the estimates might vary.

The present study focused on nine general business apps categories, so additional categories should be examined to inform the analysis and the proposed scales. Moreover, how the level of a firm's innovativeness, technology and organisational readiness, and perceived benefits of participating in business apps training could moderate the study's outcomes require attention [62]. Furthermore, the technical characteristics of each business app and the actual algorithms per business app should be examined to better assess their payoffs on firms' performance indicators.

Finally, the migrants in the present study were actively integrating into Greek society by enrolling in digital training, so one might expect different outcomes if the migrants were not active in e-training. The study did not utilise a control group, hence comparisons between firms that participated in the business apps training and firms that did not participate cannot be offered.

## **11. Conclusion**

This study found that business apps training offered to migrant entrepreneurs running small firms in Athens (Greece) was positively associated with entrepreneurs' attitudes toward technology, willingness to change (relating to technology/skills/operations), internet/digital skills, and use of business apps. Moreover, a positive association between business apps training and firms' digital competencies was found. Finally, the business apps training was positively associated with migrant entrepreneurs' integration into Greek society. Business apps training can be envisioned as a set of best practices to boost entrepreneurs' digital skills and firms' digital competencies, thus policymakers might consider developing flexible digital training for small and medium firms enabling them to exploit innovative technologies opportunities.

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**Table 1.** Descriptive statistics. Entrepreneurs and firms.

	<b>Mean</b>	<b>Standard Deviation</b>
Entrepreneurs' Age (c.)	34.79	6.83
Entrepreneurs' Gender: Male (%)	83.33	0.37
Entrepreneurs' Higher Education (%)	12.5	0.33
Entrepreneurs' Years of Migration in Greece (c.)	9.64	2.21
Entrepreneurs' Continent of Origin: Europe (%)	22.91	0.42
Entrepreneurs' Continent of Origin: Africa (%)	47.91	0.50
Entrepreneurs' Continent of Origin: Asia (%)	29.16	0.45
Firms' Years of Operation (c.)	4.14	1.55
Firms' Number of Employees (c.)	3.56	2.78
Ownership of the Firms' Premise (%)	4.16	0.20
Firms' Sector: Trade (%)	47.91	0.50
Firms' Sector: Services (%)	25.0	0.43
Firms' Sector: Hospitality (%)	27.08	0.44

*Notes: Sample 89 observations. (c.) Continuous variable.*

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**Table 2.** Alpha coefficients.

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<b>Scales</b>	<b>Alpha Coefficients</b>	<b>Number of Items per Scale</b>	<b>Observations</b>
Positive Attitudes Toward Technology scale	0.59	6	89
Willingness to Change (Technology/Skills/Operations) scale	0.53	3	89
Internet Skills scale	0.86	35	89
Business Apps in Use scale	0.67	9	89
Digital Competencies scale	0.79	9	89
Integration (Ethnosizer) scale	0.52	5	89

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**Table 3.** Descriptive statistics. Scales.

<b>Scales</b>	<b>Panel I Before the Business Apps Training</b>	<b>Panel II After the Business Apps Training</b>	<b>t-test</b>
Positive Attitudes Toward Technology scale (c.)	2.51 (0.49)	2.75 (0.52)	-2.21**
Willingness to Change (Technology/Skills/Operations) scale (c.)	2.69 (0.66)	3.02 (0.70)	-2.26**
Internet Skills scale (c.)	2.05 (0.30)	2.35 (0.41)	- 3.98***
Business Apps in Use scale (c.)	1.20 (0.78)	1.68 (0.79)	- 2.82***
Digital Competencies scale (c.)	1.38 (0.51)	2.03 (0.70)	- 4.96***
Integration scale (Ethnosizer) (c.)	2.10 (0.43)	2.49 (0.55)	- 3.70***
Observations	48	41	

*Notes.* (c.) Continuous variable. Standard deviations are in parentheses. (\*\*\*) Statistically significant at the 1%. (\*\*) Statistically significant at the 5%.

**Table 4.** Digital competencies.

<b>Categories</b>	<b>Panel I Before the Business Apps Training</b>	<b>Panel II After the Business Apps Training</b>	<b>t-test</b>
Communication (c.)	1.20 (0.14)	2.00 (0.18)	-3.40***
Networking (c.)	1.04 (0.10)	1.87 (0.14)	-4.64***
Social Media (c.)	1.27 (0.11)	1.95 (0.16)	-3.43***
Customer Relationship Management (c.)	0.95 (0.11)	1.92 (0.16)	-4.85***
Payments (c.)	1.33 (0.15)	2.09 (0.16)	-3.34***
Accounting and Finance (c.)	1.16 (0.13)	1.95 (0.18)	-3.57**
Managing Inventory (c.)	2.20 (0.19)	2.39 (0.18)	-0.65
Team and Time Management (c.)	1.95 (0.19)	2.21 (0.16)	-1.00
Project Management (c.)	1.35 (0.14)	1.87 (0.16)	-2.45**
Observations	48	41	

*Notes.* (c.) Continuous variable. Standard deviations are in parentheses. (\*\*\*) Statistically significant at the 1%. (\*\*) Statistically significant at the 5%.

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**Table 5.** Correlation coefficients.

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<b>Scales</b>	<b>Business Apps Training Correlations</b>	<b>p-values</b>
Positive Attitudes Toward Technology scale	0.23	0.02**
Willingness to Change (Technology/Skills/Operations) scale	0.23	0.02**
Internet Skills Scale	0.38	0.00***
Business Apps in Use scale	0.27	0.00***
Digital Competencies scale	0.46	0.00***
Integration (Ethnosizer) scale	0.36	0.00***

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*Notes. Sample 89 observations. (\*\*\*) Statistically significant at the 1%. (\*\*) Statistically significant at the 5%.*

**Table 6.** Regression outcomes. Associations between business apps training and entrepreneurs' positive attitudes toward technology (H1), willingness to change (technology/skills/operations) (H2), internet/digital skills (H3), and business apps in use (H4).

	Positive Attitudes Toward Technology		Willingness to Change (Technology Skills/Operations)		Internet/Digital Skills		Business Apps in use	
	Model I Random Effects	Model II Fixed Effects	Model III Random Effects	Model IV Fixed Effects	Model V Random Effects	Model VI Fixed Effects	Model VII Random Effects	Model VIII Fixed Effects
Business Apps Training <sup>^</sup>	0.267 (0.031)***	0.272 (0.029)***	0.361 (0.075)***	0.365 (0.071)***	0.332 (0.037)***	0.339 (0.034)***	0.486 (0.072)***	0.493 (0.067)***
Wald test [prob>chi <sup>2</sup> ]	310.30 [0.000]	-	88.81 [0.000]	-	182.87 [0.000]	-	154.23 [0.000]	-
F [prob>F]	-	84.36 [0.000]	-	25.93 [0.000]	-	96.69 [0.000]	-	53.08 [0.000]

Notes. Sample 89 observations. (^) The reference category is before the business apps training. The random effects models incorporate information relating to firms' sector of operation, years of operation, number of employees, ownership of the business premise, as well as, entrepreneurs' age, gender, continent of origin, higher education degree and years in Greece. Robust standard errors are reported in parentheses. (\*\*\*) Statistically significant at the 1%.

**Table 7.** Regression outcomes. Associations between business apps training and firms' digital competencies (H5), and entrepreneurs' integration (Ethnosizer) (H6).

	Digital Competencies		Integration (Ethnosizer)	
	Model I Random Effects	Model II Fixed Effects	Model III Random Effects	Model IV Fixed Effects
Business Apps Training <sup>^</sup>	0.650 (0.115)***	0.647 (0.108)***	0.402 (0.048)***	0.404 (0.045)***
Wald test [prob>chi <sup>2</sup> ]	97.12 [0.000]	-	187.03 [0.000]	-
F [prob>F]	-	37.73 [0.000]	-	80.37 [0.000]

Notes. Sample 89 observations. (^) The reference category is before the business apps training. The random effects models incorporate information relating to firms' sector of operation, years of operation, number of employees, ownership of the business premise, as well as, entrepreneurs' age, gender, continent of origin, higher education degree and years in Greece. Robust standard errors are reported in parentheses. (\*\*\*) Statistically significant at the 1%.

Appendix A

Table A.1 Evaluation of business apps

Categories of Business Apps:	Number of Interactions to Complete Tasks*	Visibility of System Status and Losability/ Findability of the Device**	Match Between System and the Real World**	Consistency and Mapping**	Good Ergonomics and Minimalist Design**	Ease of Input, Screen Readability and Glancability**	Flexibility, Efficiency of Use and Personalization**	Aesthetic, Privacy and Social Conventions**	Realistic Error Management**
<b>Panel I. Communication</b>									
App 1	4.5 (0.7)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)
App 2	4.5 (0.7)	1.5 (0.71)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	2 (0.0)	1 (0.0)	1 (0.0)	1.5 (0.71)
App 3	4 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)
<b>Panel II. Networking</b>									
App 1	4.5 (0.7)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	2 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)
App 2	5 (1.41)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1.5 (0.71)
App 3	4.5 (0.7)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1.5 (0.71)	1 (0.0)
<b>Panel III. Social Media</b>									
App 1	5 (1.41)	1 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1.5 (0.71)
App 2	5 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	2.5 (0.71)	2 (1.41)	1.5 (0.71)	1.5 (0.71)
App 3	6 (0.0)	2 (0.0)	2 (0.0)	1 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	2 (1.41)	1.5 (0.71)
<b>Panel IV. Customer Relationship Management</b>									
App 1	4.5 (0.7)	1 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	2 (0.0)	1 (0.0)	1.5 (0.71)
App 2	5 (1.41)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1.5 (0.71)
App 3	4.5 (0.7)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	2 (1.41)
<b>Panel V. Payments</b>									
App 1	7.5 (0.7)	1 (0.0)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)
App 2	7.5 (0.7)	1.5 (0.71)	1.5 (0.71)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	2 (0.0)
App 3	8 (1.41)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)
<b>Panel VI. Accounting and Finance</b>									
App 1	7 (1.41)	1.5 (0.71)	1 (0.0)	1 (0.0)	2 (0.0)	2.5 (0.71)	1.5 (0.71)	1 (0.0)	1.5 (0.71)
App 2	8 (1.41)	1.5 (0.71)	2 (0.0)	2 (0.0)	2 (1.41)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)
App 3	7.5 (0.7)	1 (0.0)	1.5 (0.71)	1 (0.0)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	2 (1.41)
<b>Panel VII. Managing Inventory</b>									
App 1	8 (1.41)	1 (0.0)	1 (0.0)	1 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1 (0.0)	1 (0.0)
App 2	8 (1.41)	1.5 (0.71)	2 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1.5 (0.71)	2 (0.0)
App 3	7.5 (0.7)	2 (1.41)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)
<b>Panel VIII. Team and Time Management</b>									
App 1	8.5 (0.7)	1 (0.0)	1.5 (0.71)	1 (0.0)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	2 (0.0)
App 2	8.5 (0.7)	1.5 (0.71)	1 (0.0)	1 (0.0)	2 (0.0)	1.5 (0.71)	1 (0.0)	1 (0.0)	2 (0.0)
App 3	7.5 (0.7)	2 (1.41)	1.5 (0.71)	2 (1.41)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	2 (0.0)
<b>Panel IX. Project Management</b>									
App 1	8 (1.41)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)
App 2	7.5 (0.7)	1.5 (0.71)	2 (0.0)	2 (0.0)	1.5 (0.71)	2 (0.0)	1.5 (0.71)	1 (0.0)	1.5 (0.71)
App 3	8 (1.41)	1.5 (0.71)	1 (0.0)	1 (0.0)	1.5 (0.71)	1.5 (0.71)	1.5 (0.71)	1 (0.0)	1.5 (0.71)

Notes. Sample: 27 business apps. (\*) Keystroke level modelling. (\*\*) Usability heuristic evaluation. Each app was assessed by two evaluators. Standard deviations are in parentheses.



## Appendix B

**Table B.1** Regression outcomes. Associations between business apps training and digital competencies per business app relating to communication, networking, social media, customer relationship management, and payments.

	Communication	Communication	Networking	Networking	Social Media	Social Media	Customer Relationship Management	Customer Relationship Management	Payments	Payments
	Model I Random Effects	Model II Fixed Effects	Model III Random Effects	Model IV Fixed Effects	Model V Random Effects	Model VI Fixed Effects	Model VII Random Effects	Model VIII Fixed Effects	Model IX Random Effects	Model X Fixed Effects
Business Apps Training <sup>^</sup>	0.838 (0.188)***	0.878 (0.175)***	0.823 (0.180)***	0.780 (0.173)***	0.708 (0.165)***	0.682 (0.158)***	0.927 (0.180)***	0.902 (0.171)***	0.777 (0.215)***	0.731 (0.210)***
Wald test [prob>chi <sup>2</sup> ]	66.05 [0.000]	-	55.53 [0.000]	-	73.79 [0.000]	-	66.61 [0.000]	-	58.38 [0.000]	-
F [prob>F]	-	24.90 [0.000]	-	20.22 [0.000]	-	18.57 [0.000]	-	27.84 [0.000]	-	12.09 [0.000]

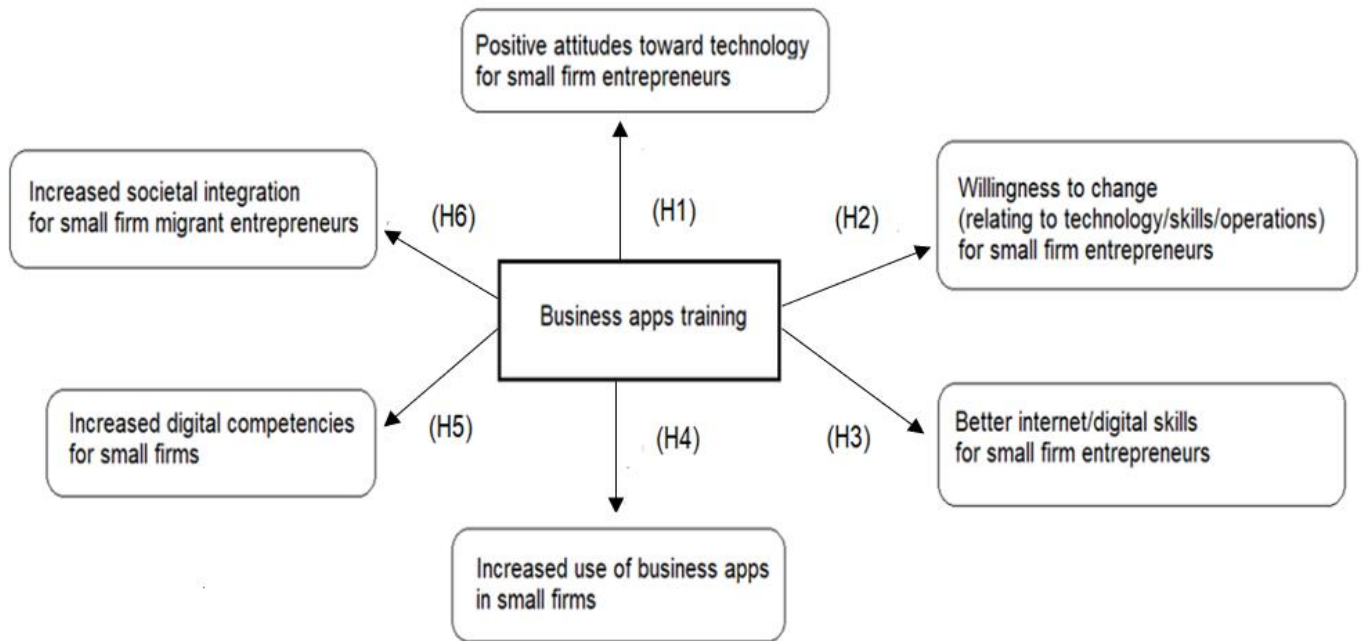
*Notes. Sample 89 observations. (^) The reference category is before the business apps training. The random effects models incorporate information relating to firms' sector of operation, years of operation, number of employees, ownership of the business premise, as well as, entrepreneurs' age, gender, continent of origin, higher education degree and years in Greece. Robust standard errors are reported in parentheses. (\*\*\*) Statistically significant at the 1%.*

## Appendix C

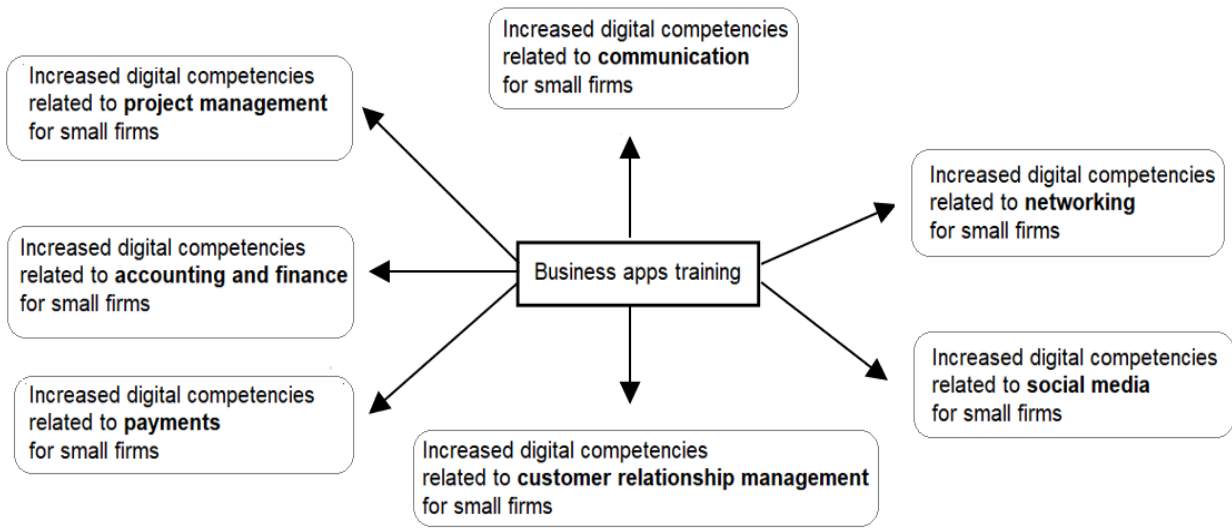
**Table C.1** Regression outcomes. Associations between business apps training and digital competencies relating to accounting and finance, managing inventory, team and time management and project management.

	<b>Accounting and Finance Model I Random Effects</b>	<b>Accounting and Finance Model II Fixed Effects</b>	<b>Managing Inventory Model III Random Effects</b>	<b>Managing Inventory Model IV Fixed Effects</b>	<b>Team and Time Management Model V Random Effects</b>	<b>Team and Time Management Model VI Fixed Effects</b>	<b>Project Management Model VII Random Effects</b>	<b>Project Management Model VIII Fixed Effects</b>
Business Apps Training <sup>^</sup>	0.753 (0.180)***	0.707 (0.169)***	0.186 (0.204)	0.219 (0.196)	0.249 (0.230)	0.268 (0.219)	0.588 (0.202)***	0.658 (0.197)***
Wald test [prob>chi <sup>2</sup> ]	43.54 [0.000]	-	56.29 [0.000]	-	49.32 [0.000]	-	101.37 [0.000]	-
F [prob>F]	-	17.51 [0.000]	-	1.24 [0.270]	-	1.50 [0.220]	-	11.16 [0.000]

*Notes. Sample 89 observations. (^) The reference category is before the business apps training. The random effects models incorporate information relating to firms' sector of operation, years of operation, number of employees, ownership of the business premise, as well as, entrepreneurs' age, gender, continent of origin, higher education degree and years in Greece. Robust standard errors are reported in parentheses. (\*\*\*) Statistically significant at the 1%.*



**Figure 1.** Business apps training payoffs. Theoretical framework.



**Figure 2.** Business apps training payoffs related to digital competencies. Estimated patterns.