Predicted and Prized Critical Skills for a Graduate to Produce Effective Innovation

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Abstract: Higher Education Institutions (HEIs) have been mandated with the task to train and produce graduates with the capability to contribute to the economy and improve societies through teaching and learning. Furthermore, they are tasked with the responsibility to produce graduates with the capability to produce innovations that change the world for the better. For a university to produce such graduates it would need to focus on the curriculum and ensure that the skills and knowledge taught are relevant to produce innovative graduates. The purpose of this research paper was to identify the predicted and prized skills that a graduate can use to produce groundbreaking innovations. This objective would yield guidance on the most critical skills that should be included in a BCom degree to produce graduates with the capability to produce groundbreaking innovations. This research employed a Mixed-method approach with the use of both qualitative and quantitative approach. Data was collected using semi-structured interviews with 11 participants from the University of Johannesburg commercialisation units and an online questionnaire from 69 innovation experts from the South African Business Innovation Community (Innovation Summit), and the Innovation, Sustainability and Visionary Leadership Group. Data was collected through descriptive content analysis with the aid of Atlas.ti and inferential statistical analysis. This study is part of a completed PhD study, the reporting is only on Predicted and Prized critical skills for a BCom degree graduate. Based on the results ideation, reasoning, problem solving, complex problem solving, critical thinking, creativity and analytical thinking are skills and competences predicted to improve innovation and produce graduates with the capability to innovate. Furthermore, based on the results critical thinking, judgement and decision making are very significant skills for a person with a BCom degree. In conclusion, HEIs should place more emphasis on critical thinking skills within the curriculum and complex problem-solving skills. These skills should not only be exclusive to certain programmes but throughout the entire HEI's curriculum.

Keywords: Commercialisation, Higher education institutions, Innovation, Curriculum, Signification framework

1. Introduction

Innovation plays a critical role as a catalyst for societal and economic growth. It is also a catalyst for wellness, and prosperity and significantly seats at the core of HEIs, Government, and the Business sector. According to Nelles, Wilton, Walsh, and Tim, (2023), "*The 2020 R&D Roadmap argued that fueling an efficient system of innovation will improve lives, services, and business right around the UK and beyond – creating a fairer, healthier more prosperous and more resilient society*". It is stated that innovation should be encouraged through various sectors, as it is essential for the future prosperity of a society and a significant key to enabling societies to achieve their objectives and in turn solve societal and global challenges related to security, biodiversity, and climate (Nelles, Wilton, Walsh, and Tim, 2023). In this case, it is significant to note that humans play an integral part in ensuring effective production of innovation and, hence should possess relevant skills conducive to producing innovation. It is with no doubt that HEIs play an important role in equipping graduates with the skills relevant to produce innovation, and this is achieved through their academic programs and degree programs, etc. People are arguably critical and key in Research and Development around innovation, therefore should be equipped with relevant skills through various initiatives.

It is significant to note that various initiatives and educational programmes enhance management, commercialisation leadership, and entrepreneurial skills that will ultimately contribute to innovation adoption, and growth in business innovation (Nelles, Wilton, Walsh, and Tim, 2023). These innovation skills are critical to support the development of an innovative workforce and enable the generation of entrepreneurs, government, and business leaders to drive innovation leadership and economic growth. In this case, therefore the purpose of this research was to identify the predicted and prized skills for a graduate to produce impactful innovations.

2. Innovation as a Concept

Innovation is the ability to create and introduce a new product or service in the market, or the improvement of an already existing product and service commonly referred to as the type of innovation that is radical and incremental (Katz, 2007:32). These four types are the overarching categories of innovation, namely product, process, marketing, and organisational innovation. These types of innovation are further categorised, for example, radical innovation, digital innovation, disruptive innovation, and other types of innovation. Some types

of innovation are commercialisable. Due to the dynamic nature of innovation commercialisation that often entails PM, it is important to unpack PM theory and innovation. For example, the type of innovation known as radical innovation can be referred to as a newly created product, incremental innovation can be described as the enhancement of an existing product, and radical innovation often has a high risk due to its nature of uncertainty and complexity (Katz, 2007:33).

Innovation can be categorised into different types of innovations that are generally key to the business strategy of a business for sustainable competitive advantage (Varadarajan, 2018:144). The different types of innovation are product innovation, marketing innovation, business model innovation, and strategic innovation. Generally, innovation can be defined as the introduction or implementation of a new or improved product, service or process, and new business practice (Varadarajan, 2018:149). Innovation can further be defined as knowledge that is used uniquely and differently, it could be a new way of thinking and innovation is normally the result of complex and dynamic interactions and learning processes by different stakeholders (Pellissier, 2012:4).

3. Innovation and Commercialisation Process

Innovation plays a significant role in business growth and the creation of new businesses; hence it is important to nurture innovativeness. Innovativeness can be described as the capacity of an invention or innovation to disrupt the business industry or create a shift in the business paradigm, specifically in the market structure of a particular industry or in science and technology (Varadarajan, 2018:150). There are various definitions of innovation, namely: innovation can be defined as the process of successfully Commercialising an invention; or innovation can be defined as the successful process of Commercialising an idea, product, or practice (Varadarajan, 2018:152). These definitions bring forth the importance of commercialisation of innovation (CoI). CoI can be defined as a process in which various connected steps are undertaken to successfully introduce a product or service to the market. Commercialisation can be executed by corporations and start-up businesses through various processes (Jordan, 2010:4).

The basic commercialisation process includes screening the ideas, measuring the objectives of the business idea and the deliverables of the business project, later the product is tested and validated until it is launched to the market (Jordan, 2010:4). It is important to nurture business ideas and innovation within universities. In the university context commercialisation can be described as an intellectual process undertaken by academics and students where ideas and knowledge are converted into businesses or commercial products and services (Razak & Murray, 2017:298). The success of commercialisation depends on the strategy implemented to introduce new ideas and innovations (Sibanda, 2021). Innovation networks and components play an essential role in the commercialisation of products and services (Razak & Murray, 2017:298). There are various components that play a role in ensuring the commercialisation of products and services, such as systems thinking for entrepreneurial universities, quality information for decision making, and design thinking in a complex environment. The section will focus on the methodology applied to this research.

The above-mentioned is important to note but it is equally important to note that various skills are required to achieve innovation with the potential to be commercialised or implemented by an employer. Whorton, Casillas, Oswald, and Shaw, (2017: 05) argue that critical thinking, creativity, customer service, teamwork, metacognition, and self-regulation are critical skills for the 21st-century workforce, furthermore, they recommend that leadership, cross-cultural knowledge, and competence, and ethics and integrity are among the most critical skills for the 21st-century workforce to be effective in the workplace and demonstrate innovation.

4. Methodology

The research philosophy was pragmatism due to the practical nature of the research project, as Saunders, Lewis, and Thornhill (2016:136-137), with an action research strategy, and mixed-method complex research approach. The methods were, semi-structured interview, and an online questionnaire. The population consisted of HEI entrepreneurial support units of a South African university, the University of Johannesburg (UJ), innovators and entrepreneurs in the ranks of UJ IKM alumni, business innovation experts represented by the delegates of the annual South African Innovation Summit, and the Innovation, Sustainability and Visionary Leadership Group. The sampling method for this study was non-probability sampling, that is, purposive. Purposive sampling is the deliberate and thoughtful selection of the right participants for the research project (Saunders, Lewis & Thornhill, 2009:237). The in-depth interview was analysed inductively using the qualitative content analysis method to obtain a rich understanding from interpreting data using thematic coding techniques. Interviews were conducted with various representatives from commercialisation units and entrepreneurs. Once the

analysis of interview data was completed, statistical analysis utilising descriptive techniques was used to analyse structured data obtained from the questionnaire.

To conduct research that is valid and undisputable, the phenomenon under investigation and the research methodology were subject to obtaining research ethics clearance prior to conducting the actual research. Since the phenomenon was the commercialisation dynamics of entrepreneurial universities, and the researcher is an employee of an HEI and has direct contact with the IKM field of research, the action research strategy was approved by the researcher's employer, the University of Johannesburg. Permission was obtained to use UJ as the research site. Furthermore, permission was obtained from the UJ College of Business and Economics Research Ethics Committee (CBEREC) to conduct research in accordance with the UJ Code of Academic Research Ethics (2007).

5. Results and Findings

Based on the results form the question on "To what extent do they predict that an individual's ability to be innovative will improve because of skills and competencies listed below. The four options given to respondents were: to no extent, to some extent, to a moderate extent, to a great extent, and 13 skills shown on the category axis were:

1. Analytical thinking.
2. Innovative disposition.
3. Active learning and learning strategies.
4. Creativity, originality, and initiative.
5. Technology design and programming.
6. Critical thinking.
7. Leadership.
8. Social influence.
9. Complex problem solving.
10. Emotional intelligence.
11. Reasoning, problem solving.
12. Ideation.
13. Systems analysis and evaluation.

The results on each of these components are illustrated in Figure 1.

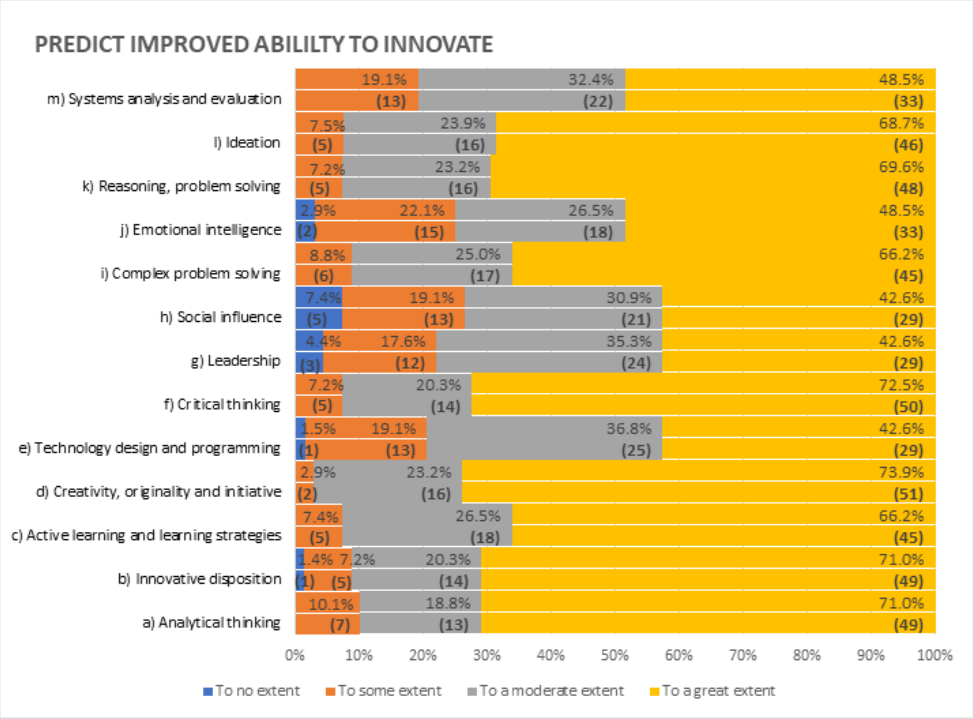


Figure 1: Skills and competencies predicted to improve ability to innovate (own source developed for this study, 2021)

Results from Figure 1, that is, the extent participants predicted that an individual's ability to be innovative will improve because of having certain skills and competencies, such as analytical thinking and active learning strategies, are illustrated in Figure 1. On analytical thinking, none of the participants indicated to no extent, 10.1% indicated to some extent, 18.8% indicated to a moderate extent, 71% indicated to a great extent. Figure 1 at b) on innovative disposition, 1.4% of the participants indicated to no extent, 7.2% indicated to some extent, 20.3% indicated to a moderate extent, 71% indicated to a great extent. Figure 1 at c) on active learning and learning strategies, none of the participants indicated to no extent, 7.4% indicated to some extent, 26.5% indicated to a moderate extent, 66.2% indicated to a great extent. Figure 1 at d) on creativity, originality, and initiative, none of the participants indicated to no extent, 2.9% indicated to some extent, 23.2% indicated to a moderate extent, 73.9% indicated to a great extent.

Figure 1 at e) on technology design and programming, 1.5% of the participants indicated to no extent, 19.1% indicated to some extent, 36.8% indicated to a moderate extent, 42.6% indicated to a great extent. Figure 1 at f) on critical thinking, none of the participants indicated to no extent, 7.2% indicated to some extent, 20.3% indicated to a moderate extent, 72.5% indicated to a great extent. Figure 1 at g) on leadership. 4.4% of the participants indicated to no extent, 17.6% indicated to some extent, 35.3% indicated to a moderate extent, 42.6% indicated to a great extent. Figure 1 at h) on social influence, 7.4% of the participants indicated to no extent, 19.1% indicated to some extent, 30.9% indicated to a moderate extent, 42.6% indicated to a great extent. Figure 1 at i) on complex problem solving, none of the participants indicated to no extent, 8.8% indicated to some extent, 25% indicated to a moderate extent, 66.2% indicated to a great extent.

Figure 1 at j) on emotional intelligence. 2.9% of the participants indicated to no extent, 22.1% indicated to some extent, 26.5% indicated to a moderate extent, 48.5% indicated to a great extent. Figure 1 at k) on reasoning, problem solving, none of the participants indicated to no extent, 7.2% indicated to some extent, 23.2% indicated to a moderate extent, 69.6% indicated to a great extent. Figure 1 at l) on ideation, none of the participants indicated to no extent, 7.5% indicated to some extent, 23.9% indicated to a moderate extent, 8.7% indicated to a great extent. Figure 1 at m) on systems analysis and evaluation, none of the participants indicated to no extent, 19.1% indicated to some extent, 32.4% indicated to a moderate extent, 48.5% indicated to a great extent.

Based on the results illustrated in Figure 1, creativity, originally and the ability to take initiative are the most significant skills and competencies that universities should put focus on, along with critical thinking skills, innovation disposition and analytical thinking. This finding coincides with the results of the interview. All participants described the importance of analysis, and two participants specifically mentioned the pitfall, lack of analytical thinking.

Participant 3 indicated:

> *"You see! Are you? Are you producing monthly financial statements? Or at least quarterly financial statements? Are you analysing your financial statements? Do you make the decisions about investing in business? Or are they just spending everything that's coming in?*

Participant 8 indicated:

> *"You know, the one thing I do not see it IRT analyses can do this is keeping, analysing, interpreting and wrinkles [sic], to constantly know exactly what happens with your stock, your inventory of cash flow, all of that, for customers, how many companies and often those kinds of entrepreneurs don't, you know, they are scared of that, because it's a data intensive thing".*

From the results of the questionnaire, creativity, originality, and initiative are the most predicted skill or capability linked to improved innovation, as illustrated in Figure 1, 73.9% of the participants indicated to a great extent. From the interviews conducted, one of the participants from the commercialisation unit emphasised creativity:

Participant 9:

> *"I think the best skill is creativity".*

Some of the entrepreneur participants interviewed, mentioned leadership and problem solving. Participant 1 indicated:

> *"[…], one of the main things is you need to be able to be a problem solver. Yeah. Because if you do not know how to solve a problem, you just be said, okay, you stand aside".*

Participant 5 indicated:

> *Okay, I think a big one for me, personally, is the ability to influence, so that talks directly to leadership, […] so, a big, big, big, big area of skill for me is that ability to influence to inspire and motivate.*

The **PRIZED** element was further informed by the results in Figure 2, from the participants when they were asked to what extent they prized the skills for a person with Bachelor of Commerce (BCom) degree obtained from a South African University; 11 skills were listed:

- Complex problem solving.
- Critical thinking.
- Creativity.
- People management.
- Coordinating with others.
- Emotional intelligence.
- Judgement and decision making.
- Service orientation.
- Negotiation skills.
- Cognitive flexibility.
- Design thinking.

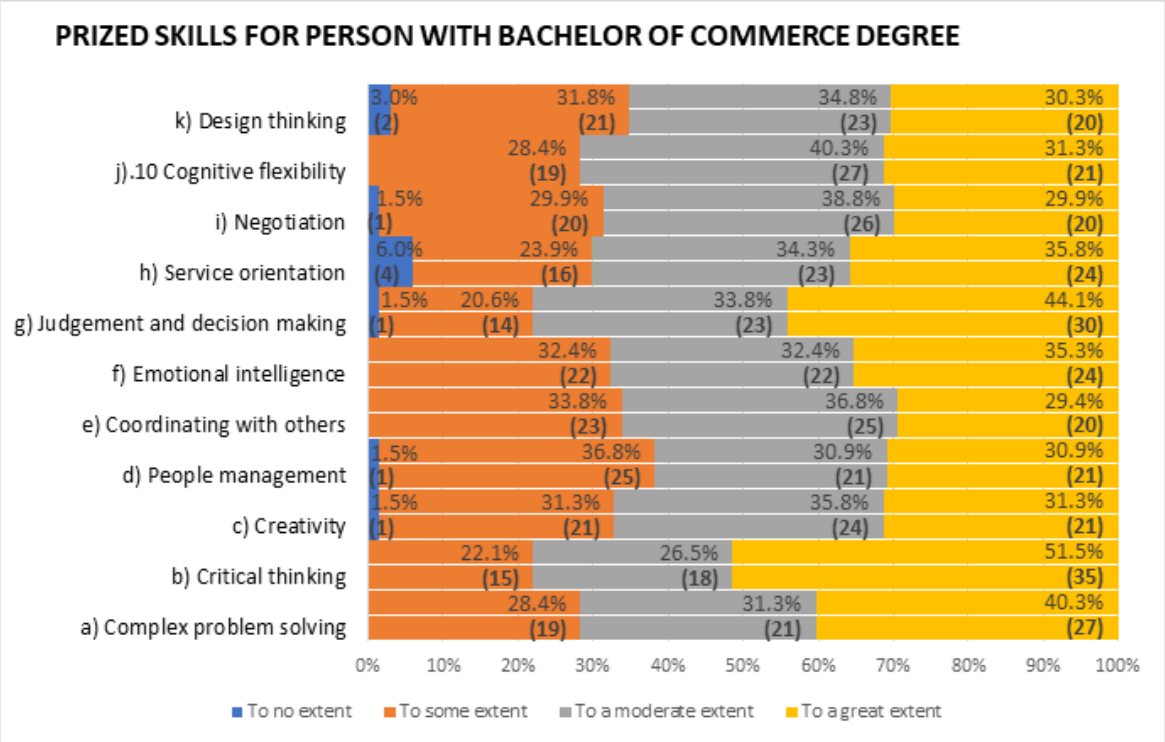


Figure 2: Prized skills for a person with a Bachelor of Commerce degree (own source developed for this study, 2021)

On Figure 2 at a), the first skill was complex problem solving, none of the participants prized to no extent, 28.4% participants prized to some extent, 31.3% participants prized to a moderate extent, and 40.3% prized complex problem-solving skill to a great extent. On Figure 2 at b), the second skill was critical thinking, none of the participants prized to no extent, 22.1% participants prized to some extent, 26.5% participants prized to a moderate extent and 51.5% participants prized to a great extent. This is a clear indication that entrepreneurial institutions should place value on instilling critical thinking within innovators and students specifically. On Figure 2 at c), the third skill was creativity. 1.5% of the participants prized to no extent, 31.3% participants prized to some extent, 35.8% participants prized to a moderate extent, and 31.3% prized creativity to a great extent.

On Figure 2 at d), the fourth skill was people management. 1.5% of the participants prized to no extent, 36.8% participants prized to some extent, 30.9% participants prized to a moderate extent, and 30.9% participants prized to a great extent the skill of people management. On Figure 2 at e), the fifth skill was coordinating with

others; none of the participants prized to no extent, in other words all participants to some extent prize the skill of coordinating with others. Of the participants, 33.8% participants prized to some extent, 36.8% participants prized to a moderate extent, and 29.4% participants prized to a great extent. On Figure 2 at f), the sixth skill was emotional intelligence, none of the participants prized to no extent, 32.4% participants prized to some extent, 32.4% participants prized to a moderate extent, and the majority (35.3%) prized emotional intelligence to a great extent. On Figure 2 at g), the seventh skill was judgement and decision making. 1.5% of the participants prized to no extent, 20.6% participants prized to some extent, 33.8% participants prized to a moderate extent, and 44.1% participants prized to a great extent.

On Figure 2 at h), the eighth skill was service orientation. In comparison to other skills, a fair percentage of the participants 6% prized the skill of service orientation to no extent. Of the participants, 23.9% participants prized to some extent, 34.3% participants prized to a moderate extent, and 35.8% prized service orientation to a great extent. On Figure 2 at i), the ninth skill was negotiation, with 1.4% of the participants indicating that they did not prize the skill of negotiation, 29.9% prized negotiation skill to some extent, 38.8% participants prized to a moderate extent, and 29.9% participants prized the skill of negotiation to a great extent. On Figure 2 at j), the tenth skill was cognitive flexibility, none of the participants prized to no extent, 28.4% participants prized to some extent, 40.3% participants prized to a moderate extent, and 31.3% prized cognitive flexibility to a great extent.

On Figure 2 at k), the eleventh skill was design thinking. 3.0% of the participants prized to no extent, 31.8% participants prized to some extent, 34.8% participants prized to a moderate extent, and 30.3% prized design thinking skill to a great extent. By integrating the findings of the interview, the researcher had with innovators, entrepreneurs, and university commercialisation units, design thinking seems to be a critical skill to aid innovation and commercialisation and enable the creation of business products and services. For instance, these research participants who were interviewed from the commercialisation unit indicated as follows.

Participant 5 indicated:

> *"Your product must fit a particular niche is very, very important. And so, you know, what we call the design thinking stage, design thinking those kinds of exercises that need to happen earlier on. So, when people come in and say this is a great idea. You go through design thinking process only to discover that there is nothing here unless we do one, two three and four You know, or things like you will be successful. If for example, we introduced a product for free to get a consumer acceptance. And then at other components, other variables onto it value addition, and then start charging for those kinds of things".*

Participant 7 indicated:

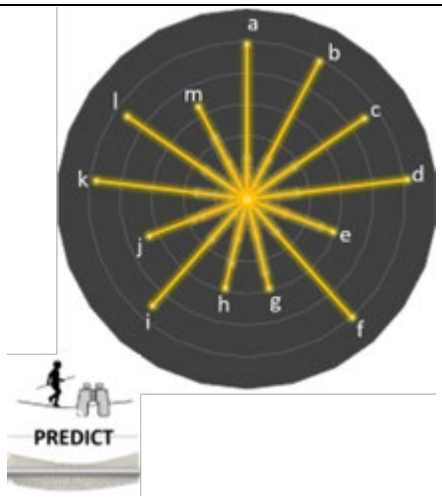
> *"So, we apply a lot of design thinking in our approach when we develop solutions. So, we very much solution orientated, and we have a requirement to ensure that whatever take all solution we want to take into an environment that it can succeed. You do that by developing as a minimum viable product. Like, testing it in that environment, seeing whether doing a bit of market research around it to see whether is addressing the problem".*

Participant 7 added:

> *"To demonstrate that the project is not feasible, that something is not feasible that they're trying to achieve. That is why we like the design thinking approach where you have a minimum viable product, before you spend a lot of money to develop a cheap and simple prototype, and to demonstrate that it can work. And then based on that, attract investment, and buy in and engage with potential buyers that would want that check to see if there's a real need within the market for it". […] So, there is this thing. Now this big thing now called design thinking […] So, my answer goes back to what I said earlier a lot of the work needs to be done in understanding the needs of the client and test the product pilot of the product with the clients to find out if they have real interest".*

The responses illustrated in Figure above indicate a fair response between some extent, moderate extent, and great extent, which indicated universities should place value on prized skills by finding balance in their curriculum. To find this balance, an intervention mechanism, such as a SIM system would then assist with the alignment of dynamic capabilities at the **PRIZED** element level. The results show that the most prized skills from among complex problem solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgement and decision making, service orientation, negotiation skills, cognitive flexibility, and design thinking, are critical thinking, judgement and decision-making skills.

Based on these findings, the researcher developed the **PREDICT** and **PRIZED** and of this study's signification framework (*cf* Figure 3 & 4).

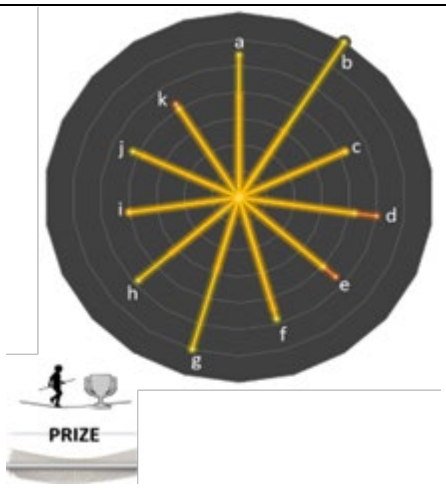


a) Analytical thinking
b) Innovative disposition
c) Active learning and learning strategies
d) Creativity, originality, and initiative
e) Technology design and programming
f) Critical thinking
g) Leadership
h) Social influence
i) Complex problem solving
j) Emotional intelligence
k) Reasoning, problem solving
l) Ideation
m) Systems analysis and evaluation

Figure 3: PREDICT Intervention key – Skills that will improve ability to innovate (own source developed for this study, 2021)

Application 1: If an entrepreneurial university provides students with an environment that encourages the creativity, originality, and initiative of innovators during academic residency, the prediction is that their ability to innovate in the business environment will improve.

Application 2: If the HEI curriculum comprises teaching and learning of a variety of skills that will improve the ability to innovate, then intervention is not necessary. The **PREDICT** intervention key will flag an issue such as unbalanced attention to one skill at the expense of another skill, in which case intervention is needed. Leadership, 2) explorative culture, and 3) brand identity.



a) Complex problem solving
b) Critical thinking
c) Creativity
d) People management
e) Coordinating with others
f) Emotional intelligence
g) Judgement and decision making
i) Service orientation
j) Negotiation skills
k) Cognitive flexibility
l) Design thinking

Figure 4: PRIZE Intervention key – Skills for a person with a BCom degree (own source developed for this study, 2021)

Application 1: When the two most prized skills of a person with a BCom degree are 1) critical thinking, and 2) judgement and decision making, but HEI designs its assessments to test BCom students' ability to memorise

theory without practical application that requires critical thinking, judgement and decision making, then intervention is needed.

Application 2: If teaching and learning activities concentrate on people management and coordinating with others yet neglecting the other prized skills of a person with a BCom degree, then teaching and learning intervention is needed.

6. Conclusion

The quest to determine the skills required to produce graduates capable of producing graduates with the capability to innovate presents a research gap for this study to add value. This study aimed to add value by determining the most predicted and prized skills required within the university curriculum to produce graduates capable of producing effective innovation. It is significant to take note of the major skills HEIs should focus on to ensure that they ensure graduates are capable of creative thinking, problem-solving, critical thinking, negotiation, decision-making skills, and leadership. This would assist in getting a clearer understanding of the level of graduates' readiness and the skills universities should be focusing on to ensure that graduates can produce innovation and business growth. Whorton, Casillas, Oswald, and Shaw, (2017: 05) confirmed some of the skills from the results by listing critical thinking, creativity, customer service, teamwork, metacognition, and self-regulation as critical skills for the 21st century workforce. Apart from the skills determined from this, it further recommended that leadership, cross-cultural knowledge and competence, and ethics and integrity are among the most critical skills for the 21st-century workforce as stated by Whorton, Casillas, Oswald, and Shaw, (2017: 05).

In conclusion, it is significant for HEIs to put an emphasis and focus on skills such as creativity, critical thinking, ideation, innovation disposition, and analytical thinking within the curriculum to produce graduates capable of producing effective innovation.

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