

**Research Article**



# Challenges and Drivers of Industrialist Propensity Among Chemical Engineering Students in STEM Institution in Zimbabwe: Towards A Conceptual Framework

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**Abstract:** NUST in Zimbabwe grapples with a significant challenge. Despite enrolling many students in chemical engineering, the nation lacks operational industries. Consequently, graduates often encounter difficulties securing employment or attachment placements post-graduation. This underscores the critical need to foster student entrepreneurship, encouraging innovation and idea generation. The study employed a mixed-methods research design to address this issue, combining qualitative and quantitative methodologies. The quantitative aspect utilized a quasi-experimental pre-test and post-test design, while the qualitative component involved conducting focus group interviews with chemical engineering students in the experimental group. The findings from both approaches complemented each other, providing a comprehensive understanding of the factors influencing entrepreneurial propensity among NUST chemical engineering students. Data collection involved distributing research instruments and questionnaires to NUST students and individuals associated with the mining and pharmaceutical industries. The collected data were then entered into an Excel spreadsheet, allowing for the recording of respondents' numbers alongside their respective responses. The study applied descriptive statistics to evaluate responses and their alignment with research objectives, revealing barriers to entrepreneurial inclination among NUST chemical engineering students, such as limited resources, risk aversion, inadequate entrepreneurial education, and cultural norms. Students benefited from personal motivation, a supportive educational atmosphere, networking opportunities, and exposure to innovative ideas. These factors nurtured self-determination, social networking, and an entrepreneurial mindset. To foster entrepreneurial spirit among NUST chemical engineering students, the study suggests educational reforms, mentorship programs, and potential policy changes create an enabling environment, empowering students to pursue entrepreneurship and contribute to economic growth.

**Keywords:** Educational Reforms; Empowering Students; Risk Aversion; Social Networking; Self-determination.

## 1. Introduction

In Zimbabwe, the current dispensation has witnessed an unprecedented surge in entrepreneurship, particularly within the Chemical Engineering sector, owing to several factors such as increased exposure, technological advancements, and the adoption of the Science, Technology, Engineering, and Mathematics (STEM) system [1], [2]. This surge can be attributed to the prevailing economic conditions, which have led to a significant

decline in employment rates, prompting individuals to explore entrepreneurial opportunities.

Implementing the STEM system in Zimbabwe around 2015 has fostered entrepreneurship, particularly in fields like Chemical Engineering. The STEM system promotes intensive science, technology, engineering, and mathematics innovation, thus positioning institutions to spearhead industrialization efforts [3]. While the STEM initiative initially faced criticism for its exclusion of arts and commercial fields, it has proven beneficial for students in

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STEM disciplines, enabling them to bridge the gap between academia and industry [4].

Students enrolled in STEM programs increasingly leverage opportunities to enhance their skills and relevance in industry and business sectors through entrepreneurship [5]. Embracing entrepreneurship allows STEM students to validate their knowledge and make tangible contributions to the market. Fredrick W. Taylor's notion that incentivizing people with payment per job has influenced this trend, as entrepreneurship in engineering motivates students to think creatively and develop unique business ideas that address market needs [6].

Chemical engineering students, in particular, are encouraged to explore entrepreneurship as a means to solve everyday problems while generating substantial revenue. By owning their business ideas, they can earn higher remuneration and contribute to economic wealth growth. Additionally, exposure to thriving entrepreneurs provides valuable insights and inspiration for students entering the field [7].

Market demand serves as a significant driver of entrepreneurial propensity for chemical engineers. Understanding when demand is high allows engineers to adjust pricing strategies accordingly, such as raising prices during peak seasons like Christmas or reducing prices during intense competition. Economic factors influence entrepreneurial activities, including the business cycle and government policies [8]. For instance, setting up new ventures becomes more challenging during economic downturns, and government taxation policies can impact investment decisions and unemployment rates.

Chemical Engineering has been thought of as one of the most challenging programs. However, now, with this embedded entrepreneurship of the programmed skills and methodologies, the programmed has been classified as one of the most interesting programs by the students because it is unlimited in terms of what the business arena is that one wants to venture into as far as Chemical Engineering is concerned, seeing that the world is now revolutionizing. There is a very high demand for chemical engineers to play a role in leading some innovations.

For NUST students, those who want to scan for gap structures in Chemical Engineering giant companies like Ingwebu, Datlabs, and National Foods face a very intense competition that seeks to accommodate two, if not one, student taken as an intern at such companies about their enrolment population; hence, such dwindles the hope of many students, but the entrepreneurial approach in the field then strikes a balance, though there is a challenge that, though some students may want to setup businesses of their own as Chemical Engineers, there will be a need for funding since setting up chemical manufacturing plants is very costly in Zimbabwe.

For the past four years, the Chemical Engineers Association of Zimbabwe has thought it wise that their students should be enrolled in entrepreneurial development as chemical engineers to enhance total change in the sector and to create more employment opportunities for even students who need internships to thrive as both engineers and entrepreneurs in their areas of trade, as well as to conduct programmed that motivate those even in high school to know what to expect in terms of embracing innovation and technology in entrepreneurship.

Entrepreneurship among science and technology students is emerging. The fourth industrial revolution and the COVID-19 pandemic fostered the urgency to embrace enterprising behaviors among many people. University students in STEM universities are important in promoting entrepreneurship and innovation. Most studies in entrepreneurship and innovation within STEM institutions have been done in the developed world. Entrepreneurship and innovation are progressing at a snail's pace among STEM institutions in Zimbabwe. What challenges and drives entrepreneur propensity among chemical engineering students in STEM university settings in Zimbabwe is unknown. A conceptual framework or model on the challenges and drivers of entrepreneur propensity among chemical engineering students is yet to be developed.

Most studies in entrepreneurship and innovation within STEM institutions have been done in the developed world such that little is known of the challenges and drivers of entrepreneur propensity among chemical engineering students in STEM university settings in Zimbabwe. The main objective is to develop a framework to explain the challenges and drivers of entrepreneur propensity among chemical engineering students at the National University of Science and Technology in Zimbabwe.

## 2. Literature Review

Entrepreneurship is pivotal in driving innovation, economic growth, and societal advancement, particularly within STEM fields. This chapter aims to underscore the critical importance of entrepreneurship in these domains through a review of key factors and scholarly perspectives. Entrepreneurship in STEM fields, especially among chemical engineering students, is essential for innovation and economic growth. However, several challenges and drivers influence their entrepreneurial inclination. This essay explores these factors to understand better the entrepreneurial propensity landscape among chemical engineering students in Zimbabwean STEM institutions.

## 2.1. Overview of the Importance of Entrepreneurship in STEM Institutions in Zimbabwe

Entrepreneurship in STEM fields is a key driver of innovation, transforming scientific and technological advancements into tangible solutions [9]. Entrepreneurs often introduce groundbreaking biotechnology, information technology, and engineering solutions, driving continuous progress and development [10]. These ventures contribute to economic growth by creating new markets, industries, and employment opportunities, increasing productivity and competitiveness [11], [12]. They also play a crucial role in addressing societal challenges like renewable energy, healthcare, environmental sustainability, and infrastructure. For example, green technologies and biomedical engineering can mitigate environmental degradation and improve healthcare accessibility. Entrepreneurship in STEM fosters a culture of innovation, risk-taking, and problem-solving, encouraging professionals to push boundaries, experiment with new ideas, and embrace failure as a stepping stone to success [13], [14]. This culture fosters resilience and adaptability in pursuing novel solutions, fostering progress in rapidly evolving technological landscapes [15], [16].

It should be noted that chemical engineering is gaining popularity in Zimbabwe due to its diverse applications in industries like pharmaceuticals, mining, agriculture, energy, and environmental conservation. The growing demand for skilled chemical engineers is crucial for fostering an entrepreneurial mindset. These students possess technical knowledge and problem-solving skills, making them well-equipped to identify market gaps and develop innovative solutions. A supportive ecosystem should be created to harness their entrepreneurial potential, including mentorship programs, entrepreneurship training, and networking opportunities. These students can drive innovation and economic growth and address societal challenges, such as access to clean water, affordable energy, and food security.

## 2.2. Entrepreneurial Propensity Challenges Among Chemical Engineering Students

Chemical engineering programs often lack dedicated entrepreneurship courses [17], [18]. The absence of entrepreneurial education limits students' exposure to business skills necessary for identifying opportunities and launching ventures [19]. Furthermore, societal norms and cultural expectations prioritize job security over entrepreneurial ventures [20]. Family pressures and societal expectations often discourage risk-taking in favor of traditional career paths. In addition, the scarcity of visible role models or success stories within the chemical

engineering entrepreneurial domain diminishes students' confidence and aspirations to pursue entrepreneurial ventures [21].

Chemical engineering students face challenges accessing financial resources, mentorship, or tailored support networks [22]. This limitation hampers their ability to fund or develop entrepreneurial ideas. Also, chemical engineering often emphasizes traditional career trajectories in established industries [23]–[25]. This dominant career perception might undervalue entrepreneurship, reducing students' inclination. Another challenge is the fear of failure and risk associated with entrepreneurship, which dissuades students from exploring entrepreneurial ventures [26]. Risk aversion undermines their willingness to pursue less conventional career paths.

Entrepreneurship education is crucial for students to navigate the business landscape, but there are gaps in the curriculum, particularly in STEM institutions. Chemical engineering programs often focus on technical knowledge, neglecting entrepreneurial skills like business planning, financial management, marketing, and strategic decision-making. Limited access to mentorship and guidance from experienced entrepreneurs can help students understand the practical aspects of entrepreneurship. Interdisciplinary collaboration and integration of entrepreneurship within the curriculum can also help develop well-rounded entrepreneurial skills. Combining business, marketing, finance, and innovation courses can give students a holistic understanding of entrepreneurship and encourage cross-disciplinary collaboration. By addressing these gaps, students can develop the skills they need to succeed in the ever-evolving business landscape.

## 2.3. Entrepreneurial Propensity Challenges Among Chemical Engineering Students

Chemical engineering programs often lack dedicated entrepreneurship courses [26]. The absence of entrepreneurial education limits students' exposure to business skills necessary for identifying opportunities and launching ventures [27], [28]. Furthermore, societal norms and cultural expectations prioritize job security over entrepreneurial ventures [29]. Family pressures and societal expectations often discourage risk-taking in favor of traditional career paths. In addition, the scarcity of visible role models or success stories within the chemical engineering entrepreneurial domain diminishes students' confidence and aspirations to pursue entrepreneurial ventures [30].

Chemical engineering students face challenges accessing financial resources, mentorship, or tailored support networks [31]. This limitation hampers their ability to fund or develop entrepreneurial ideas. Also, chemical

engineering often emphasizes traditional career trajectories in established industries [32]. This dominant career perception might undervalue entrepreneurship, reducing students' inclination. Another challenge is the fear of failure and risk associated with entrepreneurship, which dissuades students from exploring entrepreneurial ventures [33]. Risk aversion undermines their willingness to pursue less conventional career paths.

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#### 2.4. Drivers Influencing Entrepreneurial Propensity

Several factors influence the entrepreneurial propensity among chemical engineering students in Zimbabwe. STEM education fosters critical thinking and problem-solving skills, allowing students to identify problems and develop creative solutions. Thus, a strong foundation in science, technology, engineering, and mathematics enables students to explore unconventional approaches and embrace risk-taking. Furthermore, a supportive ecosystem, including mentorship programs, incubators, and support networks, is crucial for nurturing entrepreneurial initiatives. These platforms provide guidance, resources, and industry connections, allowing students to refine their business ideas, receive professional feedback, and access funding options.

Hence, successful entrepreneurial role models inspire students to pursue their entrepreneurial dreams. Their stories of overcoming challenges and achieving tangible outcomes inspire students to pursue their entrepreneurial dreams. Also, global market demands and emerging opportunities in chemical engineering act as powerful motivators for entrepreneurial-minded students. Understanding global trends allows students to identify potential niches, market gaps, and areas where their skills can be leveraged. This knowledge encourages students to explore entrepreneurial ventures that can have a global impact.

#### 2.5. Empirical Studies and Case Analyses

Law and Breznik [34] analyzed the impact of attitudinal factors on students' entrepreneurial intention, comparing engineering and non-engineering students and gender groups. A total of 998 students from Hong Kong universities were surveyed. The findings revealed that learning motivation significantly correlates with innovativeness, affecting entrepreneurship intention. The study also found that the educational measures for senior-year students differ from those for junior-year students and that the attitude of engineering students significantly contributes to their entrepreneurial intention. Female students showed more influence on entrepreneurial intention, while innovation was more influential among male students. However, the study had limitations, including sample size and survey design, and suggested future research to include students from different countries and explore demographic parameters.

Udayanganie, Jusoh, and Chinna (2019) examined the impact of cognitive variables on the intention to entrepreneurial behavior of engineering undergraduates in Sri Lanka [35]. Entrepreneurship is crucial for the economy, and recent changes present challenges and opportunities for engineering education. An investigation of 202 senior undergraduates discovered a substantial positive correlation between entrepreneurial cognition and the entrepreneurial mindset within the engineering student community. Moreover, notable connections were identified between arrangement, willingness, ability, and the entrepreneurial mindset, alongside the correlation between the entrepreneurial mindset and the inclination towards entrepreneurial behavior. This research underscores the importance of fostering an entrepreneurial mindset among engineering students.

The world's rapid changes present challenges and opportunities for engineering education [36]. Engineering students are well-suited to become entrepreneurs due to economic trends and changes in employer decision-making. The demand for engineers who can develop innovative technologies to solve global problems and improve quality of life is high. Promoting entrepreneurship and innovation in engineering education is crucial in developing countries like India. This paper presents two case studies demonstrating how students can use entrepreneurial skills to develop software solutions for real-life problems. Introducing mini-projects can motivate students to become successful entrepreneurs [37].

Entrepreneurs are key drivers of a nation's progress and development, transforming innovations into economic goods [38]. Research investigated the elements essential for managers transitioning into entrepreneurs, focusing on the personal motivational factors crucial for



business success. Key variables such as recognizing opportunities, catalyzing events, aspiration for accomplishment, fostering innovation, self-assurance in abilities, and inclination towards proactive actions were selected. A survey was distributed among 40 managers and employees within the telecommunications sector, yielding 25 valid responses. The analysis revealed a positive correlation between catalyzing events, the drive for achievement, and the inclination towards proactive behavior. However, a relatively weaker positive correlation was observed between the aspiration for accomplishment and innovation.

This study investigates entrepreneurial characteristics among university students in India studying business [39]. It examines the entrepreneurial attributes among students, distinguishing between those predisposed to entrepreneurship and those not. Six key entrepreneurial traits were pinpointed: inclination towards risk-taking, propensity for innovation, locus of control, drive for achievement, overall self-efficacy, and tolerance for ambiguity. Data was gathered from three universities in India. The findings indicated that students inclined towards entrepreneurship exhibited a greater inclination towards risk-taking, innovativeness, locus of control, drive for achievement, and tolerance for ambiguity. The study advocates for additional research exploring diverse academic disciplines and conducting comparisons across different universities.

This research aimed to understand the impact of entrepreneurial attitudes on self-employment intention among final-year engineering students in Ethiopia [40]. A survey methodology involved 921 respondents from a pool of 4327 final-year undergraduate engineering students. The findings indicated a significant relationship between entrepreneurial education, attitudes, and students' intention to pursue self-employment. Key factors such as information-seeking behavior, creativity, aspiration for achievement, self-assurance, goal-setting ability, exposure to entrepreneurship education, familial background in business ownership, previous entrepreneurial experiences, access to financial resources, and networking capabilities emerged as significant predictors. Conversely, demographic and socio-economic variables did not demonstrate significant predictive power. The study recommends that governments and universities design programs to encourage entrepreneurship among students, promoting a more entrepreneurial mindset and intention.

Ngah and Ramlan [41] state that entrepreneurship is crucial for economic growth and development, and fostering a culture of entrepreneurship is essential for higher learning institutions. University Kuala Lumpur (UNIKL) faces challenges in fostering entrepreneurship

culture, particularly regarding student attitudes and mindsets. This paper discusses the challenges lecturers and universities face in implementing entrepreneurial activities, including financial aid, student participation, and support systems. The findings could help the university improve its approach to embedding an entrepreneurship culture, which is essential for achieving economic growth and development.

The study investigates the impact of a prolonged economic recession on university students' entrepreneurial intentions, focusing on the propensity to start a new business and the perceived likelihood of becoming an entrepreneur [42]. The study involved distributing questionnaires in both electronic and paper-and-pencil forms to 3684 Italian university students from 12 faculties. The results showed that the perceived strength of the economic crisis did not influence the propensity towards entrepreneurship but significantly negatively impacted the likelihood of starting a business. Additionally, the recession affected both dimensions of entrepreneurship—propensity and perceived likelihood. The study also found that family support and economic institutions were not considered relevant in sustaining entrepreneurial intentions. It is one of the few studies to examine the influence of rapidly worsening external economic context on entrepreneurial intent.

### 3. Material and Methods

#### 3.1. Research Design

The research design describes the different types of research methodology that were used. Quasi-research is often carried out in field settings where random assignment is not feasible, primarily to assess the effectiveness of treatments or educational interventions [43], [44]. Mixed methods research design, which combines qualitative and quantitative methods [45], [46], was used in this study. The quantitative part of the study involved a quasi-experimental, Pre-test, and Post-test design sample. The qualitative part of this study involved focus group interviews with students in Chemical Engineering in the experimental group. The focus questionnaire interviews have enabled the identification of detailed findings [47]. Thus, the findings of the qualitative and quantitative parts of this research were complementary.

#### 3.2. Target population

The participants for the research are learners from those chosen at NUST. A non-probability sampling method was used. The sample size used for the research study determines the level of accuracy and the quality of the results obtained from the study being carried out, and it

yields more accurate results than a small sample size as it is representative of the whole institution under study [48].

### 3.3. Sample & Population

The students were selected randomly from the Chemical Engineering classes (cutting across to even those studying beyond Master/lecturers), ensuring they had similar academic attainment levels since they are all within the faculty of Chemical Engineering. Hence, they meet the minimum entry requirements that the university clarified upon enrolment. A total of 40 participants were used.

### 3.4. Research Instrument

A Questionnaire with ten simple questions was designed to extract information on whether entrepreneurship is key to be implemented and adopted by the chemical engineers in order for them to be relevant in the mining or pharmaceuticals industries as well as for them to get high remuneration as they employ diverse strategies to solve problems within those industries. Also, the questionnaire was designed so that each question had four responses. Namely, I agree, I strongly agree, I disagree, and I am afraid I have to disagree to capture the impact of every response regarding every question for a population size of 40 students/experts.

### 3.5. Data Analysis

Data was obtained from the research instrument/questionnaires issued to NUST students. Those linked to the mining and pharmaceutical industries were entered into an Excel package, and the number of respondents was recorded against their responses. Descriptive statistics was used to check the impact of the responses and measure how much they favor the research from their responses.

### 3.6. Validity and Trustworthiness

Trustworthiness serves as a critical test of the internal validity of regression. This validation procedure evaluates whether the analysis outcomes observed in the sample can be extrapolated to the population from which the sample

was drawn. The model can be validated by deriving a model and estimating its coefficients in one data set, then checking the residuals, and so on. Triangulation was also applied to ensure the data was trustworthy. Furthermore, models validated using the same data from which the model was developed are prone to overestimation. Therefore, validators should conduct tests of goodness of fit and discrimination on a separate dataset to assess the model's trustworthiness.

### 3.7. Ethical Consideration

All procedures conducted in studies involving human participants must adhere to the institution's ethical standards, the guidelines set by the National Research Committee, and the principles outlined in the 1964 Helsinki Declaration, including any subsequent amendments or comparable ethical standards. Christensen and Johnson say ethical considerations are the principles and guidelines that help us uphold what we value [49]. Additionally, the researchers secured consent from NUST and collaborated with representatives from the mining industry to conduct the research study on the designated students. Furthermore, consent was obtained from all individual participants included in the study. Moreover, the study adhered to the national ethical guidelines the Ministry of Education research committee set forth.

## 4. Result and Discussion

### 3.1. Questionnaire Responses

In order to delve into the nuances of participant perspectives, the researcher meticulously constructed a survey comprising 10 Likert Scale-based questions. These questions were carefully designed to elicit a comprehensive understanding of various facets related to the research inquiry. Participants were asked to express their opinions and attitudes on various topics, allowing for a nuanced exploration of their viewpoints, and the following responses were generated:

**Table 1.** Research Instrument

No.	Questions	Average	Std Dev.
Q1	Do you agree that limitations to entrepreneurial propensity among NUST chemical engineering students in Zimbabwe are very high?	3.400	1.135
Q2	Do you agree that self-determination is an important driver among NUST chemical engineering students in Zimbabwe?	4.375	1.687
Q3	Do you believe social networking behavior influences the entrepreneurial mindset among NUST chemical engineering students in Zimbabwe?	3.175	1.201
Q4	Do you agree that the innovative behavior among NUST chemical engineering students in Zimbabwe is very high?	2.800	1.458

No.	Questions	Average	Std Dev.
Q5	Do you agree that experiences of self-determination impact entrepreneurial propensity among NUST chemical engineering students in Zimbabwe?	3.575	1.350
Q6	Do you agree that social networking behavior is related to an entrepreneurial mindset among NUST chemical engineering students in Zimbabwe?	3.125	0.871
Q7	Do you agree that an entrepreneurial mindset drives innovative behavior among NUST chemical engineering students in Zimbabwe?	3.975	0.999
Q8	Do you agree that entrepreneurial propensity positively and highly impacts NUST chemical engineering students in Zimbabwe?	3.550	1.303
Q9	Do you believe that experiences of self-determination and social networking behavior collectively influence entrepreneurial mindset among NUST chemical engineering students in Zimbabwe?	3.025	1.072
Q10	Do you agree that the relationship between innovative behavior and entrepreneurial propensity among NUST chemical engineering students in Zimbabwe is high?	4.175	1.069

**Question 1:** The average score for the agreement that limitations to entrepreneurial propensity among NUST chemical engineering students in Zimbabwe are very high is 3.4, with a standard deviation of 1.135. This suggests some variation in the responses, with some students agreeing more strongly with the statement than others. The variation in responses to entrepreneurial propensity may be attributed to personal experiences, differing perspectives, and varying understandings of "limitations." Students may strongly agree with limitations, while others may have different perspectives based on their experiences or viewpoints.

**Question 2:** The average score for the agreement that self-determination is an important driver among NUST chemical engineering students in Zimbabwe is 4.375, with a standard deviation of 1.687. This indicates a higher level of agreement among the students regarding the importance of self-determination as a driver. Most students agree on the importance of self-determination in shaping their entrepreneurial mindset and actions. This suggests that personal drive and motivation are crucial for entrepreneurial success. However, individual differences may affect this understanding. Self-determination is often associated with qualities like initiative, perseverance, and autonomy, essential for entrepreneurial success.

**Question 3:** The average score for the belief that social networking behavior influences entrepreneurial mindset among NUST chemical engineering students in Zimbabwe is 3.175, with a standard deviation of 1.201. This suggests that there is some variation in the perception of the influence of social networking behavior on the entrepreneurial mindset. The impact of social networking behavior on entrepreneurial mindset varies among students. Some may see it as a valuable tool for idea generation and resource access, while others may not. The influence of social networking behavior on entrepreneurial mindset can vary based on individual preferences, cultural factors, and the specific context. Some students may find

social networking influential, while others may prioritize factors like personal drive, education, or mentorship.

**Question 4:** The average score for the agreement that innovative behavior among NUST chemical engineering students in Zimbabwe is very high is 2.8, with a standard deviation of 1.458. This indicates some disagreement among the students regarding the level of innovative behavior. Peer perception, educational approaches, and cultural influences influence the perception of innovative behavior among NUST chemical engineering students in Zimbabwe. These factors can lead to varying levels of agreement on the concept and its application.

**Question 5:** The average score for the agreement that experiences of self-determination impact entrepreneurial propensity among NUST chemical engineering students in Zimbabwe is 3.575, with a standard deviation of 1.35. This suggests some agreement among the students regarding the impact of self-determination on entrepreneurial propensity. A study in the Journal of Accounting and Finance in Emerging Economies examined the impact of self-determination experiences on entrepreneurial propensity among NUST chemical engineering students in Zimbabwe. The study highlights the broader interest in understanding the influence of experiences on entrepreneurial propensity, which can vary depending on individual circumstances, cultural factors, and personal motivations.

**Question 6:** The average score for the agreement that social networking behavior is related to an entrepreneurial mindset among NUST chemical engineering students in Zimbabwe is 3.125, with a standard deviation of 0.871. This indicates student agreement regarding the relationship between social networking behavior and an entrepreneurial mindset.

**Question 7:** The average score for the agreement that an entrepreneurial mindset drives innovative behavior among NUST chemical engineering students in Zimbabwe is 3.975, with a standard deviation of 0.999. This suggests some agreement among the students regarding the role

of an entrepreneurial mindset in driving innovative behavior.

**Question 8:** The average score for the agreement that entrepreneurial propensity positively and highly impacts NUST chemical engineering students in Zimbabwe is 3.55, with a standard deviation of 1.303. This indicates some variation in the perception of the impact of entrepreneurial propensity.

**Question 9:** The average score for the belief that experiences of self-determination and social networking behavior collectively influence entrepreneurial mindset among NUST chemical engineering students in Zimbabwe is 3.025, with a standard deviation of 1.072. This suggests that there is some variation in the perception of the collective influence of these factors on entrepreneurial mindset.

**Question 10:** The average score for the agreement that the relationship between innovative behavior and entrepreneurial propensity among NUST chemical engineering students in Zimbabwe is high is 4.175, with a standard deviation of 1.069. This indicates some student agreement regarding the strength of the relationship between innovative behavior and entrepreneurial propensity.

### 3.2. Limitation to Entrepreneurial Propensity

This comprehensive strategy underscores the imperative of concerted efforts to mitigate the identified limitations and foster an environment conducive to entrepreneurial pursuits among NUST chemical engineering students. Entrepreneurial propensity among NUST chemical engineering students is subject to various limitations, which encompass:

**Limited Access to Resources:** A predominant challenge NUST chemical engineering students face revolves around restricted resource access. This encompasses financial capital, a pivotal asset for initiating and sustaining entrepreneurial ventures. Insufficient funds impede investments in research and development, procurement of requisite equipment, and recruitment of competent personnel. Moreover, the absence of mentorship and guidance hampers students' adept navigation through the entrepreneurial terrain. Facilitating mentorship programs and networking avenues is indispensable for assimilating industry insights, honing business acumen, and accessing potential investors [50]–[52].

**Risk Aversion:** A pervasive apprehension among NUST chemical engineering students stems from the fear of failure and the inherent uncertainty in entrepreneurial endeavors. The academic milieu predominantly accentuates conventional career trajectories, thereby

fostering risk-averse mindsets. Students harbor reservations regarding financial perils, potential setbacks, and the exigencies inherent in entrepreneurship. Such risk aversion impedes proactive exploration of entrepreneurial avenues [37], [53].

**Lack of Entrepreneurial Education:** Another impediment NUST chemical engineering students encounter is the dearth of exposure to entrepreneurial concepts, competencies, and training. While the curriculum underscores technical proficiency and engineering fundamentals, it often neglects foundational entrepreneurial tenets encompassing business planning, market analysis, financial management, and marketing strategies. The absence of such requisite knowledge impedes active engagement in entrepreneurial pursuits and formulation of viable business propositions [54]–[56].

**Cultural and Societal Norms:** Cultural and societal paradigms substantially influence entrepreneurial propensity among NUST chemical engineering students. Prevailing societal norms and cultural expectations may undermine or undervalue entrepreneurship as a viable career trajectory. Consequently, entrepreneurial endeavors may encounter limited validation and support. The prevailing societal ethos may coerce students towards conforming to conventional career paths, thereby stifling entrepreneurial aspirations. Nurturing an enabling ecosystem conducive to entrepreneurship is imperative to surmount cultural barriers and challenge entrenched societal norms, fostering an environment conducive to innovation and economic progress [12], [57]–[59].

**Addressing these Limitations:** Mitigating these constraints necessitates a multifaceted approach. Facilitating access to resources such as seed funding, mentorship initiatives, and entrepreneurial networks is pivotal in overcoming resource constraints. Propagating entrepreneurial education through specialized coursework, workshops, and experiential learning endeavors is indispensable for equipping students with requisite competencies. Fostering an entrepreneurial ecosystem that champions and sustains entrepreneurship can effectively counteract prevailing cultural and societal norms undermining entrepreneurial endeavors [60]–[62].

### 3.3. Drivers to Entrepreneurial Propensity

NUST chemical engineering students are poised to experience and benefit from several drivers that positively influence self-determination, social networking behavior, entrepreneurial mindset, and innovative behavior. These drivers encompass:

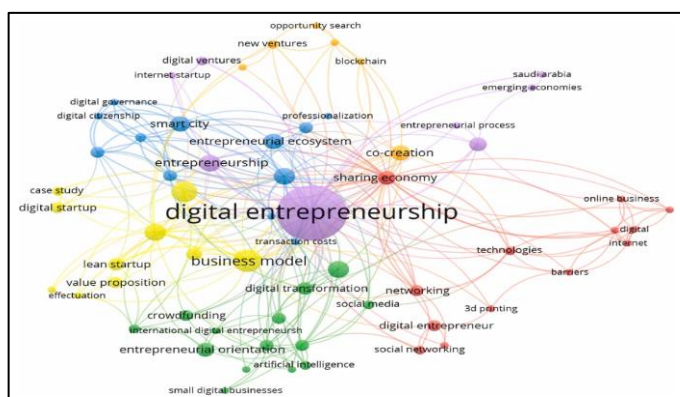
**Personal Motivation and Passion:** Intrinsic drive and passion for entrepreneurship are potent catalysts for self-determination and entrepreneurial mindset among NUST



chemical engineering students. Students exhibit heightened initiative, goal-setting prowess, and resilience in adversity when fueled by their interests and aspirations. Personal motivation and passion act as formidable forces propelling students towards their entrepreneurial ambitions, empowering them to surmount challenges encountered [63], [64].

**Supportive Educational Environment:** NUST offers an array of entrepreneurship courses, workshops, and mentorship programs, constituting a supportive educational milieu conducive to fostering self-determination and facilitating networking and skill development. This nurturing environment encourages students to explore their entrepreneurial aptitude, giving them the knowledge and resources for success. By embracing many entrepreneurship-focused initiatives, NUST instills an entrepreneurial mindset within students, catalyzing their pursuit of innovative ventures [55], [60], [65].

**Networking Opportunities:** Active engagement in social networking behavior, both online and offline, presents avenues for forging connections with kindred spirits, potential collaborators, and mentors. NUST chemical engineering students stand to reap substantial benefits from networking opportunities inherent within the university's ecosystem, encompassing entrepreneurship clubs, industry symposiums, and guest speaker sessions. Cultivating a robust network furnishes students with indispensable support, guidance, and resources, nurturing their entrepreneurial journey and fostering innovation through collaborative endeavors [66], [67].



**Figure 1.** Visualization Digital Entrepreneurship Co-Occurrence Word Network and Clusters [13].

**Exposure to Innovative Ideas and Technologies:** Endowed with access to leading-edge research, nascent technologies, and active participation in innovation-centric pursuits, NUST chemical engineering students are primed to cultivate a proclivity for innovative thinking. This

exposure kindles their curiosity and stimulates creative ideation, empowering them to devise novel solutions to real-world challenges. By remaining abreast of cutting-edge developments in their domain, students discern avenues for innovation and leverage their expertise to effectuate tangible impact. Such exposure fosters an entrepreneurial ethos, fostering a culture of creativity and critical inquiry among students [68], [69].

Moreover, the confluence of these drivers collectively nurtures the development of self-determination, social networking behavior, entrepreneurial mindset, and innovative behavior among NUST chemical engineering students. By fostering an environment conducive to nurturing these drivers, NUST emboldens students to explore their entrepreneurial potential and effectuate meaningful societal contributions through innovation and entrepreneurship.

## 5. Conclusion and Recommendation

Several important insights emerged from the findings of this research. Firstly, it is evident that students have a common understanding of the key factors influencing entrepreneurial success. This shared understanding signifies a foundational knowledge base among the students, which can serve as a starting point for fostering an entrepreneurial mindset.

However, it is important to note that individual students may possess unique perspectives on how these factors contribute to their entrepreneurial mindset. This diversity in viewpoints reflects the complexity of entrepreneurship and underscores the need for tailored approaches to nurture and support the entrepreneurial aspirations of each student. One standout finding from the research is the importance of personal drive and motivation in achieving entrepreneurial success, particularly among Chemical Engineering Students. This underscores the role of intrinsic motivation as a driving force behind entrepreneurial endeavors. Personal motivation can create a potent formula for entrepreneurial growth when combined with external factors such as a supportive educational environment, networking opportunities, and exposure to innovative ideas and technologies.<sup>6</sup>

The researcher's findings suggest that facilitating access to resources, promoting entrepreneurial education, creating a nurturing and supportive ecosystem, and cultivating personal motivation are all critical elements in developing a thriving entrepreneurial culture among these students. These insights provide valuable guidance for educational institutions and underscore the significance of holistic approaches in empowering aspiring entrepreneurs in the Chemical Engineering field. By embracing these

principles, institutions can play a pivotal role in shaping their students' future of entrepreneurial success and contributing to broader economic and technological advancements.

Institutions such as NUST should organize specific entrepreneurship seminars for chemical engineering students. These seminars should also provide opportunities for students to present their innovative ideas, with funding provided for the most promising projects. This will motivate students and foster innovation, industrialization, and job creation, boosting Zimbabwe's economy. The chemical engineering sector should recognize and support entrepreneurial engineers with business acumen and technical expertise. These professionals can play a pivotal role in improving efficiency and innovation in sectors like mining. Additionally, chemical engineering students should receive education in market philosophies to understand the importance of pricing and economies of scale in entrepreneurship.

They encourage networking and collaboration among chemical engineering entrepreneurs by connecting them with influential individuals and organizations. Strong branding efforts can also boost the confidence and visibility of these entrepreneurs in the market. Educational reforms should be considered to promote entrepreneurial propensity among chemical engineering students. This includes integrating entrepreneurship courses, offering experiential learning opportunities, and organizing business plan competitions. Mentorship programs through alum networks and industry partnerships can provide valuable guidance.

Policy changes, such as funding initiatives and clear intellectual property policies, should be explored to support aspiring entrepreneurs. Collaborations between academic institutions, industry, and government agencies can create a conducive environment for entrepreneurship. These recommendations aim to foster a culture of entrepreneurship among chemical engineering students, helping them develop essential skills and contribute to economic growth and innovation in Zimbabwe.

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