Architecture_MPS

Article

Fostering Innovative Entrepreneurial Design Students: Exploring the Relationship between Innovation Characteristics and Attitudes towards Entrepreneurship in South African Design Students

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Peer review:
This article has been peer-reviewed through the journal's standard double-blind peer review, where both the reviewers and authors are anonymised during review.

Open access:
Architecture_MPS is a peer-reviewed open-access journal.

Abstract

Innovation and entrepreneurship have been increasingly recognized as drivers of socio-economic development. The term innovative entrepreneur is a relatively new one and could be necessary for economic growth during a challenging and changing global environment. Previous studies have found that limited job opportunities for architectural graduates has meant that many have changed careers while others have had to innovate to survive within the profession. Therefore, architects must transform and innovate to survive and so should our curriculum. Learning how to train these innovative entrepreneurs effectively is key. Innovation can be taught and result in improved entrepreneurial skills that develop better entrepreneurial competence. The challenge is for educators, researchers and policymakers to

create curricula that will impact design students to foster innovative entrepreneurial graduates and lead to eventual growth in the economy. This article is the result of a study that explored and measured the characteristics and dynamics of an innovative entrepreneur in design students. The sample consisted of South African students from the architecture, interior, graphics and multimedia disciplines. The study is the first step in understanding what behaviours and attitudes are present in African innovative entrepreneurs. The findings suggest that there is a relationship between entrepreneurial attitudes and innovation characteristics and behaviours. These can be nurtured through a dynamic design curriculum and increase a design student's propensity to become a better designer within a thriving economy.

Keywords: innovation; entrepreneurship; design; students; architecture

Introduction

The current business environment is constantly changing. New technologies and globalization have meant greater opportunities in business and economic development. However, these rapid changes have also shaped a turbulent, crowded and highly competitive market.[1] African economies continue to be constrained and challenged by threats such as poverty, social deprivation and large income gaps that create inequality.[2] As a result, people in these economies are being pushed towards entrepreneurship out of necessity, without any entrepreneurial education or a predisposition towards business ownership and commercial endeavours.[3] 'Creativity, innovation and entrepreneurship have been increasingly recognized as engines to foster an entrepreneurial culture, driving forward socio-economic development.'[4] The traditional career path of working oneself up the ladder in a large organization is outdated. Entrepreneurship is a great force for economic growth and societal progress.[5] Job creators as opposed to job pursuers are becoming a necessity.[6]

A 2016 census found a 26.5 per cent unemployment rate in South Africa,[7] a figure that highlights the limited employment opportunities for South Africans. Entrepreneurship has become an important equalizer, helping to bridge the gap and providing people with opportunities that historically were not accessible.[8] Adding to this, communities that host institutions that promote entrepreneurial behaviour can enjoy trickle-down benefits.[9] In this current global economy, it has also become increasingly necessary to think in innovative ways to earn money.[10] Currently the fast-paced, changing business environment requires innovation for survival.[11] Innovation can play an essential role in fostering the economy and changing industries to create and enhance lifestyles. Innovation has developed as a significant tool to facilitate positive change in a competitive and increasingly turbulent business environment.[12] In the past decade innovation has received increasing global attention as the best path to development and prosperity.[13] Both entrepreneurship and innovation could drive the development of today's society to produce entrepreneurial innovators.

'Economic realities such as downsizing, labour-force shifts, and restructuring mean that the path from higher education to sustainable employment is less direct than in previous years.'[14] Tertiary education is no longer a guarantee for employment.[15] As a result, there is a renewed interest in understanding how education can facilitate innovative entrepreneurship to provide graduates with a competitive advantage.[16] Governments in emerging countries believe that entrepreneurship and innovation can be taught and should become the necessary catalyst for future entrepreneurial activity within a growing economy.[17] Universities have started to develop programmes, centres and institutes that focus on nurturing innovative entrepreneurial thinking.[18]

Creative thinking and the ability to be innovative can affect entrepreneurial competencies and attitudes and may vary depending on the educational paradigm.[19] Therefore, it is necessary to understand the relationship between innovation and entrepreneurship in undergraduate students so that curricula can be adapted and developed to facilitate gaps in the current education system.

A study by the Federal Reserve Bank of New York (2009–13) revealed that unemployment among recent US college graduates was significantly high. For the purposes of their study a college graduate was considered unemployed if they were working in a job that did not normally require a bachelor's degree. The unemployment rate in the USA for recent college graduates averaged 4.3 per cent, compared to 2.9 per cent for past college graduates up until 2013. The results imply that finding a job is more difficult for those who have recently graduated versus those who graduated a couple of years previously. There is concern that recent graduates are finding themselves underemployed or working in occupations that do not require a college degree.[20]

A separate study carried out by Georgetown University's Center on Education and the Workforce (2012), based on data from the 2009 and 2010 Census Bureau's American Community Survey, found that American college graduates with a bachelor's degree in architecture (13.9 per cent), arts (11.1 per cent) and humanities (9.4 per cent) experienced significantly higher rates of unemployment. Conversely those with engineering and business degrees progressed well. Interestingly, both business and engineering students follow curricula that explore knowledge and skills in innovative entrepreneurship as opposed to architecture and the arts. Their earnings were 50 per cent higher than the incomes of those who majored

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in the lowest-employed disciplines.[21] A follow-up study by the American Institute of Architects and the National Council of Architectural Registration Boards (2012) found that out of 10,000 survey responses, 78 per cent reported that they were employed as professional architects.[22] Although the unemployment rate is lower than in previous studies, architecture still has one of the highest unemployment rates among college graduates in the USA.

The UK reports similar unemployment rates. Results of an unemployment study carried out by Building Design in the UK found that 22 per cent of architects were unemployed. The survey was carried out over two weeks in February 2013 and included professional and graduate architects in training. Forty-five per cent of the professional architects were self-employed, highlighting a trend towards more freelance work within the profession. Among graduates in training 44 per cent were unemployed, 20 per cent were employed in an architecture-related business, 18 per cent were employed in a non-architecture-related business, and a further 18 per cent were self-employed, meaning only 38 per cent of graduates were making it into the profession. Among the graduates in training who were not employed by a practice: 69 per cent were doing non-related architectural work; 8 per cent were running their own architecture practice; 9 per cent were doing freelance work for architecture practices; 10 per cent were freelancing for other construction-industry related businesses; and 4 per cent were teaching architecture.[23] These figures show an inclination among professional architects in the UK towards innovative entrepreneurship moving beyond the field of architecture.

To date there is no updated study on employment rates for architecture graduates in the UK or the USA, and no similar studies have been carried out in South Africa. What is interesting about these studies is that, for numerous reasons, many practising and recently graduating architects have shifted from a career in architecture to pursue employment elsewhere. A commonly held belief often expressed to students and young architects from experienced professionals is that 'recession is – to an extent – good for young architects. The logic goes that lower employment rates force graduates to innovate and find robust ways to survive in the profession which serve them for years to come'.[24] This statement applies more than ever as architects must transform and innovate to survive.

One place to start to transform these issues is in the education system. There is an increasing demand for students to graduate as innovative contributors to the global economy. Educational institutes need to develop curricula that enhance students' innovative and entrepreneurial abilities to prepare them for prosperous careers.[25]

Innovative Entrepreneurs

Innovation and entrepreneurship have been increasingly recognized as drivers of socio-economic development. The term *innovative entrepreneur* is a relatively new one, and little in the way of literature or definition exists to explain it. Although there are many similarities between entrepreneurs and innovators, being an entrepreneur does not necessarily mean you are innovative. Innovation refers to creativity and experimentation, which are also key traits of entrepreneurs.[26] Innovation occurs at various stages during the technical, managerial, business and financial parts of the entrepreneurial process.[27] Innovators, much like entrepreneurs, understand the current opportunities, challenges and direction that need to be taken to implement a successful venture by gaining support from a variety of networks to create ideas that become effective realities.[28]

Innovation is similar to the entrepreneurial process, and entrepreneurship is often defined in terms of innovation. Therefore, innovation and entrepreneurship are complementary. Innovative entrepreneurs provide a novel business (product or method) that is new to the marketplace. They can be understood as people who build a new business from scratch based on an original idea or who offer something unique within an existing network to fix a problem. Put simply, innovative entrepreneurs act differently to think different and, in the end, they make a difference.[29] What is clear is that innovative entrepreneurs need innovation to transform entrepreneurship. What is clear from the research is that innovative entrepreneurs could be necessary for economic growth during a challenging and changing global environment. A variety of factors interact to cultivate a successful innovative entrepreneur.

Scholars have recognized that innovative practices and entrepreneurial competencies can be developed from the earliest years.[30] The impact of a holistic and well-integrated design education has been recognized as a crucial factor in fostering a student's understanding and eventual attitude towards innovative entrepreneurship and therefore solving the unemployment gap.[31] Innovation can be taught and can result in improved entrepreneurial skills that develop better entrepreneurial competence.[32] Attitudes and behaviours are open to change; therefore, opportunities exist for educators and practitioners to affect innovative entrepreneurship by identifying and influencing the relevant courses. Consequently, it is necessary to understand what role pedagogical practices play in the development of students and how this can eventually lead to students becoming entrepreneurial innovators.[33] The skills required to face the challenges of the next century will require collaboration among disciplines and multidisciplinary thinking.

The Innovators' DNA Model

One of the most prominent and promising innovative entrepreneurial models is the *Innovator's DNA model*. Research by Dyer, Gregersen and Christensen defined an innovative entrepreneur as someone who derives an original idea or who creates novel endeavours that offer a unique value proposition to start a venture.[34] In their extensive study, they found that previous research suggests that only a small percentage of all entrepreneurs start innovation ventures,[35] meaning that an innovative entrepreneur is not common among entrepreneurs and is a specific and unique person. This model asserts that certain critical behaviours in the process of innovation can determine the success or failure of an innovative entrepreneur. The model was validated and tested on 6,000 business professionals from 75 countries on 72 successful and unsuccessful innovative entrepreneurs with 310 executives. Five hundred of these 6,000 were innovators, and 100 were inventors of revolutionary products and services.[36] The research identified five specific discovery skills which, the authors argue, underpin innovative thinking. They proposed that these four behavioural skills and one cognitive skill activate the connections that are the catalysts for innovative ideas.[37] These are:

1. *Questioning*: a willingness to ask provocative questions that challenge the status quo (their own and others' assumptions) to provoke possibilities, connections and insights.
2. *Observing*: regularly viewing the world through intense observations in new situations as well as familiar encounters which often trigger fresh ideas.
3. *Networking*: a social behaviour that actively forms and maintains networks of people with various perspectives and ideas who provide original insights.
4. *Experimenting*: the need for innovators to frequently take calculated risks, actively experiment and be prepared to fail and try again.
5. *Associating*: a cognitive process whereby individuals connect disparate ideas in new ways to create novel possibilities across apparently unconnected disciplines, problems, ideas or fields.

The research reinforced the importance of these constructs for the business world and packaged them in an accessible and catchy format. Researchers used the DNA metaphor as a way of explaining these core constructs in innovation and how they may be structured to enhance innovation. Previous innovation models propose a combination of traits and behaviours, suggesting that innovation and entrepreneurship are innate and therefore cannot be learned. The innovator's DNA model defies this by arguing that a willingness to change your behaviour can increase your potential to become an innovative entrepreneur, 'but you must CHOOSE to do so'.[38] By suggesting that mastery of the five skills can teach anyone how to become an innovative entrepreneur, the authors present an opportunity to educators.[39] For this reason, these five discovery skills have been used by the authors of this article to measure the innovative behaviours of design students in South Africa.

The Entrepreneurial Attitudes and Innovative Characteristics (EAIC) Study

An extensive literature review defines and discusses the issues around innovation and entrepreneurship to show how in recent years these concepts have merged into *innovative entrepreneurship*. The purpose of this study was to further understand the dynamics of an innovative entrepreneur by

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exploring whether there is a relationship between innovation characteristics and entrepreneurial attitudes in South African design students. The next step was to operationalize these variables to test the significance of the relationship and understand more specifically which characteristics and attitudes are related to innovative entrepreneurship. This study was a non-experimental, quantitative research design (questionnaires). The research was concerned with gathering objective data that has not been influenced or manipulated.

As heads of departments in architecture and interior design at both public and private institutions, we tested our architecture, interior design, graphics and multimedia students for entrepreneurial attitudes and innovative characteristics (EAIC). The sample consisted of full-time, degree-seeking, undergraduate architecture students (48.36 per cent) from the University of Johannesburg (UJ) and undergraduate interior design (29.58 per cent), graphics (13.62 per cent) and multimedia (8.45 per cent) design students from the Greenside Design Center (GDC) in Johannesburg. The sample was made up of first-year (36.67 per cent), second-year (37.62 per cent) and third-year (19.52 per cent) students.

Findings

Previous studies used predominantly business students from developed countries and found a relationship between innovation and creativity. Our study exposed similar findings among design students as the statistical results highlighted a significant positive relationship between certain innovation characteristics and entrepreneurial attitudes. However, many of the innovation characteristics did not correlate with the entrepreneurial measures in our study.

Correlations between Innovation and Entrepreneurial Variables

Efficacy is the ability to produce an intended result. It is about action and doing. Efficacy results were not surprising as four innovation characteristics correlated with entrepreneurial efficacy. These were questioning, associating, networking and experimenting. These all involve actions or active participation such as engaging, critical and divergent thinking, socializing and testing. Observing, a passive behaviour, was the only innovation characteristic that does not correlate with either entrepreneurial efficacy or motivation. The results clearly reflect that efficacy is related to the innovation characteristics that encourage proactive behaviours. This suggests that positive attitudes towards entrepreneurial efficacy are more likely to develop in proactive students who enjoy doing.

The only innovation characteristic that correlated with entrepreneurial motivation was networking, a social and interactive behaviour that cannot be carried out in isolation. The nature of motivation and networking is very similar. An individual with the motivation and skills to network successfully is more likely to put themselves out there. Motivation and networking go hand in hand.

Interestingly, the literature review does not align with the statistical findings. An extensive literature review revealed that only experimenting appears to have a relationship with entrepreneurship. Much of the literature reflects the need for innovative entrepreneurs due to a struggling global economy, especially in developing countries. However, when students were asked whether they felt 'the country needs more entrepreneurs' and if they felt 'obligated' to be an entrepreneur because of this, only half the students agreed or strongly agreed with this statement, suggesting that the students' views differ from those of academics and economists.

Previous studies found that family influence and a history of entrepreneurship in the family had a significant relationship with a student's intentions to start a business. However, the results of this study found that students scored lowest on the two statements about the influence of family in terms of expectations; having a 'strong sense of duty to take over an existing family-related business'; and being around an entrepreneurial family. This suggests that perhaps the influence of family on entrepreneurship might be dependent on other aspects such as the country, socio-economics or family dynamics.

Correlations of Biological Groupings

In terms of age, there were no significant correlations with any of the seven variables. There were no significant differences between disciplines for all seven variables. The study had similar findings

to previous studies and found that males had higher mean for entrepreneurial motivation than females. For innovation, questioning was the only other variable to have overall higher male mean scores than females. For gender, there were no significant differences among the other characteristics. However, there was a significant difference in entrepreneurial motivation for race (Figure 1). Interestingly, White students scored the lowest and Black students had the highest mean score. This could be because people from an ethnic minority background were previously disadvantaged and now feel a stronger motivation to prove themselves or that today's policies, such as Black Economic Empowerment[40], mean that non-White students now have more opportunity and access to start a business and therefore are more motivated.
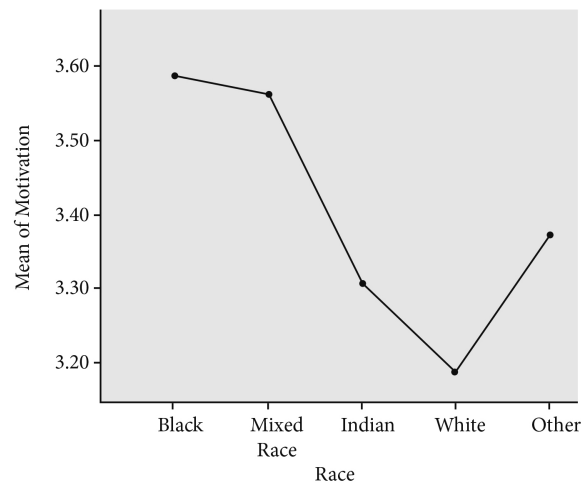

Figure 1   Mean of motivation versus race results in South African design students (Source: Authors, 2020).

There were significant differences with respect to mean scores for entrepreneurial motivation and efficacy in the year of study. Third-year students had the lowest scores for entrepreneurship (motivation and efficacy) while first-year students scored highest (Figure 2). This seems contrary to what educators think about undergraduate degrees. The perception is that older students would be more prepared to start a business. However, this study shows that as they continue studying, their entrepreneurial motivation and efficacy decreases. This could be because they are more aware of the reality of the industry and this has possibly made them more cautious to start a business, or that the educational programme is not set up to motivate and encourage students to become entrepreneurs; and therefore, as they progress through the years, their entrepreneurial motivation and efficacy decreases.

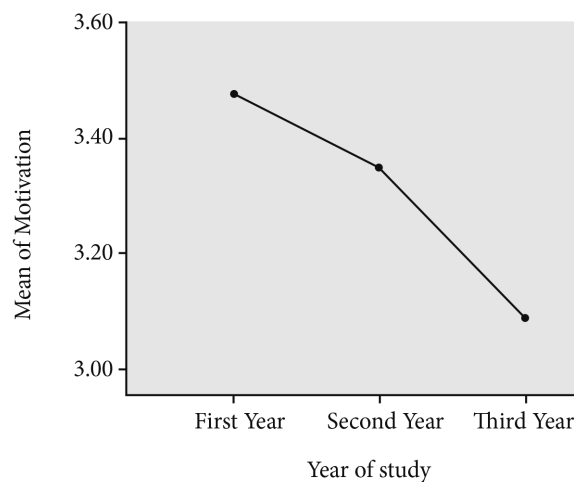**Figure 2**   Mean of motivation versus year of study results in South African design students (Source: Authors, 2020).

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The EAIC study is a first step in understanding which characteristics and attitudes make an innovative entrepreneur. Positive associations suggest there is a relationship which, if nurtured, could increase one's propensity to become a successful innovative design entrepreneur. The study precludes definitive conclusions about cause-and-effect relationships among the variables; we can only speculate as to the differences found in gender, race and year of study. Therefore, generalizations about the real world must be carried out with caution.

Intervention

As heads of departments in architecture and interior design at both public and private institutions, we have re-designed educational programmes to promote innovation. Through a series of workshops, the staff body of the institutions developed a series of different approaches to the curriculum to make it more dynamic. We set out in search of a progressive pedagogical ideal which could ultimately be measured. When reshaping curriculum, we need to have a human-centred approach and we need to be cognizant of the net cultural effect. To reimagine the traditional understanding of entrepreneurship and innovation we need to equip students with the necessary skills to address increasingly complex issues.

The challenge is for educators, researchers and policymakers to create a curriculum which will foster innovative entrepreneurs who could create growth in the economy. It will be important for us to transform our paradigms of education based on these findings. It is the culture that we as lecturers and learners bring to discourse that defines the inherent value. In other words, learning has no prescribed methodologies. It can occur in myriad spaces, processes or conditions. It is what we define through consensus to be the appropriate for our time, with the necessary values which support a diverse, multicultural and learner-centred utopian pedagogical condition for now.

Subsequent to the EAIC study we have implemented key strategies in our design curricula to enhance and build on these characteristics and relationships, and equip students with the necessary skills for the next few decades. The interventions were then articulated across the various characteristics defined by the innovative entrepreneur to foster entrepreneurial innovation in design students.

Questioning

Traditionally the lecturer embodies and is the source of knowledge. However, today we recognize that a single lecturer with a specific background and understanding of the world is naturally a biased voice. This contradicts the modern concept of widening discourse to multiple contributions of knowledge. We intend to flatten the 'master' and 'student' paradigm at our respective schools and to transform the lecturer's role into that of facilitator instead. We encourage lecturers to play this facilitation role in design workshops, sharing their knowledge and encouraging students to both share experience and question knowledge. The student contact classroom is a discursive and engaging design studio format and uses a participatory methodology, which leads to discussions that introduce the values of plurality and diversity.

These pedagogical changes have created a new synergy in our studio culture. In addition, two other strategies to encourage participation and further promote equality of voices in the space were participation in peer reviewing and adopting a different physical arrangement in the classroom from cinema-style seating to central, focused seating arrangements. The intention is to challenge the status quo (their own and others') while allowing participants to exchange ideas without dependency on a lecturer. Facilitators ensure all learners participate in the discussion by asking students relevant questions to provoke possibilities, connections and insights. The facilitator also has to balance the class between the presentation of new material, debate and discussion in such a way that the outcomes of the module are met, while ensuring that all participants are valued and can contribute to the learning process.

Observing

Visual research and analysis are encouraged through observation, which is also known as architectural mapping. Criteria for sites for architectural projects were identified to exhibit realistic world problems with actual communities. Students were expected to visit these sites often at different times of the day and week to observe a change in patterns over time. Through this practice of observation, research and analysis,

these learners discover the physical, social and economic constraints of the site, existing site activities, and existing spatial relationships. They are expected to engage and react to their observations and their research in their architectural design projects. These real-life case studies assist students to broaden their knowledge and skills and to practise how to deal with the diverse issues presented. This skill develops the student's ability to read real-life situations and develop a methodological process of analysing, reflecting, decision making and intervening.

Networking

To facilitate networking among peers, students are assigned to work in groups. Networking across disciplines (horizontally) and years (vertically) is facilitated through collaborative and integrated projects. For 10 per cent of the yearly curriculum, each facilitator/lecturer develops a project focused on their own interests and research. These are presented as electives to the students who select their first, second and third choices. The students select the projects that align with their interests. Each elective is averaged out to contain a similar amount of first-, second- and third-year students. In some cases, the projects were also integrated across disciplines to include interior design, graphics and multimedia students. The idea of creating cross-collaborative studios is not new. However, it was important to cross-pollinate the students and lecturers to allow for social behaviour that involves actively forming and maintaining networks of people with various perspectives and ideas that each student can access for original insights. At an architectural industry level, the lecturers were encouraged to foster a strong engagement with the industry through guest lecturers and industry representatives. This also requires the lecturers to attend networking events such as product launches and awards.

Experimenting

Experimentation focuses on a discursive self-learning process as opposed to being fixed on an output and getting it right. Learning about design through making is important because learners develop an understanding of what does not work and learn to see failure in a positive light. The authors established a fabrication laboratory to implement a more robust relationship between creativity, entrepreneurship and innovation through new technologies. Our institutions have invested significant capital into new technologies for the development of fabrication laboratories. Institutions are continuously developing new curricula to support experimentation methodology. This methodology forced the authors to review the assessment rubric and align it with levels of exploration, diverse approaches to a problem, a range of experimentation, and reflection on the process as opposed to measuring the output. The laboratory not only fosters an unscripted learning path, it locates students in the contemporary era where digital design technology is the norm. Students are also made aware of and encouraged to consider that new innovation will be patented and that the legal department is available to support that level of entrepreneurship culture. We have established that there is a need for innovators to frequently take calculated risks and that the rewards are tenfold and worth pursuing.

Associating

Contact periods with students have been shortened. The learning is problem-oriented, personalized and accepting of participants' needs for self-direction and personal responsibility. The sessions were de-siloed and structured around learning methods such as studio, lectures and tutorials rather than design, construction, etc. Projects are taught in an integrated manner covering multiple subject outputs for each project. In the authors' opinion, successful learning occurs when three thinking processes are integrated to connect disparate ideas in new ways and create novel possibilities across apparently unconnected disciplines, problems, ideas or fields. These thinking processes are: design thinking (brainstorming and sketching), critical thinking (debate, analysis and discussion) and logical thinking (experimenting, testing and making). All design studio sessions rely heavily on critique. More time has been allocated to this type of learning to encourage associative thinking.

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Entrepreneurial Efficacy

Student expectations are articulated, clarified and managed by the learner and facilitator. As authors, we found that lectures can tend to prescribe briefs which have little or no relationship to learners. The new objective is to move away from 'designing an art studio for an artist on a hill' and instead allow learners to co-write the briefs. These briefs would bring the learners closer to their own references of architecture and space. We created an inclusive approach in our curriculum in which students can contribute to the project by bringing their personal narrative. For example, a design project in first year was to design a space for one person based on a daily private practice. This structure would be located in a public space of their choice for others to use for the same function. As part of the mapping exercise, learners were required to document their own private practice of their choice, for example, braiding their hair, praying, exercising, etc. In this way students were allowed to co-author the brief. What we found was that learners presented their design concepts more confidently because it was personal and that they could boldly share with others how they arrived at their designs. The architectural process was now owned by the student, bringing embodied knowledge to the design process.

Entrepreneurial motivation

To strengthen entrepreneurial motivation, the authors have developed a relationship with the business schools through teaching and content exchange. This has been introduced as an entrepreneurship module. Studying this subject allows students to gain a business understanding of the design industry. Students can envisage a professional career path as an entrepreneur in architecture by highlighting specific roles, responsibilities and relationships in the profession. Characteristics of entrepreneurs, developing an entrepreneurial mindset, and pathways into entrepreneurship, as well as soft skills, (interpersonal skills) are integrated with design office practices (management structures, legislation, governing bodies, duties and responsibilities of role players), and are explained and compared.

Conclusions

Curriculum planning in design requires constant reflection because it is not situated in a vacuum. These curriculum revisions required 100 per cent buy-in from colleagues and could contribute significantly to a larger cultural transformation in our design schools. This proposed methodology can only be developed and tested over time. The authors expect to see some failures, but are also starting to see some qualitative positive results. These interventions are merely the beginning of a long series of approaches to facilitate a more balanced pedagogy.

The authors believe strengthening and reshaping the curricula will eventually transform design pedagogy to align with global economic trends. The informal feedback so far from learners and lecturers has been both positive and negative regarding curriculum interventions. Generally, students feel the new programmes are interesting and help to ground the schools as a whole. The authors have observed students express a newfound appreciation for peers with different skills and perspectives.

Students have become more engaged in the studio and have developed a supportive role to each other. Class attendance has increased, and dropout rates have decreased. Learners are developing a level of empathy for each other and their own learning development.

Declarations and Conflict of Interests

The authors declare no conflict of interests with this work.

Notes

[1] Fillis and Rentschler, 'Creativity in Entrepreneurship'.
[2] Rambe, Ndofirepi, and Dzansi, 'Influence of Entrepreneurial Education'.
[3] Bridgstock, 'Not a Dirty Word'.
[4] Edwards-Schachter et al., 'Disentangling Competences', 3.
[5] Soomro and Shah, 'Developing Attitudes and Intentions'.

6 Karimi et al., 'Fostering Students' Competence'.

7 Statistics South Africa, 'Statistics South'.

8 Phipps, 'Contributors to an Enterprising Gender'.

9 Rambe, Ndofirepi, and Dzansi, 'Influence of Entrepreneurial Education'.

10 Schmidt, Soper, and Facca, 'Creativity in the Entrepreneurship Classroom'.

11 George and Zhou, 'Openness to Experience and Conscientiousness'.

12 Gopalakrishnan, Kessler, and Scillitoe, 'Navigating the Innovation Landscape'.

13 Mortati, 'A Framework for Design Innovation'.

14 Bell, 'Unpacking the Link', 4.

15 Denanyoh, Adjei, and Nyemekye, 'Factors That Impact on Entrepreneurial Intention'.

16 Mayhew et al., 'Exploring Innovative Entrepreneurship'.

17 Rambe, Ndofirepi, and Dzansi, 'Influence of Entrepreneurial Education'.

18 Kline et al., 'The Innovation Canvas in Entrepreneurship Education'.

19 Edwards-Schachter et al., 'Disentangling Competences'.

20 Abel, Deitz, and Su, 'Are Recent College Graduates Finding Good Jobs?'

21 Whoriskey, 'New Study Shows Architecture, Arts Degrees Yield Highest Unemployment'.

22 Vinnitskaya, 'Resurgence in Employment Rates for Architects?'

23 Klettner, 'One-Fifth of UK Architects Unemployed'.

24 Stott, 'The Reality Behind Those UK Unemployment Statistics'.

25 Menold et al., 'The Characteristics of Engineering Innovativeness'.

26 Bell, 'Unpacking the Link between Entrepreneurialism and Employability'.

27 Zampetakis, 'The Role of Creativity and Proactivity'.

28 Trifan, Guica, and Micu, 'Entrep§reneurial Creativity'.

29 Dyer et al., 'The Innovator's DNA'.

30 Halilović, Cankar, and Tominc, 'Innovation and Entrepreneurship'.

31 Chen, Greene, and Crick, 'Does Entrepreneurial Self-Efficacy Distinguish Entrepreneurs from Managers?'

32 Halilović, Cankar, and Tominc, 'Innovation and Entrepreneurship'.

33 Ragusa, 'Engineering Creativity and Propensity'.

34 Dyer et al., 'The Innovator's DNA'.

35 Dyer, Gregersen, and Christensen, 'Entrepreneur Behaviors'.

36 Menold et al., 'The Characteristics of Engineering Innovativeness'.

37 Dyer et al., 'The Innovator's DNA'.

38 Dyer and Gregersen, 'Are You an Innovative Entrepreneur?'

39 Menold et al., 'The Characteristics of Engineering Innovativeness'.

40 Race classifications in South Africa, Apartheid, is defined as a system of institutionalized racial segregation created by the minority White Afrikaner government in the early 1900s. Classification of race was used to identify and categorize in the application of the various laws of segregation. Since 1994 a new constitution has been enshrined for democracy. However, the latent impact of the marginalized is still rife and the need to use classification still exists, but for the intention of promoting access to opportunities.

References

Abel, Jaison R., Richard Deitz, and Yaqin Su. 'Are Recent College Graduates Finding Good Jobs?'. *Federal Reserve Bank of New York* 20, no. 1 (2014). Accessed 5 August 2020. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2378472.

Bell, Robin. 'Unpacking the Link between Entrepreneurialism and Employability: An Assessment of the Relationship between Entrepreneurial Attitudes and Likelihood of Graduate Employment in a Professional Field'. *Education+ Training* 58, no. 1 (2016): 2–17. [CrossRef]

Bridgstock, Ruth. 'Not a Dirty Word: Arts Entrepreneurship and Higher Education'. *Arts and Humanities in Higher Education: An International Journal of Theory, Research and Practice* 12, nos. 2–3 (1 April 2013): 122–37. [CrossRef]

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Byman, Reijo. 'The Development of a Gender-Free Curiosity Inventory'. *Personality and Individual Differences* 101 (2016): 177–84. [CrossRef]

Chen, Chao C., Patricia Gene Greene, and Ann Crick. 'Does Entrepreneurial Self-Efficacy Distinguish Entrepreneurs from Managers?'. *Journal of Business Venturing* 13, no. 4 (1998): 295–316. [CrossRef]

Denanyoh, Richard, Kwabena Adjei, and Gabriel Effah Nyemekye. 'Factors That Impact on Entrepreneurial Intention of Tertiary Students in Ghana'. *International Journal of Business and Social Research* 5, no. 3 (2015): 19–29.

Dyer, Jeffrey H., and Hal B. Gregersen. 'Are You an Innovative Entrepreneur?' Newspaper. *Forbes*, 4 June 2012. Accessed 5 August 2020. https://www.forbes.com/sites/innovatorsdna/2012/06/04/are-you-an-innovative-entrepreneur/.

Dyer, Jeffrey H., Hal B. Gregersen, and Clayton Christensen. 'Entrepreneur Behaviors, Opportunity Recognition, and the Origins of Innovative Ventures'. *Strategic Entrepreneurship Journal* 2, no. 4 (2008): 317–38. [CrossRef]

Dyer, Jeffrey H., Hal B. Gregersen, and Clayton M. Christensen. 'The Innovator's DNA'. *Harvard Business Review* 87, no. 12 (2009): 60–7.

Edwards-Schachter, Mónica, Ana García-Granero, Mabel Sánchez-Barrioluengo, Henry Quesada-Pineda, and Nabil Amara. 'Disentangling Competences: Interrelationships on Creativity, Innovation and Entrepreneurship'. *Thinking Skills and Creativity* 16 (2015): 27–39. [CrossRef]

Fillis, Ian, and Ruth Rentschler. 'The Role of Creativity in Entrepreneurship'. *Journal of Enterprising Culture* 18, no. 1 (2010): 49–81. [CrossRef]

George, Jennifer M., and Jing Zhou. 'When Openness to Experience and Conscientiousness Are Related to Creative Behavior: An Interactional Approach'. *The Journal of Applied Psychology* 86, no. 3 (2001): 513–24. [CrossRef]

Gopalakrishnan, Shanthi, Eric H. Kessler, and Joanne L. Scillitoe. 'Navigating the Innovation Landscape: Past Research, Present Practice, and Future Trends'. *Organization Management Journal* 7, no. 4 (2010): 262–77. [CrossRef]

Halilović, Patricija, Franc Cankar, and Polona Tominc. 'Innovation and Entrepreneurship Can Be Learned and Built On'. *Hrvatski Časopis Za Odgoj i Obrazovanje* 16, no. 3 (2014): 133–53.

Karimi, Saeid, Harm J. A. Biemans, Thomas Lans, Mousa Aazami, and Martin Mulder. 'Fostering Students' Competence in Identifying Business Opportunities in Entrepreneurship Education'. *Innovations in Education and Teaching International* 53, no. 2 (2016): 215–29. [CrossRef]

Klettner, Andrea. 'One-Fifth of UK Architects Unemployed'. *Building Design*, n.d. Accessed 5 August 2020. http://www.bdonline.co.uk/news/one-fifth-of-uk-architects-unemployed/5051355.article

Kline, William A., Cory A. Hixson, Thomas W. Mason, Patricia Brackin, Robert M. Bunch, Kay C. Dee, and Glen A. Livesay. 'The Innovation Canvas in Entrepreneurship Education: Integrating Themes of Design, Value, and Market Success'. *The Journal of Engineering Entrepreneurship* 5, no. 1 (2014): 80–99. [CrossRef]

Mayhew, Matthew J., Jeffrey S. Simonoff, William J. Baumol, Batia M. Wiesenfeld, and Michael W. Klein. 'Exploring Innovative Entrepreneurship and Its Ties to Higher Educational Experiences'. *Research in Higher Education* 53, no. 8 (2012): 831–59. [CrossRef]

Menold, Jessica, Kathryn J. Jablokow, Daniel M. Ferguson, Senay Purzer, and Matthew W. Ohland. 'The Characteristics of Engineering Innovativeness: A Cognitive Mapping and Review of Instruments'. *International Journal of Engineering Education* 32, no. 1A (2016): 64–83.

Mortati, Marzia. 'A Framework for Design Innovation: Present and Future Discussions'. *Design Issues* 31, no. 4 (2015): 4–16. [CrossRef]

Phipps, Simone T. A. 'Contributors to an Enterprising Gender: Examining the Influence of Creativity on Entrepreneurial Intentions and the Moderating Role of Political Skill Controlling for Gender'. *Academy of Entrepreneurship Journal* 18, no. 1 (2012): 77–90.

Ragusa, Gisele. 'Engineering Creativity and Propensity for Innovative Thinking in Undergraduate and Graduate Students'. Paper presented at 2011 ASEE Annual Conference & Exposition, Vancouver, BC. https://peer.asee.org/17861.

Rambe, Patient, Takawira Munyaradzi Ndofirepi, and Dennis Yao Dzansi. 'Influence of Entrepreneurial Education and Technological Creativity on Entrepreneurial Intentions of Students in Zimbabwe: A Theoretical Perspective'. *Proceedings of the European Conference on Innovation & Entrepreneurship* (2015): 576–84.

Schmidt, Jacqueline J., John C. Soper, and Tina M. Facca. 'Creativity in the Entrepreneurship Classroom'. *Journal of Entrepreneurship Education* 15 (January 2012): 123–31.

Soomro, Bahadur Ali, and Naimatullah Shah. 'Developing Attitudes and Intentions among Potential Entrepreneurs'. *Journal of Enterprise Information Management* 28, no. 2 (2015): 304–22. [CrossRef]

Statistics South Africa. 'Statistics South Africa | The South Africa I Know; The Home I Understand'. Accessed 28 April 2017. http://www.statssa.gov.za/.

Stott, Rory. 'The Reality behind Those UK Unemployment Statistics'. *ArchDaily*, 21 March 2013. Accessed 5 August 2020. http://www.archdaily.com/348035/the-reality-behind-those-uk-unemployment-statistics/.

Trifan, Laura, Raluca I. Guica, and Constantin Micu. 'Entrepreneurial Creativity and Innovation Management in Engineering'. *Annals of DAAAM & Proceedings* 23, no. 1 (2012): 0783–88.

Vinnitskaya, Irina. 'Resurgence in Employment Rates for Architects?'. *ArchDaily*, 15 April 2013. Accessed 5 August 2020. http://www.archdaily.com/359798/aia-ncarb-survey-indicates-resurgence-in-employment-rates-for-architects.

Whoriskey, Peter. 'New Study Shows Architecture, Arts Degrees Yield Highest Unemployment'. *The Washington Post*, 4 January 2012. Accessed 5 August 2020. . https://www.washingtonpost.com/business/economy/new-study-shows-architecture-arts-degrees-yield-highest-unemployment/2012/01/03/gIQAwpaXZP_story.html?utm_term=.d31ecdff7eb1.

Zampetakis, Leonidas A. 'The Role of Creativity and Proactivity on Perceived Entrepreneurial Desirability'. *Thinking Skills & Creativity* 3, no. 2 (2008): 154.

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