

# Achievement in University Engineering Studies: A Case for Resilience and Self-efficacy

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**Abstract** The prevalent high failure rate among the nontraditional black university students, in particular, those who attempt engineering studies has generated research to resolve this problem. A variety of factors leading to this have been cited by research. Impoverished backgrounds which means learners are stuck in poorly resourced backgrounds and schools seems to be the leading factor as this has a ripple effect on a number of other achievement variables. However, there is a gap on research that explores factors underpinning successful cases. Hence, this paper is based on the exploration of a successful engineering student from abject poverty. Resilience and self-efficacy were found to be the pertinent factors that led to achievement in engineering. Self-efficacy based interventions and therapies have served clinical and medical psychology very well. The paper concludes by proposing further exploration of self-efficacy in tandem with resilience as an alternative to improve achievement for black engineering students.

**Keywords** Resilience, Self-efficacy, Achievement, Engineering Studies, Disadvantaged University Students

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## 1. Introduction and the Context of the Problem

Admission to engineering studies for the South African youth of all races signaled a demise of the Job Reservation of 1926 and Bantu Education Act of 1954. The former ensured that blacks were excluded from professions such as engineering, whilst Bantu Education Act of 1954 by Verwoerd<sup>32</sup>, provided inferior education to blacks that they would not qualify to study engineering anyway. Repealing these was the 1996 Constitution which promulgated the right to choose occupation or profession freely for all South African citizens. Consequently, black youth in their numbers, have entered engineering studies in the country's universities for the past two decades. However, national research by the Department of Higher Education has found that the majority of these have a very high drop-out rate<sup>3</sup>. Confirming this for engineering students is the finding of a very low academic

success rate, 30%, by Fletcher<sup>7</sup>. Consequently, one of the objectives of the National Development Plan is to increase the number of throughput from the universities<sup>19</sup>.

The problem has attracted much research with the aim of uncovering blockages and factors that need to be removed so as ensure that the positive constitution and policies aimed at actualizing the human potential in the country regardless of race and class, are efficiently implemented. Factors cited are underpinned by the continued disadvantages within the black communities.

Cognitive ability of students seems to be viewed as a factor for the high dropout rate for students. Loji<sup>15</sup> asserts that the significant number of South African students lack problem solving skills in engineering studies, making it difficult for them to succeed. In support of this view van Eeden et al<sup>31</sup> argue that cognitive ability and learning potential are predictors of academic achievement by engineering students. Hence, a pre university intervention has been proposed<sup>21</sup> as well as the introduction of psychological assessment with a view of identifying the students' cognitive weaknesses before and after entry to the university<sup>9</sup>.

Another frequently cited culprit for the high failure and dropout rate is the mismatch between grade 12 results and academic performance at the university<sup>30</sup>. This means the National Senior Certificate examinations (NSC) has been found to be a poor predictor of first year academic success at the university<sup>20</sup>. Admission to South African universities is based on students' performance on NSC examinations which are national and common for all students in their final year of high school. The view of NSC being a poor predictor for success at the university has kindled a debate whether it is an appropriate sole entry requirement for the university. Therefore, strategies to compliment NSC as an entry requirement to the university have been initiated as a strategy to resolve the high dropout rate of students<sup>9</sup>.

The final culprit cited is the continued disadvantaged schooling of the majority of black children. Township schools lack educational resources<sup>12</sup>. This renders black high school graduates ill prepared to cope with the transition from high school to university and to cope with the new academic demands<sup>11</sup>. This is despite the promulgation of the South

African Schools Act (SASA) of 1996 which aimed to redress many forms of inferior education accorded to the blacks in accordance with Bantu Education Act, township and rural schools are still entirely segregated and lack educational resources enjoyed by schools

All the above factors for achievement at the university are underpinned by disadvantaged schooling in impoverished neighborhoods. For example, poor schooling lacks cognitive enhancement learning, and consequently good grades are a mostly likely a result of rote learning. At university level, learning by and large is based on higher level of cognitive functioning such as problem solving. Much as lack of cognitive ability of students at the university is viewed as a problem, students who make to the engineering studies at university do so on the basis of their superior high school achievement in mathematics and science. According to Renzulli<sup>24</sup> this is schoolhouse giftedness; which is in contradiction with the lack of cognitive ability<sup>15</sup>. Derailed cognitive functioning may be at play. Definitely not lack of cognitive ability.

According to Feuerstein et al<sup>6</sup>, derailed cognitive functioning causing poor performance can be effectively corrected by Instrumental Enrichment (IE) intervention. IE is based on the tenet that adolescents have experienced cognitive growth, but affective-motivational factors affecting the cognitive processes can combine negatively and influence the attitudes of learning among adolescents in a way that derails the effective cognitive functioning.

Therefore, there is a need to explore other alternative factors which may be affecting academic achievement of students who have demonstrated superior cognitive ability prior university, particularly those who continue to do well at the university. In fact there is a gap in researching the factors behind the successful disadvantaged engineering students. Therefore, this study investigated a successful engineering student who had all the attributes of impoverished disadvantaged background and schooling. In this case, the students have survived the environment which should make her fail, thus theory points to resilience as a factor. However, resilience operates in tandem with self-efficacy. Therefore, the following section gives a brief review of resilience and self-efficacy as alternative factors for academic achievement for the disadvantaged students.

## 2. Resilience and Self-efficacy Alternative Achievement Factors

Luthar<sup>16</sup> states that resilient children as those who survives risky environment by using their strong self-confidence, coping skills and abilities to avoid risky situations. Also, 'Resilience generally refers to a class of phenomena characterized by positive adaptation in the context of significance adversity or risk'<sup>18</sup>. Risky environments and adversity include disadvantaged families and neighborhood. Children from such neighborhoods have been found to be vulnerable to mental health problems, hence these are in the

majority of the group afflicted with mental health problems<sup>29</sup>. Therefore, it makes sense that disadvantaged backgrounds have a negative impact on the cognitive functioning of students.

The concept of resilience suggests that regardless of the disadvantaged backgrounds, resilient children do not succumb to these adverse conditions<sup>14</sup>. But they are able to apply coping skills and through self-confidence persist against the odds and eventually achieve their goals. Also resilience exists across different cultures<sup>2</sup>. Hence, students from low socio economic backgrounds in South Africa can have resilience in the area of learning and academic achievement.

In defining resilient children, Luthar incorporates self-confidence as a vehicle for resilience. This means one of the motivators to persist in the face of adversity, is the confidence that one has the ability to bounce back. Therefore, resilience does not operate in a vacuum. According to Bandura<sup>1</sup> self-efficacy theory is a person's beliefs in their capabilities to produce desired effects by their own actions. This seems to imply that self-efficacy beliefs are not tainted by environment. But, they are so strong that the believer will do whatever it takes to overcome the obstacles and eventually succeed in achieving the intended purpose.

Literature is rife with the power of self-efficacy in different domains of human lives. For example, in the area of clinical psychology, self-efficacy based therapy has been used<sup>17</sup>. For example, DiClemete et al<sup>4</sup>, assert that measures of self-efficacy continue to prove valuable in the assessment of addictive behaviors, particularly with maintenance or relapse. Also, self-efficacy interventions have been used to treat phobias<sup>33</sup>.

However, of interest to this paper is self-efficacy in the area of academic achievement. Pintrich et al<sup>22</sup> argue that one of the models of achievements motivation has found that 'when people expect to do well they tend to try harder, persist and perform better'. Pintrich<sup>23</sup> further argues that adaptive self-efficacy and competence perception motivates students in the learning environment.

## 3. Method

Exploring factors behind the success of a disadvantaged student was the objective of this study. Therefore, the study fits in with the definition of a case study. According to Stake<sup>27</sup> a case study is not a methodological choice but a choice of what has to be studied. It is noted that the case study has long been stereotyped as a weak sibling among social science methods<sup>35</sup>. However, Thomas<sup>28</sup> argues that there is no need to adopt and subsume the credentials of inductivist thinking when using a case inquiry since it can stand on its own as a method based in the phronesis of the both the inquirer and the reader. But more importantly according to Flyvberg<sup>8</sup> the case study produces the context – dependent and 'in the study of human affairs, there appears to exist only context-dependent knowledge'<sup>8</sup>. Finally,

Ruddin<sup>25</sup> presents a very good argument about the valuable information that can be produced by a case study. He argues that much of the ancient philosophical theories are based on case studies.

Willig<sup>34</sup> sounds a warning that case studies are not a method themselves and hence many methods can be used in case study research. For this particular case inquiry, a semi-structured, but in-depth interviewing<sup>13</sup> was utilized. Also this was an intrinsic case study. Such cases are selected in order to explore 'how the phenomenon exists within a particular case'<sup>27</sup>. The phenomenon of interest here is achievement in spite of factors found by research to mitigate against academic achievement in engineering studies at the university.

Global analysis of qualitative data advocated by Henning<sup>10</sup>, was employed. Hence analysis of qualitative data was looked in an integrated manner as opposed to fragmented codes. This means the very structure of data from interviews and accompanying notes are seen as the organizing logic or themes for data. In other words, the priority in data analysis was placed on understanding the participants' voice not just finding themes. However, the voice led to themes.

#### 4. Defining the Case

Zama, not her real name, was the case chosen for the study. She is a 20 year old engineering student who fit the profile of disadvantaged. She and her younger siblings were raised by a single parent, who died when she was sixteen years old. Then Zama was forced to be the head of her household. Zama and her siblings rely on the Government's grant for orphans. They live in low housing projects meant for the poorest in the country. Despite all this adversity in her life Zama managed to pass high school very well. She had applied for engineering in one of the largest universities in the country. Finding support to pursue engineering studies became mission impossible. However, she persisted until she succeeded. Defying the odds! The enquiry sought to find out what motivated Zama to pursue when all odds were stacked against her.

##### THEME 1: THE SEEDS OF PURSUING LEARNING

The seeds of pursuing education for Zama seem to have been planted by her mother when she was alive. Despite limited resources, her mother not only provided regular meals, but also school requirements. Until, recently, South African parents regardless of their low socio economic status were supposed to buy stationary and all the school textbooks. Hence, Zama said; "Ma. Whatever we wanted for school, Ma (mother) always made sure we got it. Even if she had no money, she would borrow it just to make sure we have what we need." This clearly seems to have sent a message that school is very important!

Not only was her mother a provider, but she encouraged and cajoled her to be serious about school. Therefore, attending school every day for Zama's mother was not

negotiable.

**Zama:** *She used to encourage me to go to school even if I did not feel like it. If encouraging failed, she threatened to beat me up.*

This encouragement and cajoling had long term effects even in the face of failure to pursue studies.

##### THEME 2: PURSUING AGAINST THE ODDS AND EVENTUALLY SUCCEEDING

Zama had no means to go the university. However, the community seem to have been touched by her high school success.

**Zama:** *When I passed matric (grade 12), I had no one to pay for my university fees. My results were very good. I almost got distinctions in maths and science (she smiles). A pastor of the church I attend to get my story in the newspaper. In response, to the article in the newspaper, a businessman in Heidelberg (a town which is about 50 km South of Johannesburg), volunteered to pay my university fees. But, he only paid the registration fee and the rest of the school fees he never paid.*

She had to travel by public transport about 100 km. But, it seems the distance was not a problem. The cost of travelling was the problem.

**Zama:** *I took some of our grant and used it for travelling, but even this was not enough for travelling every day. I ended up having no money for buying food! After trying to get help from all my relatives, I decided I had no choice, but to stop going back to the university after the first semester.*

The year was wasted as she had to stay at home. Her efforts to apply for bursaries were thwarted by the fact that the university would not release her results as she owed. She could have given up, but she spent the whole year trying to get some help. She eventually did. It was SAYEP (South African Youth into Engineering Programme), a Non- Profit Organization which supports disadvantaged youth to pursue engineering that came to her rescue as she called the organization almost every day.

When she eventually returned to the university, she found out that the university had excluded her. This meant she was no longer allowed to study at this university. The exclusion was a result of her absconding. She never informed the university that she had to leave her studies. Therefore by default, she was excluded. Most students are excluded from the university because of poor performance. She was not aware when you register you enter into a study contract with the university. Even though she signed it, she did not read the fine lines.

**Zama:** SAYEP was upset at first thinking I took them for a ride. But investigating, SAYEP discovered that the University had excluded me by default. They explained that if a student does not show up for classes for months on end without cancelling the registration, the university system exclude the student.

But, even though she had never seen her results for the first semester (first half of the year), Zama was convinced that she had done well. Therefore, with the help of her new

sponsors, she appealed the exclusion.

**Zama:** I was told I had to appeal the exclusion as long as it was not an academic exclusion. See, you do not appeal academic exclusion. I assured SAYEP that it was not academic exclusion.

**Researcher:** What made you so sure it was not academic exclusion

**Zama:** Haaa !! Me failing! That will never happen! Even when I ran out of candles to study when I got home, I used to go under the street lights and study there! My problem could only be computer literacy as this required me to practice. I had to leave early for home and I had no computer at home.

During the interview it was very clear that Zama had confidence in her ability to succeed. If only she could be given a chance.

**Researcher:** You keep on saying you cannot fail. Are you intelligent?

**Zama:** I don't think I am intelligent, but I am hard worker and I do not give up easily. Hard work has never failed me. Ma taught me to work hard. I am also telling my brother and sister to do the same and they will never fail in life.

The seeds of the mother's motivation are coming again.

When her results were eventually released, it turned out that Zama had passed all the subjects she had registered for the previous year, except computer literacy. Two factors resulted into her failing computer literacy, namely, she had no computer to practice on and more importantly she had no time to use the university computers at the computer laboratory as she had to rush home after the end of her classes.

With the support of SAYEP, Zama was assisted with accommodation which was very near to the university as well as textbooks and stationary.

## 5. Discussion: A Case Applied of Resilience and Efficacy

Zama goes beyond the general definition of disadvantaged as she is an orphan who became a household head at a tender age of sixteen. When she returned to the university through SAICE and with the holistic support of SAYEP, Zama excelled. Out of seven courses she was registered for in the first semester, she got six distinctions. In the seventh course she was five marks away from a distinction.

The interview with Zama, brings to practice the theoretical meaning of resilience and efficacy.

Throughout the interview, what stands out for Zama is resilience. Throughout the adversity of losing her only parent, the responsibility at a tender age of heading her household, the disappointment of having to leave university in the middle of the year, Zama always finds a way of coping with all these in a positive and optimist manner. This has led her to continue with her university education even when odds were stacked against her.

On two occasions Zama expressed her strong belief in her academic capabilities. She further elaborated that this belief

is not based on her confidence in her intelligence but on her hard work. This is what she said in one instance, "I don't think I am intelligent, but I am hard worker and I do not give up easily. Hard work has never failed me. Ma taught me to work hard. I am also telling my brother and sister to do the same and they will never fail in life". This proves assertion by Pintrich<sup>14</sup> that 'students who believe they are able and that they can, are more likely to be motivated in terms of effort, persistence'

## 6. Conclusion and Recommendations

The study does not at all claim applicability to all students. However, it does raise questions on whether current research has omitted factors which may be at play in the failure for disadvantaged engineering students. Could it be, failing engineering students from the disadvantaged backgrounds are succumbing to the adversity of poor schooling, that is, they lack resilience? Lack of resilience could be from their low self-efficacy beliefs. After all, according to Pintrich<sup>22</sup> self-efficacy beliefs of students is a predictor of their academic achievement. 'Students who believe they are able, are more likely to be motivated in terms of effort, persistence, and behavior than those who believe they are less able'.

Clinical and health psychology have successfully applied self-efficacy in the treatment of their patients<sup>16</sup>. For example, self-efficacy enhancement during routine care can facilitate recovery from patients who had suffered from acute myocardial infarction<sup>5</sup>. Self-efficacy therapies are applied in the treatment of anxiety and phobic disorders<sup>33</sup>. Similarly, research on self-efficacy assessment and self-efficacy enhancement interventions of failing students could offer a different dimension to the current research which is focusing on the disadvantaged backgrounds and its consequences. What is of particular importance is that self-efficacy is almost always in tandem with resilience. This was clearly the case with Zama, her self-efficacy beliefs motivated her to bounce back<sup>26</sup> to pursuing engineering studies even though the university system had kicked out and despite her background of abject poverty in terms of finance and moral support. In other words self-efficacy facilitated resilience.

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