THE ROLE OF HIGHER EDUCATION INSTITUTIONS IN INTRODUCING ENTREPRENEURSHIP EDUCATION TO MEET THE DEMANDS OF INDUSTRY 4.0

Yamkela Nhleko, University of KwaZulu Natal
Thea van der Westhuizen, University of KwaZulu Natal

ABSTRACT

Despite the entrepreneurial opportunities presented by Industry 4.0, this fourth era of technological change presents challenges to both industry and educational institutions. In particular, the operational model of the traditional higher education institution is affected. The aim of the research described in this article was to investigate the effect of Industry 4.0 on entrepreneurship education (EE), especially at higher education institutions (HEIs), and to identify how undergraduate students view the attempts of these institutions to turn out graduates capable of coping in a work environment characterised by complex and ever-changing technology. The quantitative research involved a case study of the Westville Campus of the University of KwaZulu-Natal by means of a survey of final year undergraduate commerce students who completed 248 questionnaires, the response rate of which was 100%. Data analysis produced descriptive and inferential statistics, which led to the recommendation that the existing EE system at HEIs should incorporate Industry 4.0 enabling courses to equip students adequately for the world of work.

Keywords: Industry 4.0, Entrepreneurship Education, Higher Education Institutions, Higher Education, University of KwaZulu-Natal.

INTRODUCTION

Youth unemployment, poverty and other societal ills are socio-economic problems that might be solved by entrepreneurship (Van der Westhuizen, 2019). Therefore, entrepreneurship education (EE) is necessary for the promotion and adoption of a culture of entrepreneurship. Boldureanu et al. (2020) are of the opinion that any country that wishes to compete in the global market must embrace entrepreneurship because it promotes economic growth, creativity and innovation. Thus, higher education institutions (HEIs) have introduced educational programmes that motivate students to espouse entrepreneurship.

Hahn et al. (2017) describe EE as instructional courses, programmes and procedures delivered to students with the aim of equipping them with entrepreneurial behaviors, features and skills. Hence, EE is aimed at encouraging students to consider self-employment as a career option of career, instead of building competencies for employability upon graduation. EE equips students with skills to succeed and excel in setting up businesses and taking financial risks for a profit. EE exposes students in HEIs to an entrepreneurial mindset, which leads to the development of entrepreneurs who venture into businesses that create employment opportunities for others (Ghina et al., 2017).

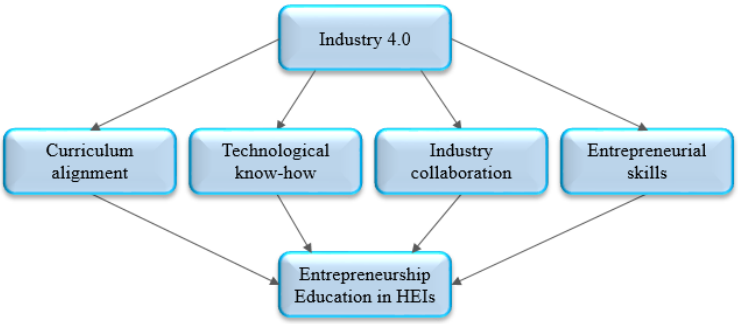
Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Industry 4.0, also termed the fourth industrial revolution (4IR) is the fourth wave of industrialisation, which has not only disrupted the activities of most industries worldwide (Schwab, 2016) but also the nature of entrepreneurship and EE. Owing to the digitalised nature of Industry 4.0, students need to acquire digital skills to function effectively as entrepreneurs. Xing and Marwala (2018) maintain that higher education for Industry 4.0, although complex, can be a platform for societal transformation and development. Therefore, EE should align with the requirements of Industry 4.0.

AIM OF THE STUDY

The aim of the study was to assess whether undergraduate students at the exit-level perceived that the curriculum of EE in HEIs equipped them with sufficient technological know-how to meet the requirements of being entrepreneurs in a world determined by Industry 4.0, by exposing them to appropriate information, communication and technology (ICT) platforms. In other words, the focus of the study was to understand the effect of Industry 4.0 on EE and determine how HEI can develop suitable skills to equip students for the demands of Industry 4.0.

Figure 1 below present the conceptual framework of the study. While the dependent variable was EE in HEIs, the independent variables were curriculum alignment; technological know-how; industry collaboration; and entrepreneurial skills.



Source: Adapted and modified from Tuteski and Kocov (2018)

FIGURE 1
CONCEPTUAL FRAMEWORK

CURRICULUM ALIGNMENT

The first independent variable of the conceptual framework, curriculum alignment is defined as the process whereby the state and educational consultants formally access and evaluate an existing educational programme with the aim of addressing and correlating the varying needs of students with the dynamic requirements of the work environment (Wijngaards-de Meij & Merx, 2018). Van der Westhuizen and Nhleko (2021) argue that the authorities of HEIs need to promote the need for quality education that is aligned with the demands of the world of the work of the future, which will also reflect the global effect of COVID-19. Although introducing courses modules in HEIs on the impact of the pandemic may not be feasible, they should be in line with the demands of Industry 4.0 (Mzekandaba, 2019a), which would involve new ways of teaching as well.

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Curriculum alignment should be ensured by HEIs to meet societal needs and interests. HEIs need to be sensitive to the demands of society and proactive in continually restructuring the system to make room for a progressive technological economy (Ogunde et al., 2005, cited in DEFSA, 2017). An example of successful curriculum alignment in South Africa was evident in the educational initiatives that emerged to tackle the unsatisfactory education system of the pre-democratic period (Tshiredo, 2013). Therefore, to ensure the effectiveness of EE in universities, building the competencies of students to meet Industry4.0 requirements needs to be infused into a curriculum, which teaches the kind of entrepreneurship that develops new products and services for consumers.

TECHNOLOGICAL KNOW-HOW

The second variable refers to the technological skills that students acquire from ICT platforms created by their HEIs. Norström (2014) points out that technological know-how consists of what could be termed "knowing that" and "knowing how", and that technological activities, such as the development of technological artefacts, are aided by technological knowledge. Where the notion "knowing that" quantifies the knowledge of technology, the concept "knowing how" is based on experience of the use of a specific kind of technology.

Those who need to meet the demands of Industry 4.0 must acquire technological know-how in a world that functions through artificial intelligence. This knowledge will empower them in a revolutionised environment and equip them with digital skills when generating income. According to Elmes (2017b), digital literacy encompasses the acquisition of technological skills, in-depth understanding of the digital environment, and structuring an environment for adaptation to and creation of new context and content adaptation. Therefore, HEIs must develop a curriculum and an enabling educational environment that promote higher order thinking skills, thereby building agents of social transformation, which will stand up to the requirements of the uncertain, complex and dynamic world economy.

INDUSTRY COLLABORATION

Industry collaboration, the third variable of the conceptual framework, refers to the partnership between industry and any aspect of HEIs aimed at fostering technology knowledge and experiential learning (Ankrah & AL-Tabbaa, 2016). Kunttu (2017) argues that a university-industry collaboration (UIC) should boost practical learning through joint educational activities, with the sole aim of training students and investing in their projects. This is similar to Nwosu and Chukwudi's (2018) argument that EE should translate theoretical aspects of the curriculum into practice, which is a long-standing educational problem. Thus, students of entrepreneurship would be better equipped when they learn through interaction with existing businesses. Moylan et al. (2016) observe that the nature of EE demands real-life participation and experiential opportunities incorporated in a skills-based, practical learning process (Nakagawa et al., 2017).

ENTREPRENEURIAL SKILLS

The fourth variable, entrepreneurial skills, is required for effective productivity and participation in Industry 4.0. Pahuja and Sanjeev (2015) define an entrepreneur as an individual who is always on the look-out for change, responds to it and takes advantage of the opportunity it may create. In defining a skill, Sousa and Almeida (2014) maintain that it is the quality of a

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

performance, which is not only dependent on the unique abilities of an individual but also the capacity of humans to develop and improve through consistent practice, training and experience. Therefore, entrepreneurial skills are those required for an individual to begin, grow and ensure the stability of a business enterprise.

HEIs should undergo restructuring to create an enabling environment for students to learn the skills for entrepreneurial success. According to Sa and Serpa (2018), entrepreneurial skills should be fortified with transversal skills (related to other fields), such as technical and scientific competencies that are applicable in diverse spheres of knowledge, which will help them succeed in the era of Industry 4.0 upon graduation and create job opportunities for others.

AN OVERVIEW OF INDUSTRY 4.0

An industrial revolution is an unavoidable happening propelled by swift transformation in procedures and processes (Mkwanazi & Mbohwa, 2018). The emergence of the fourth industrial revolution (4IR) also termed "Industry 4.0" is a transformation that is increasing exponentially (Ghobakhloo, 2020). The dynamic nature of technology places it in a position of constant development, which means that Industry 4.0 will impact most sectors, including the educational sector. Xing and Marwala (2018) indicate the emergence of a new kind of university, where teaching, research and other activities are based on the influence of Industry 4.0, which is evidenced by the increasing number of virtual campuses.

The three industrial revolutions that preceded Industry 4.0 had a great impact on the mode of teaching in HEIs. While the first industrial revolution witnessed a transformation from handicraft and an agrarian economy to an economy of machines and industrial manufacturing, the second was characterised by emergence of electricity and oil, which facilitated mass production. The third and fairly recent revolution was based on information technology (IT), which introduced automation to production (Xu et al. 2018). However, Industry 4.0 is grounded in three mutually connected goals, which are to digitise and integrate techno-economic responses with intricate networks, develop new market models such as virtual stores and introduce smart products and services (Zezulka et al., 2016), which are aimed at the progress of humanity and reduction of dependency on human labour for production.

Industry 4.0 is defined as the linkage between digital and physical technologies, the Internet of Things, artificial intelligence, robotics, 3-D printing and virtual classrooms (Pillay et al., 2017). It is the digital revolution of industrial and consumer marketing activities in an era of smart manufacturing, which involves placing the entire value chain onto a digitised platform, including business communication and investment in current intelligence (Ghobakhloo, 2020; Mkwanazi et al., 2018). Industry 4.0 is a term coined by the German government to describe a highly technological strategy the major purpose of which is to develop existing computerisation and industrialisation (Du Plessis, 2017). From these definitions, it is evident that Industry 4.0 permits endless possibilities for economies, technologies, academics, health and other fields and creates room for alternatives that will make life easier.

ENTREPRENEURSHIP EDUCATION

Almahry et al. (2018) describe EE as an important part of the entrepreneurship ecosystem, which is aimed at boosting stability in business creation. It is the study of the basis of opportunities and the systematic procedure of discovery whereby the endeavors of individuals, their creative ability and ideas are transformed into actions (Gautam, 2015; Ghina 2014)

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

maintains that entrepreneurship is a phenomenon characterised by economic growth worldwide, which has aa positive effect through the development and emergence of new business start-ups. This description accentuates the importance of EE in ensuring that individuals have access to the knowledge needed for creating new ventures that promote economic growth. Boldureanu et al. (2020) argue that research has shown that as EE develops skills and know-how as well as improving attitudes towards and motivation for entrepreneurship and economic development, HEIs should integrate it into academic studies.

Chimucheka (2014) points out that although countries like South Africa strive to manage high levels of unemployment and the low level of entrepreneurship, which hinder economic development, by placing EE on the policy agenda, the outcomes are not clear. Nevertheless, if EE is propelled by HEIs, students will acquire entrepreneurial skills and competencies, which will boost their creativity, motivate them to take the risks of entrepreneurship and ensure their survival (Ghina et al., 2017).

The main focus of Industry 4.0 is innovation, which is a characteristic of entrepreneurship. However, the innovations strategies required by Industry 4.0 indicate new requirements for EE (Wei et al., 2019). In other words, EE in HEIs need to enable future entrepreneurs to initiate start-ups that adopt an advanced level of technology.

ENTREPRENEURSHIP EDUCATION IN THE SOUTH AFRICAN CONTEXT

A high rate of unemployment, a low rate of entrepreneurial activity and an increasing failure of small businesses are some of the challenges facing South Africa, which might be overcome by improving EE and exposing more young people to it (Amadi-Echendu et al., 2016; Van der Westhuizen, 2019). One of the challenges of entrepreneurship in the country is that a number of South Africans do not see themselves as entrepreneurs, which may be due to a lack of exposure to entrepreneurial activities while growing up (Mary & Mitchel, 2006). Van Praag and Versloot (2007), Radipere (2012), Ghina et al., (2017) and Kanonuhwa et al., (2018) argue that offering EE in higher education would encourage students to adopt an entrepreneurial mindset.

A number of South African HEIs now offer entrepreneurship courses from undergraduate to post graduate level, with the sole aim of reducing the increasing rate of unemployment. The National University Entrepreneurship Ecosystem Baseline Report released by the Department of Higher Education (2020) showed that 26 universities in South Africa offered EE at some level, either as a full course, incubation hub, 10 week online course, module or a course in the business school. The report indicated that the impact of the HEIs' EE initiatives differed, with some having considerable influence, whilst others had less of an effect. Moreover, although EE was included at undergraduate level, it was emphasised more at postgraduate level. Nevertheless, the fact that it was included at both levels indicates acceptance and awareness of the need for EE in South African universities (Sá & Serpa, 2018).

HEIs could enhance the impact of EE by developing a full curriculum to teach students how to identify opportunities, manage risk, develop their entrepreneurial skills and manage the rewards associated with running a business venture (Chimucheka, 2014), thereby contributing to economic development and job creation (Van der Westhuizen, 2019c). Thus, expanding EE might mitigate the increasing unemployment in the country by increasing the number of entrepreneurs.

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

THE ROLE OF HIGHER EDUCATION INSTITUTIONS IN ENTREPRENEURSHIP DEVELOPMENT

Srivastava and Thomas (2017) maintain that job-orientated educational programmes are being replaced by those that are focussed on job-creation, such as entrepreneurial management programmes and diplomas in entrepreneurship, which prepare students for entrepreneurial endeavours. Biney (2019) avers that the younger generation of South Africans demands such programmes because of increased awareness of the benefits of owning their own business. Therefore, Ierapetritis (2019) argues that the role of HEIs in preparing youth for entrepreneurship in the era of Industry 4.0 should not be limited to transferring knowledge and technological expertise but should also develop business mindsets and the ability to take action, establish a business and access venture capital.

Boldureanu et al. (2020) argue that EE should include a study of successful entrepreneurs as role models, which would encourage students to embrace entrepreneurship. In particular, students could study successful entrepreneurs from their own country, with whom they would relate when learning the skills of starting their own business and the capacity to sustain it (Mani, 2018). In addition, having a local role model would motivate future entrepreneurs to look for and recognise business opportunities as well as developing the confidence to become successful entrepreneurs.

THE FEASIBILITY OF DEVELOPING SUCCESSFUL ENTREPRENEURS AT HEIs

Cui et al. (2019) maintain that the development of EE programmes is based on the premise that entrepreneurship can be taught and that the skills as well as the qualities can be developed. However, Ghina et al. (2017) are of the opinion that entrepreneurial skills are in-born and cannot be taught. In addition theories of psychological development maintain that entrepreneurial behaviour is learnt in early childhood, which suggests that it would not be successfully taught in HEIs. For example, these theories explain that the learning of creativity and opportunistic attitudes/behaviour, which are entrepreneurial qualities, takes place between the ages of two and three years, although it may also depend on genetics. According to psychological development theories, the ability to recognise/take risks and endure failure is learnt between the ages three and five years, whilst survival is a mindset that results from self-efficacy and a high internal locus of control (Ghina et al., 2017).

Ajzen's (1998) theory of planned behaviour (TPB), which is often adopted as a framework for explaining human behavior, views attitude, subjective perceptions of social norms and perceived behavioural control as determining behavioural intention. Attitudes can be favorable or unfavorable; subjectively perceived social norms can be experienced as social pressure; and perceived behavioural control is the ease or difficulty of performing a behaviour. Therefore, the TPB suggests that entrepreneurship could be taught at HEIs if EE could encourage positive attitudes in student towards it, establish a supportive social environment and enable students not to perceive entrepreneurial activity as difficult (Ajzen, 2002).

Ekekwe (2010); Preston (2017) argue that being a successful entrepreneur does not require the input of higher education. They identify successful entrepreneurs, who despite their lack of higher education, built successful business empires. Ghina et al. (2017) maintain that although higher education might contribute towards the development of successful entrepreneurs, a number of countries are not able to offer either formal and informal EE (Ra et al., (2019).

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Table 1 below shows a number of owners of small, micro and medium enterprises (SMMEs) according to the level of education they attained. It shows that over the years, the number of business owners who had attained tertiary education increased. There was a quarterly increase of 11.2% between 2017 and 2018, with an annual change of 2.8%. In addition, the number of owners who had finished only secondary school was reduced by 7.3%. This indicates that HEIs can play a role in educating and developing successful entrepreneurs.

Table 1
OWNERS OF SMMES ACCORDING TO LEVEL OF EDUCATION

Schooling	2017 Q1		2017Q4		2018Q1		Quarterly change		Yearly change	
	Number	Distri-bution	Number	Distri-bution	Number	Distri-bution	Number	%	Number	%
No schooling	94 799	3.8%	98 757	4.1%	87 822	3.6%	-10 935	-11.1%	-6977	-7.4%
Less than completed primary	238 124	9.6%	222 620	9.2%	210 446	8.6%	-12 174	-5.5%	-27 678	-11.6%
Completed primary	117 820	4.8%	94 800	3.9%	106 477	4.4%	11 677	12.3%	-11 342	-9.6%
Completed secondary	667 850	26.9%	631 984	26.3%	618 897	25.3%	-13 087	-2.1%	-48 953	-7.3%
Secondary school not completed	819 086	33.0%	855 819	35.5%	864 202	35.4%	8 201	1.0%	44 934	5.5%
Tertiary	504 519	20.4%	466 109	19.4%	518 545	21.2%	52 437	11.2%	14 027	2.8%
Other	36 679	1.5%	37 351	1.6%	36 955	1.5%	-396	-1.1%	276	0.8%
Total	2 478 877	100%	2 407 440	100%	2 443 163	100%	35 722	1.5%	35 714	-1.4%

Source: SEDA (2018:20)

RESEARCH DESIGN AND METHODOLOGY

Primary data were collected in the empirical study, which followed a descriptive research design to answer the research questions and meet the objectives. The aim of the study was to describe the Industry 4.0 phenomenon, its impact on higher education, the resultant changes that are taking place in HEIs, and what is being done to address the demands of Industry 4.0. The research focussed more on what was happening at the time of the study being conducted, as opposed to what had already taken place or the reasons for the particular phenomenon (Nassaji, 2015).

Quantitative data collection methods were adopted in the study to enable the researcher to determine the relationship between the dependent and independent variables described above (Hopkins, 2008). Thus the research paradigm was quantitative in nature and the questionnaire was associated with a deductive approach. A comprehensive questionnaire was designed and

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

administered to the respondents, who were asked to choose between options and to fill in their responses in the spaces provided. The questionnaire contained closed- and open-ended questions. The inclusion of open-ended questions allowed the participants to give a variety of responses and opinions as well as giving them an opportunity to elaborate on their perceptions.

SITE OF THE STUDY AND TARGET POPULATION

The study site was the Westville Campus of the UKZN, which houses commerce and management disciplines as well as health sciences. The campus is the official address of UKZN and houses the office of the vice-chancellor. It was a legitimate location for this study, as the focus was on students in the School of Management, Information Technology and Governance (SMIG).

The target population for this research study was students enrolled as exit-level undergraduate students in the SMIG. The undergraduate programmes offered by the SMIG include the Bachelor of Commerce – General, which allows for specialisation in accounting, economics, finance, human resources management, information systems, management, marketing, supply chain management and public management; a Bachelor of Business Administration; a Bachelor of Administration (Human Resource Management); and a Bachelor of Administration. This population was selected, as the students were on the brink of completing their qualifications and entering the labour market. The population was appropriate for determining whether the curriculum had been developed in a manner that produced participants fit for Industry 4.0. The population of the study was 657, and the sample size was 248. The calculation of the sample size is indicated in the following section.

SAMPLING FRAME/SIZE

The Taro Yamani formula, also known as the Taro Model, was used to determine the sample size. According to Yamane (1967, cited in Israel, 2013), the Taro Model provides a simplified formula for calculating sample sizes. The sample size was derived from 657 exit-level undergraduate students who comprised the population of the study by using the formula $\boldsymbol{n}=\boldsymbol{N}\mathbf{1}+\boldsymbol{N}*(\boldsymbol{e})\mathbf{2}$

Where n is the sample size, N is the population size of 657, and e is the level of precision of 0.05.

$$\boldsymbol{n}=\mathbf{6571}+\mathbf{657}*(\mathbf{0.05})\mathbf{2}\ \boldsymbol{n}=\mathbf{6572.645}$$

Therefore, $\boldsymbol{n}$ = 248

MEASUREMENTS

This study adopted the six-point Likert scale for measurement. Likert scales are commonly used to measure respondents' perceptions of the construct under consideration. In the current study, the construct under measurement was the impact of Industry 4.0 on EE, and how HEIs are bridging student skills to keep abreast with the demands of Industry 4.0. The respondents were asked to indicate the level of their agreement with the statements in the questionnaire, according to a six-point Likert Scale rating of strongly disagree, disagree, slightly disagree, slightly agree, agree and strongly agree. This type of Likert scale gives better data than

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

the five-point scale, and should the need for a 'neutral' arise, the 'slightly disagree' and 'slightly agree' could be combined to form an average (Thompson, 2018).

RELIABILITY AND VALIDITY

The KMO and Bartlett's statistic tests were conducted to ensure that the sample and data were suitable for factor analysis. A factor analysis was performed on the 13 items based on the curriculum alignment construct to see if they could be clustered into a few reliable groups. According to Kaiser (1974), the threshold for the KMO statistic is 0.60, inferring that a KMO statistic that is > 0.60 is adequate for factor analysis. Bartlett's test = $p < .000$, which was $p < .05$, indicated that correlations between the items were not too low and that the data collected were valid for factor analysis.

RELIABILITY OF THE DATA

Cronbach's Alpha was used to measure the internal consistency of the scale used. The acceptable threshold for Cronbach's Alpha is 0.7 for the scale to be considered acceptable, 0.60 and 0.50 for it to be considered as significant, while < 0.50 is considered as unacceptable (Makhanya, 2017). The first construct of the EE section in the questionnaire was curriculum alignment. This construct was used to answer the research question: What are the perspectives of exit-level undergraduate students regarding whether curriculum alignment in EE in an HEI is aligned to the world of work requirements of Industry 4.0.? For curriculum alignment, both factors, namely CA1 and CA2, had internal consistency, as they had a Cronbach's Alpha of .869 and .783, respectively.

The second construct in the EE section was technological know-how. This construct related to the second research question of this study: What perceptions are the perceptions of exit-level undergraduate students regarding the efficiency of the ICT platforms used in EE in an HEI to equip them with the technological know-how for Industry 4.0 work readiness? For technological know-how, the general result was acceptable, as both factors, namely TECH1 and TECH2, had coefficients of .760 and .576, respectively. However, TECH2 had a coefficient considered as significant, because it was > 50, most probably because it had only three items, automatically making the Alpha coefficient lower, as it was n-dependent.

Industry collaboration was the third construct for EE and was used to answer the research question: How do exit-level undergraduate students perceive the effectiveness of industry collaboration during their EE in an HEI? Industry collaboration had a coefficient of .831, indicating internal consistency.

The final construct for EE, entrepreneurial skills, was used to answer the research question: How do exit-level undergraduate students perceive the usefulness of Industry 4.0 entrepreneurial skills, which are taught in their EE in an HEI?

DATA ANALYSIS

The data obtained were quantitative in nature. Therefore, they were statistically analysed to generate descriptive and inferential statistics, using the SPSS software so that the research questions, objectives and research hypotheses could be addressed. According to Sekaran and Bougie (2016), the quantitative data must be coded, entered into a database and edited. Then, they should be transformed from initial numerical values to others. The ANOVA, one sample t-

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

test and independent sample t-tests were performed on the data. This type of test was appropriate because it tested the independent variables of the conceptual framework and the single dependent variable, namely EE. The one sample t-test was conducted to make inferences about the population by testing whether the mean score was significantly different from the scalar value.

ETHICAL CONSIDERATIONS

The study complied with the ethical standards of academic research. Ethical clearance was obtained from the relevant authorities in order to conduct the research at the Westville Campus of UKZN. The participants were informed that they would be participating voluntarily, and that no respondent would be forced to participate against his/her will. The respondents were informed about the study by means of a consent form. Confidentiality was ensured by the respondents being given the option of concealing their identity. In compliance with the policy of UKZN, the data will be kept for five years, to which only the researcher and the supervisor will have access.

FINDINGS

Research Question 1: Curriculum Alignment with Industry 4.0

Tables 2 in Appendices 1 present an overview of the one-sample statistics and one sample t-test performed on the variables. The one sample t-test was used to test if the average agreement score was significantly different from the central score of 3.5 as the test value (halfway between 1 and 6 – the Likert scale used). The results were interpreted as agreement if the results were significant and had a mean score > 3. Moreover, the results were interpreted as disagreement if the results were significant and the mean score was < 3.

The results of the data analysis of participants' responses related to the first research question indicated significance and scored a mean of >3, which inferred agreement. There was significant agreement that the courses taught the respondents to be critical thinkers ($M = 4.93$, $t [247] = 22.973$, $p < .0005$); to communicate effectively ($M = 4.80$, $t [247] = 21.287$, $p < .0005$); and to collaborate with others ($M = 5.02$, $t [247] = 29.859$, $p < .0005$). Moreover, the participants agreed that the courses taught them to think creatively ($M = 4.80$, $t [247] = 23.184$, $p < .0005$); to be adaptable to different situations ($M = 4.65$, $t [247] = 16.235$, $p < .0005$); to educate themselves using electronic means ($M = 5.06$, $t [247] = 30.921$, $p < .0005$); to take the lead/show initiative ($M = 4.65$, $t [247] = 17.833$, $p < .0005$); to use available infrastructure ($M = 4.98$, $t [(247] = 34.407$, $p < .0005$); to have relevant skills ($M = 4.32$, $t [247] = 12.520$, $p < .0005$); to analyse situations and information ($M = 4.85$, $t [(247] = 33.989$, $p < .0005$) and to solve problems, $M = 4.60$, $t [247] = 20.654$, $p < .0005$).

The results of the analysis of the participants' responses related to the first research question revealed neither a significant agreement, nor a significant disagreement to having enough knowledge and skills ($M = 3.54$, $t [247] = .374$, $p < .0005$) and to learning to analyse numerical data ($M = 3.45$, $t [247] = -539$). This infers that the students perceived that the curriculum had not enabled them to receive enough training in the knowledge and skills needed for Industry 4.0 and had not heightened their skills in analysing numerical data. The literature used in this study argues for the development of an adequate curriculum that will prepare students for Industry 4.0. Moreover, a former minister of the DHET has stated that the curriculum ought to be based on competences in the skillset demanded by Industry 4.0.

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Research Question 2: Relevance of Platforms for Industry 4.0

Tables 3 in Appendix 2, present an overview of the one-sample statistics and the one sample t-test performed on the variables, respectively. The following items resulted in significance with a mean >3, which inferred agreement with the statements. There was significant agreement concerning the relevance of platforms for Industry 4.0: I have used emerging technologies (M = 4.72, t [247] = 19.861, p < .0005); I acquired digital leadership skills (M = 3.79, t [247] = 19.861, p < .0005); the content taught was relevant (M = 4.10, t [247) = 7.943, p < .0005); I have gained technological skills (M = 4.71, t [247] = 21.888, p < .0005); and ICT platforms were adequate (M = 4.58, t [247] = 18.989, p< .0005). The responses to the statement about an enabling environment for digital innovation revealed neither significant agreement nor significant disagreement (M = 3.44, t [247] = -.638, p < .0005).

Research Question 3 - Technological Confidence

Tables 4 in Appendix 3 present an overview of the one-sample statistics and the one sample t-test performed on the items, respectively. The items that indicated significant results and a mean > 3 were used to infer that the respondents had technological confidence. They revealed significant confidence in the following technology: A word processor (M = 4.79, t [247] = 59.076, p < .0005); spreadsheet manipulation(M = 3.93, t [247] = 13.0313, p < .0005); doing presentations (M = 4.40, t [247] = 27.773, p < .0005); creating/manipulating/managing digital media (M = 3.88, t [247] = 11.862, p < .0005); Internet skills (M = 4.74, t [247] = 40.832, p < .0005); and using social media effectively (M = 4.70, t [247] = 43.457, p < .0005). On the contrary, the results indicated that students lacked confidence in the use of the following technological items: product development software (M = 2.55, t [247] = 5.322, p < .0005) and commercial software (M = 1.85, t [247] = 15.804, p < .0005).

Research Question 4: Industry Collaboration

Tables 5, which are attached as Appendix 4, represent an overview of the respective one sample t-tests. The mean of > 3.5 determined significant agreement and significant disagreement with this item concerning industry collaboration. Participants revealed significant agreement that the EE courses encouraged practical learning (M = 4.00, t [247] = 4.739, p < .0005) and provided exposure to the working environment (M = 4.69, t [247] = 21.619, p < .0005). However, the results revealed significant disagreement with the statements that courses provided strong support for practical learning (M = 3.01, t [247] = -5.546, p < .0005) and that university and industry collaboration was effective (M = 3.29, t [247] = -2.503, p < .0005) and led to training that bridged the gap between theory and practices (M = 3.51, t [247] = .146, p < .0005).

Research Question 5: Entrepreneurial Skills

Tables 6 depicted in Appendix 5 present an overview of the results for the one-sample t-test, which was conducted to test if the average agreement score was significantly different from the central score of 3.5 as the test value. The results indicated significant disagreement that the courses taught critical thinking (M = 5.08, t [247] = 34.798, p < .0005); data skills (M = 5.23, t [247] = 39.769, p < .0005); communication skills (M = 4.84, t [247] = 26.879, p < .0005); drafting business proposals and plans(M = 4.25, t [247] = 12.122, p < .0005) and marketing skills (M = 4.56, t [247] = 15.592, p < .0005). However, the results showed significant disagreement that the course taught data skills, (M = 3.35, t [247] = -1.767, p < .0005) and financial management/ planning skills (M = 3.55, t [247] = .625, p < .0005).

DISCUSSION OF FINDINGS

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Research Objective 1

To assess the perceptions of exit-level undergraduate students of whether there is curriculum alignment in EE in an HEI with the world of work requirements of Industry 4.0

The purpose of this objective was to ascertain whether the current HEI curriculum equips students with the skillset needed for success in the entrepreneurial world and labour market of Industry 4.0. The findings would assist the researcher in knowing whether the institution offered EE courses that ensured that students were competent for the future world of work. Ra et al. (2019) argue that the "current education systems are ill equipped to meet changing skill needs." The former Minister of the DHET, Dr Naledi Pandor, emphasised the need for employees to future-proof their careers by having different skills in areas, such as the Internet of Things and artificial intelligence. Hence, the need for South African HEIs to embrace new teaching methods and courses (Mzekandaba, 2019b).

The finding related to this objective revealed that while the courses offered in the institution enabled students to obtain useful skills to some extent, the students were of the view that there was still a need for these courses to be modified to focus more on key skills of Industry 4.0, such as data analytics, and to incorporate new technology enabling digital innovation.

Research Objective 2

To determine the perceptions of exit-level undergraduate students of whether the ICT platforms used in EE in an HEI equip them with technological know-how for Industry 4.0 work readiness

This objective was formulated to establish whether the students had been equipped with technological know-how by using the ICT platforms in the university, which would enable them to master the technology used in the world of work. This was based on the view that Industry 4.0 is characterised by speedy technological advancement influencing the digitalisation of almost every sector. The study findings indicated that the respondents had been adequately exposed to certain technological skills through their courses; however, the modules did not create an enabling environment for digital innovation. Furthermore, the findings revealed that the students were confident in using different ICT platforms; however, they lacked confidence in the use of specific technological applications, such as web development products and commercial software. This suggested that there is a need for the institution to focus on improving these particular aspects.

Ra et al. (2019) argue that future employees will experience the impact of technology on jobs and skills. Moreover, technology development will lead to job loss, and new industries will emerge, which will require employees to learn new technological skills. Therefore, future entrepreneurs and employees need to be exposed to various essential digital skills to future-proof their careers.

Research Objective 3

To determine the perceptions of exit-level undergraduate students of the effectiveness of industry collaboration during their EE in an HEI

This objective was formulated to ascertain whether the collaboration between the university and the industry concerning EE was effective. The findings would assist the researcher in understanding whether the collaboration led to practical learning as part of EE. The literature

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

suggests that the main reason for the ineffectiveness of EE is because there are no practical learning exercises for students.

The results of the data analysis revealed that the collaboration did not result in practical learning, and therefore it was ineffective as an entrepreneurship training platform. However, the results also revealed that when the collaboration between the university and industry involved organised conferences, for instance, the respondents gained exposure to the working environment.

Research Objective 4

To assess the perceptions of exit-level undergraduate students of Industry 4.0 entrepreneurial skills learnt through EE in an HEI

The purpose of this objective was to ascertain whether students learnt useful entrepreneurial skills through EE. The findings would assist the researcher in understanding whether the entrepreneurial skills taught would be useful in Industry 4.0. The findings revealed that the respondents had learnt key skills appropriate to Industry 4.0 skills, such as critical thinking, digital skills and transacting and communicating online. The importance of digital skills cannot be overemphasised as the basis of Industry 4.0 is digitalisation. However, the results revealed that the respondents were not confident in their data analysing and financial planning skills.

RECOMMENDATIONS

The following recommendations are suggested based on the results of the study.

Curriculum Alignment

Curriculum alignment is important in realising the institutions' objectives, and the study revealed that for HEIs to equip students for the future world of work, it is essential to offer courses that will meet the demands of Industry 4.0. Therefore, HEIs need to review the usefulness of the courses that they offer periodically. The institution should keep track of societal and economic trends so that necessary changes can be made. For instance, courses that do not meet the requirements of Industry 4.0 should be done away with. Moreover, important technical skills, such as coding, should be included in EE, as students might not have taken technical courses. The institution could conduct satisfaction surveys whereby the opinions of students concerning the courses offered could be obtained.

Technological know-how

The digital transformation of every industry requires that future employees have sound technological knowledge. The outbreak of the COVID-19 led to an inevitable need for the fast adoption of digital technology, and in the realm of education, led to a shift from traditional methods to online learning. The study findings revealed that the majority of the students disagreed that the courses in the institution created an enabling environment for digital innovation. It is, therefore, recommended that the HEIs find ways to ensure that digital innovation is encouraged and feasible with the available resources. It is also recommended that they invest more in digital learning to enhance the technological know-how of students. HEIs

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

managed to find remote e-learning solutions to COVID-19 in a short time, which indicates that they would be able to adapt to preparing students for Industry 4.0. Being well-versed in technology will undoubtedly lead students to having a greater chance of acquiring employment.

Industry Collaboration

The results from the data analysis revealed that the collaboration between the university and industry did not lead to practical learning. Therefore, HEIs should ensure that EE includes practical learning in the form of vocational training, with appropriate equipment, human resources and facilities. In addition, funding should be use to enhance the practical side of entrepreneurship. Rather than only having lectures, seminars and conferences for EE, project-based collaborative learning should be provided to yield better-skilled future entrepreneurs and bridge the gap between theory and real-life application.

Entrepreneurial skills

The findings indicated that students had been equipped with certain entrepreneurial skills, but many indicated that they had not acquired key Industry 4.0 entrepreneurial skills, such as analysing data. It is, therefore, recommended that the institution evaluate the kind of entrepreneurial skills that will be required in the future, which are appropriate for Industry 4.0, and review whether current EE provides adequate training for students to develop these skills.

Future Research

Although Industry 4.0 has become a focus of research in recent times, there is limited literature on EE in the era of Industry 4.0. The researcher recommends that future studies conduct follow-up investigations into the impact of EE on the success of students who become entrepreneurs in a world dominated by Industry 4.0. It is also recommended that future research investigates and compares the impact of Industry 4.0 on EE in both universities and TVET colleges to assess the degree of experiential learning in both types of institutions.

CONCLUSION

The descriptive and inferential statistics generated by the data analysis were able to provide answers to the research questions and achieve the specific study objectives as well as the overall aim of the study. The research findings showed that the HEI under study had met some of the requirements for equipping students with a skillset for Industry 4.0 through the EE courses offered, ICT platforms and collaboration with industry. However, the findings indicated that the students felt that they had not received enough knowledge and skills to be ready for the working world of Industry 4.0. They were not confident in their ability to use web development tools, analyse data, use commercial software and participate in digital innovation. Based on these findings, recommendations were made for improving the development of these skills in the EE courses. The HEI under study and others could follow these recommendations to rectify challenges identified by the study participants.

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Table 2

ONE SAMPLE STATISTICS OUTPUT FOR CURRICULUM ALIGNMENT AND ONE SAMPLE T-TEST OUTPUT FOR CURRICULUM ALIGNMENT

ONE SAMPLE STATISTICS

One sample statistics output for the relevance of platforms					**One sample t-test output for the relevance of platforms (Test value = 3.5)**					
										95% confidence interval of the difference
	N	**Mean**	**Std. Devn**	**Std. error mean**	**T**	**DF**	**Sig (2-tailed)**	**Mean diff**	**Lower**	**upper**
1.1…to be a critical thinker	248	4.93	.981	.062	22.973	247	.000	1.431	1.31	1.55
1.2… to communicate effectively	248	4.80	.964	.061	21.287	247	.000	1.302	1.18	1.42
1.3… to collaborate with others on projects	248	5.02	.800	.051	29.859	247	.000	1.516	1.42	1.62
1.4… to think creatively when working on a project	248	4.80	.885	.056	23.184	247	.000	1.302	1.19	1.41
1.5… to be adaptable to different changing situations	248	4.65	1.111	.071	16.235	247	.000	1.145	1.01	1.28
1.6… to educate myself using electronic means and on-line media	248	5.06	.793	.050	30.921	247	.000	1.556	1.46	1.66

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

1.7… to take the lead/initiative and not always be a follower	248	4.65	1.018	.065	17.833	247	.000	1.153	1.03	1.28
1.8… to use available infrastructure to find out what I need to know	248	4.98	.679	.043	34.407	247	.000	1.484	1.40	1.57
1.9 …enough knowledge and skills to be ready for the working world of Industry 4.0	248	3.54	1.527	.097	.374	247	.708	.036	-.15	.23
1.10… relevant skills to equip me for Industry 4.0	248	4.32	1.030	.065	12.520	247	.000	.819	.69	.95
1.11… to analyse situations and information	248	4.85	.624	.040	33.989	247	.000	1.105	1.00	1.21
1.12… to solve problems in an innovative way	248	4.60	.842	.053	20.654	247	.000	1.105	1.00	1.21
1.13… to analyse numerical data	248	3.45	1.413	.090	-.539	247	.590	-.048	-.23	.13

Table 3

ONE SAMPLE STATISTICS OUTPUT FOR THE RELEVANCE OF PLATFORMS AND ONE SAMPLE T-TEST OUTPUT FOR THE RELEVANCE OF PLATFORMS

ONE SAMPLE STATISTICS

One sample statistics output for the relevance of platforms		**One sample t-test output for the relevance of platforms (Test value = 3.5)**				
						95%

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

										confidence interval of the difference
	N	**Mean**	**Std. Devn**	**Std. error mean**	**T**	**DF**	**Sig (2-tailed)**	**Mean diff**	**Lower**	**upper**
2.1.1…I have used emerging technologies that will equip me for the workplace and the waves of digital innovation	248	4.72	.969	.062	19.861	247	.000	1.222	1.10	1.34
2.1.2…I acquired digital leadership skills including collaboration, seeking and learning new knowledge and collaboration tools like Office 365 tools, yammer, teams, delve etc.	248	3.79	1.392	.088	3.330	247	.001	294	.12	.47
2.1.3…the content that I am taught is relevant to ICT I will need to work in Industry 4.0	248	4.10	1.199	.076	7.942	247	.000	.605	.45	.75
2.1.4…I have gained technological skills that will equip me adequately for career readiness	248	4.71.	.870	.055	21.888	247	.000	1.210	1.10	1.32
2.1.5…the course(s) I have taken created an enabling environment for digital	248	3.44	1.593	.101	-638	247	.524	-065	-26	.13

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

innovation										
2.1.6…the ICT platform I was exposed to/learned about is relevant to work in Industry 4.0	248	4.58	.896	.057	18.989	247	.000	1.081	.97	1.19

Table 4

ONE SAMPLE STATISTICS OUTPUT FOR TECHNOLOGICAL CONFIDENCE AND ONE SAMPLE TEST OUTPUT FOR TECHNOLOGICAL CONFIDENCE

ONE SAMPLE STATISTICS

One sample statistics output for technological confidence					**One sample t-test output for technological confidence (Test value = 3)**					
										95% confidence interval of the difference
	N	**Mean**	**Std. Devn**	**Std. error mean**	**T**	**DF**	**Sig (2-tailed)**	**Mean diff**	**Lower**	**upper**
2.2.1…Word processors e.g. WORD	248	4.79	.478	.030	59.076	247	.000	1.794	1.73	1.85
2.2.2… Spreadsheet manipulation e.g. EXCEL	248	3.93	1.127	.072	13.013	247	.000	.931	.79	1.07
2.2.3… Doing presentations using e.g. PowerPoint	248	4.40	.793	.050	27.773	247	.000	1.399	1.30	1.50
2.2.4… Creating/ manipulating/ managing digital media e.g. audio files, graphics	248	3.88	1.167	.074	11.862	247	.000	.879	.73	1.02
2.2.5… Internet skills e.g.	248	4.74	.672	.043	40.832	247	.000	1.742	1.66	1.83

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

online communication (emailing etc.) using search engines										
2.2.6…product development software e.g. using web development tools such as WordPress, Adobe photoshop etc.	248	2.55	1.325	.084	-5.322	247	.000	-.448	-.61	-.28
2.2.7…using commercial software e.g. SPSS	248	1.85	1.149	.073	-15.804	247	.000	-.153	-1.30	-1.01
2.2.8…utilising social media effectively e.g. LinkedIn, Twitter, Facebook etc.	248	4.70	.617	.039	43.457	247	.000	1.702	1.62	1.78

Table 5

ONE SAMPLE STATISTICS OUTPUT FOR INDUSTRY COLLABORATION AND ONE SAMPLE TEST OUTPUT FOR INDUSTRY COLLABORATION

ONE SAMPLE STATISTICS

One sample statistics output for industry collaboration					**One sample t-test output for industry collaboration (Test value = 3.5)**					
										95% confidence interval of the difference
	N	**Mean**	**Std. Devn**	**Std. error**	**T**	**DF**	**Sig (2-tailed)**	**Mean diff**	**Lower**	**upper**

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

				mean						
3.1…The course I'm doing encourages practical learning	248	4.00	1.648	.105	4.739	247	.000	.496	.29	.70
3.2… There is strong support for practical learning to take place within industry-academic collaborations	248	3.01	1.397	.089	-5.546	247	.000	-.496	-.67	-.32
3.3… The university and industry collaboration in my school is effective as an entrepreneurship training platform	248	3.29	1.345	.085	-2.503	247	.013	-214	-.38	-.05
3.4… The course I'm taking provides enough training to bridge the gap between theory and real-life applications	248	3.51	1.307	.083	.146	247	.884	.013	-.15	.18
3.5… industry and university collaborations, such as organized conferences and seminars have enabled me to gain exposure to	248	4.69	.869	.055	21.619	247	.000	1.194	1.8	1.30

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

the working environment										

Table 6
ONE SAMPLE STATISTICS OUTPUT FOR ENTREPRENEURIAL SKILLS AND ONE SAMPLE T-TEST OUTPUT FOR ENTREPRENEURIAL SKILLS

ONE SAMPLE STATISTICS

One sample statistics output for entrepreneurial skills					**One sample t-test output for entrepreneurial skills (Test value = 3.5)**					
										95% confidence interval of the difference
	N	**Mean**	**Std. Devn**	**Std. error mean**	**T**	**DF**	**Sig (2-tailed)**	**Mean diff**	**Lower**	**upper**
4.1… critical thinking	248	5.08	.715	.045	34.798	247	.000	1.581	1.49	1.67
4.2…digital skills e.g. transacting and communicating online	248	5.23	.685	.043	39.769	247	.000	1.730	1.64	1.82
4.3…data skills e.g. analyzing data	248	3.35	1.329	.084	-1.767	247	.078	-.149	-.32	.02
4.4…communication skills	248	4.84	.787	.050	26.879	247	.000	1.343	1.24	1.44
4.5…drafting of business proposals and plans	248	4.25	.974	.062	12.122	247	.000	.750	.63	.87
4.6…financial management planning skills	248	3.55	1.321	.084	.625	247	.533	.052	-.11	.22
4.7…marketing skills	248	4.56	1.067	.068	15.592	247	.000	1.056	.92	1.19

REFERENCES

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32*(4), 665-683.

Amadi-Echendu, A.P., Phillips, M., Chodokufa, K., & Visser, T. (2016). Entrepreneurial education in a tertiary context: A perspective of the university of South Africa. *International Review of Research in Open and Distributed Learning, 17*(4), 21-35.

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Ankrah, S., & Omar, A.T. (2015). Universities–industry collaboration: A systematic review. *Scandinavian Journal of Management, 31*(3), 387-408.

Biney, I.K. (2019). Unearthing entrepreneurial opportunities among youth vendors and hawkers: challenges and strategies. *Journal of Innovation and Entrepreneurship, 8*(1), 1-14.

Boldureanu, G., Ionescu, A.M., Bercu, A.M., Bedrule-Grigoruță, M.V., & Boldureanu, D. (2020). Entrepreneurship education through successful entrepreneurial models in higher education institutions. *Sustainability, 12*(3), 1267.

Chimucheka, T. (2013). The impact of entrepreneurship education on the establishment and survival of small, micro and medium enterprises (SMMEs). *Journal of Economics, 4*(2), 157-168.

Chimucheka, T., 2014. Entrepreneurship education in South Africa. *Mediterranean Journal of Social Sciences, 5*(2), 403-403.

Cui, J., Sun, J., & Bell, R. (2021). The impact of entrepreneurship education on the entrepreneurial mindset of college students in China: The mediating role of inspiration and the role of educational attributes. *The International Journal of Management Education, 19*(1), 100296.

DEFSA, 2017. Decolonizing Thought Practices with Discussion Approaches for Built Environment Educators. DEFSA contact details, p.213.

EDHE. (2020). The National University Entrepreneurship Ecosystem Baseline Report. USAf, Hatfield. Available at: https://edhe.co.za/wp-content/uploads/National-University- Entrepreneurship-Ecosystem-Baseline-study__Interactive-Report-Feb-2020.pdf [Accessed: 04 Feb. 2021]

Ekekwe, N., (2010). Does an entrepreneur need a college degree? Harvard Business Review. Available at: https://hbr.org/2010/12/does-an-entrepreneur-need-a-co.

Elmes, J., (2017). Six significant challenges for technology in higher education in 2017. Times higher education. [Online]. Available at: https://www.timeshighereducation.com/ features/six-significant-challenges-technology-higher-education-2017.

Gautam, M.K., Singh, D., & Kumar, S. (2015). Entrepreneurship education: concept, characteristics and implications for teacher education.

Ghina, A. (2014). Effectiveness of entrepreneurship education in higher education institutions. *Procedia-Social and Behavioral Sciences, 115*, 332-345.

Ghina, A., Simatupang, T. M., & Gustomo, A. (2017). The relevancy of graduates'competencies to the effectiveness of entrepreneurship education: a case study at sbm itb–indonesia. *Journal of Entrepreneurship Education, 20*(1).

Ghobakhloo, M. (2020). Industry 4.0, digitization, and opportunities for sustainability. *Journal of Cleaner Production, 252*, 119869.

Hahn, D., Minola, T., Van Gils, A., & Huybrechts, J. (2017). Entrepreneurial education and learning at universities: exploring multilevel contingencies. *Entrepreneurship & Regional Development, 29*(9-10), 945-974.

Hopkins, W., (2008). Quantitative Research Design. Research Institute for Sport and Exercise Sciences, p.1. Auckland.

Ierapetritis, D.G. (2019). Discussing the role of universities in fostering regional entrepreneurial ecosystems. *Economies, 7*(4), 119.

Israel, G.D. (2013). Determining Sample Size. Institute of Food and Agricultural Sciences (IFAS), University of Florida, PEOD-6, 1-5.

Kaiser, H.F. (1974). An index of factorial simplicity. *Psychometrika, 39*(1), 31-36.

Kanonuhwa, M., Rungani, E.C., & Chimucheka, T. (2018). The association between emotional intelligence and entrepreneurship as a career choice: A study on university students in South Africa. *SA Journal of Human Resource Management, 16*(1), 1-9.

Kunttu, L. (2017). Educational involvement in innovative university–industry collaboration. *Technology Innovation Management Review, 7*(12).

Mkwanazi, S., & Mbohwa, C. (2018). Implication of the 4th Industrial Revolution on Entrepreneurship Education. In Proceedings of the International Conference on Industrial Engineering and Operations Management Washington DC, USA.

Moylan, T., Gallagher, N., & Heagney, C. (2016). Exploratory Studies on the use of Experiential Learning in Entrepreneurship Education. *All Ireland Journal of Higher Education, 8*(1).

Mzekandaba, S., (2019). SA millennials fear impact of Industry 4.0 on jobs. IT Web. [Online]. Available at: https://www.itweb.co.za/content/6GxRKMY8bJQ7b3Wj [Accessed: 24 Jul. 2019].

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.

Nakagawa, K., Takata, M., Kato, K., Matsuyuki, T., & Matsuhashi, T. (2017). A university–industry collaborative entrepreneurship education program as a trading zone: the case of Osaka university. *Technology Innovation Management Review, 7*(6).

Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis.

Norström, P. (2014). How technology teachers understand technological knowledge. *International Journal of Technology and Design Education, 24*(1), 19-38.

Pillay, K., Ori, A., & Merkofer, P. (2017). Industry 4.0: Is Africa ready for digital transformation. A Case Study of Deloitte South Africa-White Paper Report.

Preston, J. (2017). Entrepreneurs don't need higher education I'm proof. Virgin. [Online]. Available at: https://www.virgin.com/entrepreneur/richard-branson-entrepreneurs-dont-need-higher-education-im-proof [Accessed: 13 Jul. 2019].

Ra, S., Shrestha, U., Khatiwada, S., Yoon, S.W. and Kwon, K., (2019). The rise of technology and impact on skills. *International Journal of Training Research, 17*(sup1), 26-40.

Radipere, S. (2012). South African university entrepreneurship education. *African Journal of Business Management, 6*(44), 11015-11022.

Sá, M.J., & Serpa, S. (2018). Transversal competences: Their importance and learning processes by higher education students. *Education Sciences, 8*(3), 126.

Schwab, K. (2016). The Fourth Industrial Revolution: what it means, how to respond. World Economic Forum. In World Economic Forum. https://www. weforum. org/agenda/2016/01/thefourth-industrial-revolution-what-it-meansand-how-to-respond, Accessed July (Vol. 21, p. 2019).

SEDA. (2018). SMME quarterly update 1st quarter 2018. [Online]. Available at: http://www.seda.org.za/Publications/Publications/SMME%20Quarterly%202018-Q1.pdf.

Sousa, M.J. & Almeida, M.D.R. (2014). Entrepreneurial skills development. *Recent Advances in Applied Economics*, 135-139.

Thompson, C. (2018). The case for the six-point Likert scale. Quantum Workplace.

Tshiredo, L.L. (2013). The impact of the curriculum change in the teaching and learning of science: A case study in under-resourced schools in Vhembe district (Doctoral dissertation).

van der Westhuizen, T., & Nhleko, Y. (2021). Dichotomy and Violent Student Protests: Perceptions From Students. In Transdisciplinary Perspectives on Risk Management and Cyber Intelligence *IGI Global, 29*(4),351-382.

Van der Westhuizen, T. (2019). South African Undergraduate Students' Access to Entrepreneurial Education and Its Influence on Career Choice: Global Considerations for Developing Countries. *In Global Considerations in Entrepreneurship Education and Training*, 232-252. IGI Global.

Wei, X., Liu, X., & Sha, J. (2019). How does the entrepreneurship education influence the students' innovation? Testing on the multiple mediation model. *Frontiers in Psychology, 10*, 1557.

Wijngaards-de Meij, L., & Merx, S. (2018). Improving curriculum alignment and achieving learning goals by making the curriculum visible. *International Journal for Academic Development, 23*(3), 219-231.

Xing, B., & Marwala, T. (2018). Implications of the Fourth Industrial Age for Higher Education.[Online]. Retrieved from: The_Thinker_Issue_73_Third_Quarter_2017.

Xu, M., David, J.M., & Kim, S.H. (2018). The fourth industrial revolution: Opportunities and challenges. *International Journal of Financial Research, 9*(2), 90-95.

Zezulka, F., Marcon, P., Vesely, I., & Sajdl, O. (2016). Industry 4.0–An Introduction in the phenomenon. IFAC-*PapersOnLine, 49*(25), 8-12.

Citation Information: Nhleko, Y., & Westhuizen, T.V. (2022). The role of higher education institutions in introducing entrepreneurship education to meet the demands of industry 4.0. *Academy of Entrepreneurship Journal, 28*(S1), 1-23.