





The Role of Mathematics and Science Education in the Adult Offender Rehabilitation Process



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ABSTRACT

After the advent of democracy, the South African Department of Correctional Services implemented offender rehabilitation programmes as a means towards the humanistic approach to imprisonment, as opposed to the punishment approach. These programmes, even though not ostensible at first, were designed as the means for catalysing positive social behaviour, and for equipping offenders with the necessary skills to function in the work of skilled trade. The paper sought to explore, amongst the plethora of offender rehabilitation programmes, the role of mathematics and science education post-offender incarceration. From the pragmatic epistemological stance, qualitative and quantitative data were collected through semi-structured interviews and structured questionnaires, from four conveniently sampled ex-offenders. Framed within the QUANT-QUAL explanatory sequential mixed methods research design, and analysed thematically, through the lens of Vroom's (1964) Expectancy Motivation Theory, the findings revealed that mathematics and science offender education does not significantly correlate with offenders' ex-offenders' employment prospects. The study also revealed an insignificant correlation between mathematics and science education and reduced recidivism. The researchers recommend the intervention from the South African legal; framework, to reduce ex-offenders' criminal record duration so that their employment prospects will be broadened. The study presented in this intellectual piece will contribute to scholarship by situating mathematics and science learning within the ubiquitous offender rehabilitation cycle. The study will further aid in disseminating the unique role of offender mathematics and science education, particularly for scholars and policymakers whose focus is on offender rehabilitation in the democratic dispensation.

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INTRODUCTION

The South African Department of Correctional Services has a constitutional mandate to provide rehabilitation programmes that induce humane behaviour through a humanistic approach (as opposed to a punishment approach) and prepare offenders for reintegration into society. As such, each correctional facility entails the Development and Care component (amongst the multitude of other components), which

seeks to develop offenders both socially and educationally, through social work activities and educational programmes.¹ While all other rehabilitation components simultaneously and equally contribute to the offender rehabilitation process, the present paper sought to explore particularly the role of mathematics and science education in capacitating ex-offenders for the post-incarceration world. The researchers began to investigate how mathematics and science education are instrumental in treating offenders' behaviours while focusing on their needs-based aspect. To subvert perplexity that might emerge owing to the fact that mathematics and science education programmes under investigation, in this context, are those offered within the context of correctional centres, while the participants in the study were ex-offenders, it is important to note that the researchers conceptualise offender mathematics and science education as the continuum, whose inception is within the correctional centre classroom and its prolongation extends to the society and the world of skilled trade. In other words, the intellectual piece sought to explore mathematics and science education in the context of the term "holistic offender rehabilitation" by centralising and locating it [mathematics and science education] within the offender rehabilitation process, which is useful during and post-incarceration. The study seeks to address the following research question:

- **What is the discernible role of offender mathematics and science education in the post-incarceration context?**

To address this question, researchers will frame the study within the case-study research design, and use qualitative data, through semi-structured interviews with ex-offenders.

Where the present study differs from the preceding scholarly works which focus on offender rehabilitation is that it seeks to explore the role of mathematics and science in offender education beyond the parameters of the correctional centre facilities. In other words, the preceding scholarship focuses on investigating rehabilitation programmes and the role(s) thereof within the context of correctional centre facilities.² While the exploration of rehabilitation programmes from within the incarceration process is important, it is equally important to investigate the impact thereof in the world outside of "prison." In fact, offender rehabilitation programmes are implemented for a limited period, to prepare offenders for survival after societal reintegration, because, it [societal reintegration] is a complex process, that occurs over time. Thus, it [societal reintegration] requires offenders to be equipped for life beyond bars.

Locating offender rehabilitation within the formal education continuum

Offender rehabilitation is intended primarily, to improve positive behavioural change, broaden offenders' vocational skills and knowledge and reduce recidivism.³ As a matter of fact, the positive correlation between recidivism, employment prospects and offender formal education has been identifiable in various scholarly works. This correlation inostensibly denotes that sufficient education attainment is proportional to offender employment prospects. This denotation can be further strengthened by research whose findings indicated the relationship between ex-offenders' "prison" job training and reduced recidivism.⁴ While this is the case, a quantitative study indicates the highest unemployment rate for ex-offenders aged 35 to 44 (see Figure 1 below).⁵ The two latter views present the polarized arguments on the correlation between offender education and post-incarceration employment prospects. It is important, nonetheless, to note that the quantitative study on the high rate of ex-offenders' unemployment was contextualised in the United States of America; therefore, the question of whether the findings translate satisfactorily to the South African context, is worthwhile. Even though the contextual gap, in this regard, is discernible, these findings can be used to predict the state of ex-offenders unemployment rate in the South African context, and subsequently benchmark South African ex-offenders unemployment rate against the United States ex-offenders unemployment rate.

¹ Matata Mokoale, "Correctional Sentence Plan: A Pathway to Adult Correctional Education," *Adult Learning* 27, no. 2 (2016): 87–89.

² Nicholas Raphael Netto, James Michael Carter, and Christopher Bonell, "A Systematic Review of Interventions That Adopt the 'Good Lives' Approach to Offender Rehabilitation," *Journal of Offender Rehabilitation* 53, no. 6 (2014): 403–32.

³ Gillian Balfour, "Searching Prison Cells and Prisoner Bodies: Redacting Carceral Power and Glimpsing Gendered Resistance in Women's Prisons," *Criminology & Criminal Justice* 18, no. 2 (2018): 139–55.

⁴ James McGuire, "What Works' to Reduce Re-offending: 18 Years On," *What Works in Offender Rehabilitation: An Evidence-based Approach to Assessment and Treatment*, 2013, 20–49.

⁵ Melissa Alexander, "Applying Implementation Research to Improve Community Corrections: Making Sure That New Thing Sticks," *Fed. Probation* 75 (2011): 47.

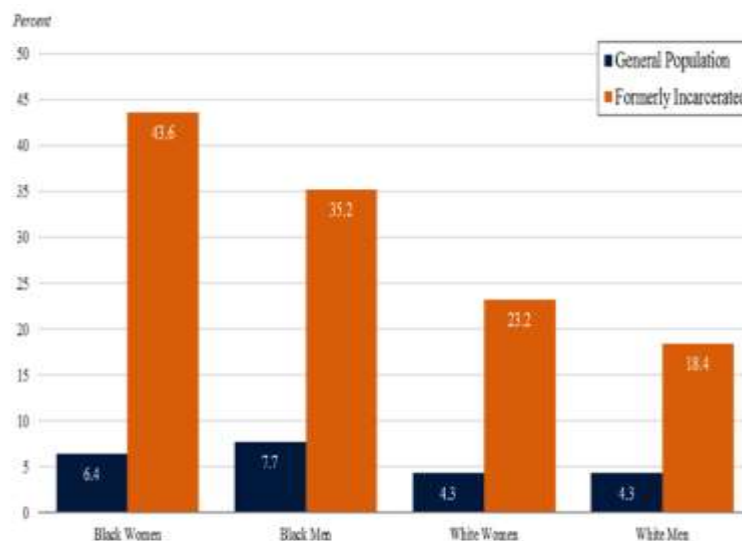


Figure 1: Unemployment rate for offenders aged 35 to 44.

It is imperative to note that, the aforementioned scholarship does not specify the curriculum aspect that has the largest statistically significant impact on ex-offenders' employment prospects. For example, outline the correlation between correctional education, prison training and reduced recidivism without identifying the learning area(s) that this correlation is attributed to. From this noticeable gap in the literature, the researchers sought to explore the correlation between mathematics/science offender education and offender rehabilitation.

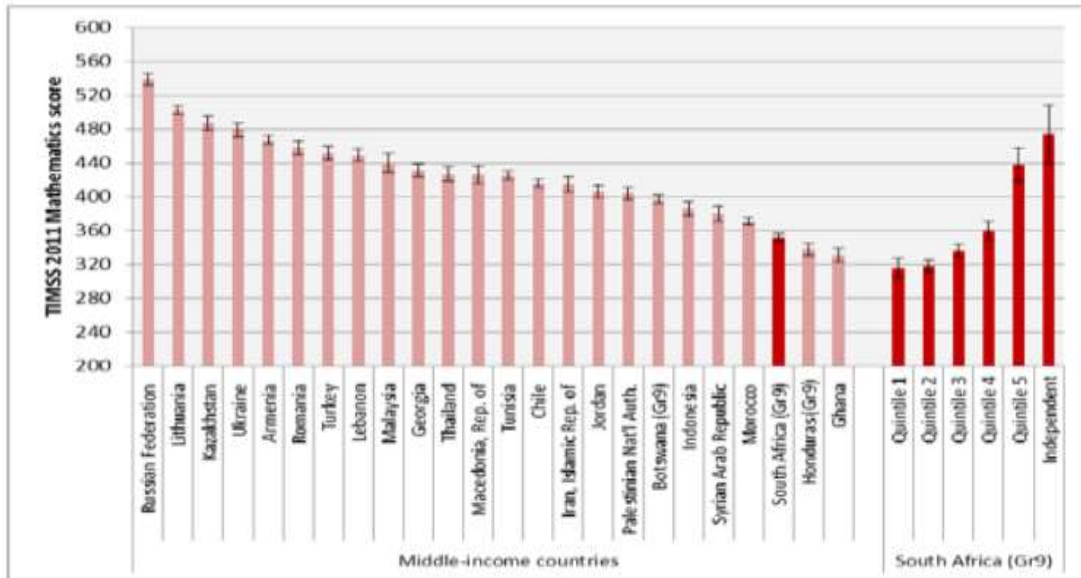
Contextualising mathematics and science education within the correctional centre classrooms

The state of mathematics and science performance in the South African Basic Education phase is something other than dire,⁶ with only 16% of grade three learners performing at a grade three level in mathematics, and the poorest 60% of learners being three grades behind the wealthiest 20% of learners across all basic schooling grades.⁷ While the latter scholarship ostensibly reveals economic factors as the determining variable for poor mathematics and science performance, it is worth noting that contextual factors cannot be controlled in a discussion of this nature. The scholarly work of Spaul can be drawn to affirm the argument that both economic and contextual factors can be equally and simultaneously attributed to poor mathematics performance (see also the graph in Figure 2, which indicates that South African grade 9 learners performed the lowest in the 2011 Trends in Mathematics and Science Study owing to economic and contextual factors).⁸

⁶ Nicholas Spaul and Janeli Kotze, "Starting behind and Staying behind in South Africa: The Case of Insurmountable Learning Deficits in Mathematics," *International Journal of Educational Development* 41 (2015): 13–24.

⁷ Nicholas Spaul, Elizabeth Pretorius, and Nompumelelo Mohohlwane, "Investigating the Comprehension Iceberg: Developing Empirical Benchmarks for Early-Grade Reading in Agglutinating African Languages," *South African Journal of Childhood Education* 10, no. 1 (2020): 1–14.

⁸ Nicholas Spaul, "Poverty & Privilege: Primary School Inequality in South Africa," *International Journal of Educational Development* 33, no. 5 (2013): 436–47.



Source: Spaull 2013, report for CDE, *South Africa's Education Crisis: The quality of education in South Africa 1994-2011*

Figure 2: Average Grade 9 mathematics achievement in 2013, in comparison to other middle-income countries.

Discussions that locate mathematics and science performance within the parameters of contextual and economic factors cannot exclude the exploration of mathematics and science performance in what is termed “protected spaces.”⁹ It is paramount to note, however, that the discussion around mathematics and science performance in protected spaces has to be discussed within the context of offender rehabilitation because, in prevalent studies, offender education is considered an important subset of the rehabilitation cycle.¹⁰

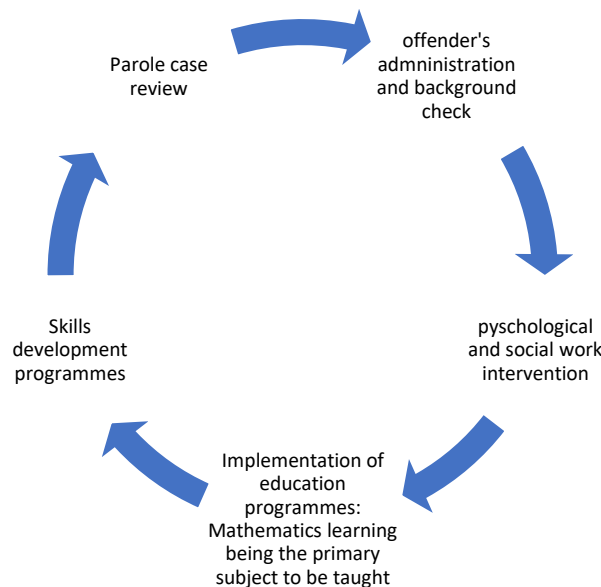


Figure 3: Learning mathematics as a subset of the rehabilitation process

⁹ N J Mokoale, M J Masenya, and K I Makalela, “Performance Management as a Mechanism to Effective Public Service Delivery in South Africa,” *African Journal of Public Affairs* 10, no. 4 (2018): 106–18.

¹⁰ Sipehele Mbatha, “The Role of Translanguaging in Teaching Mathematics at Adult Correctional Centre Classrooms in South Africa,” *E-Journal of Humanities, Arts and Social Sciences* 5, no. 6 (June 4, 2024): 825–34, <https://doi.org/10.38159/ejass.2024563>.

The state of mathematics and science performance in correctional centre classrooms

The South African law sets educational standards for offenders in two categories, which are school-age and adults without level four training.¹¹ School-age offenders are usually juveniles, who are still at the school-going age, and hence are expected to enrol for a full-time basic education programme, with grades seven, eight, nine, ten, eleven and twelve. Offenders of school-going age should leave a correctional service facility once they achieve a senior certificate (high school equivalence). Adult offenders, on the other hand, are required to attain level four of the Adult Education and Training Programme. In each of the two categories, basic literacies (such as writing and reading), mathematics, science and social studies are to be learnt. At an advanced level, adult correctional education also includes post-secondary and vocational studies, however, these studies require offenders to have gone through either the school-going age education or Adult Basic Education and Training. Furthermore, the two categories are considered paramount for the case rehabilitation process.¹² It is perceived paramount to indicate how offenders, in each of the two latterly mentioned categories, are enrolled, and perform particularly in mathematics and science.

According to the media statement on Basic Education Improvement of Matric Mathematics and Science, there was an increase in the number of offenders (both juvenile and adult), who enrolled in mathematics and science from 2011 to year 2015.¹³ (also see the graph in Figure 4 below) However, there is limited scholarship the of performance of offenders in mathematics and science, and the significance thereof in the rehabilitation process, which extends to the world beyond bars.

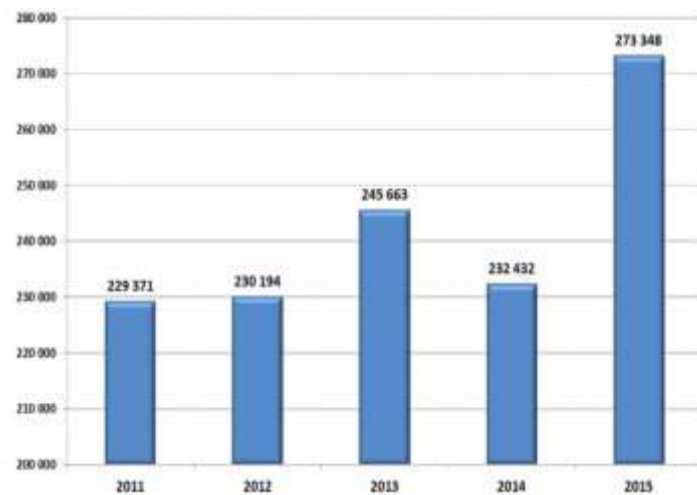


Figure 4: Mathematics and science full-time offenders' enrolment

THEORETICAL UNDERPINNING

This article is underpinned by Vroom's Expectancy Motivation Theory which proposes that one's perception of an outcome determines his or her level of motivation.¹⁴ This theory explains why individuals choose a certain activity or act over another. According to the theory, motivation emanates from multiple functions of valence, instrumentality, and expectancy (VIE).¹⁵

¹¹ Ntombizanele Gloria Vandala, "The Transformative Effect of Correctional Education: A Global Perspective," *Cogent Social Sciences* 5, no. 1 (2019): 1677122.

¹² Vandala, "The Transformative Effect of Correctional Education: A Global Perspective."

¹³ Nomalanga Ellen Mnisi and Marelize Schoeman, "An Analysis of Offender Social Reintegration Programmes Delivered by Non-Governmental Organisations," *Acta Criminologica: African Journal of Criminology & Victimology* 36, no. 3 (2023): 1–20.

¹⁴ Lina Daouk-Öyry and Hadi El-Farr, *Vroom's Expectancy Theory* (SAGE Publications, Inc., 2023); Asmidar Lokman et al., "Investigating Motivation for Learning via Vroom's Theory," *International Journal of Academic Research in Business and Social Sciences* 12, no. 1 (2022): 504–30.

¹⁵ Arvin Subramanian, A Seetharaman, and Koilakuntla Maddulety, "Critical Review Of Binge Watching Behaviour Through The Prism Of Vroom's Expectancy Theory," *Academy of Marketing Studies Journal* 24, no. 3 (2020): 1–11.

Expectancy

Expectancy is congruent with the notion that an increased effort in a task often yields better performance. In the context of this study, increased performance and (or) enrolment in mathematics and science education presumably catalyses offenders' rehabilitation and prepares them for the world of skilled trade post-incarceration (see Figure 5 below).

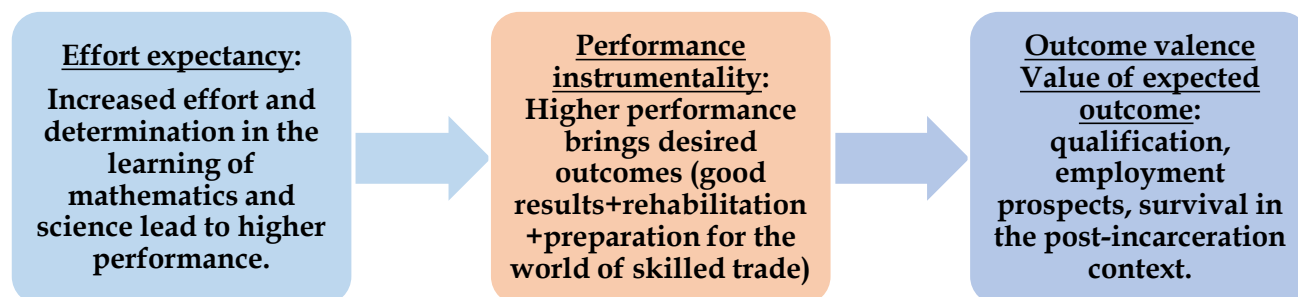


Figure 5: Vrooms Expectancy Theory

Other scholars define expectancy motivation as a person's short-lived behavior, which is cemented on the expectation for a prolonged positive outcome.¹⁶

Instrumentality

Instrumentality is the perception that better performance yields a valued outcome. In other words, better performance is the catalyst for, and is instrumental in achieving a desirable outcome. In the context of this study, offenders' increased effort in enrolling for, and studying mathematics and science in correctional centres presumably leads to higher performance. Subsequently, higher performance brings the desired outcomes (which are rehabilitation and preparation for the world of skilled trade).

Outcome Valence Value of expected outcome

This entails qualification for the individual offender, employment prospects and survival in the post-incarceration context.

METHODOLOGY

The study was contextualized within the province of KwaZulu-Natal, and the participants were three male ex-offenders who have completed the rehabilitation process from three different KwaZulu-Natal correctional centres. Through the thematic data analysis approach, and by operationalizing Vroom's Expectancy Motivation Theory as a lens, researchers inferred various contributions of mathematics and science education in the rehabilitation process and the "beyond bars" context.

In this study, the pragmatic epistemological stance was adopted, acknowledging both the quantitative and the deeper inquiry into the phenomenon, and aiming to understand the unique perspectives of ex-offenders about the teaching and learning of Mathematics and Science subjects offered in correctional centre facilities. The mixed methods approach was used to attain both an in-depth and quantitative inquiry into the phenomenon under investigation. Framed within the QUANT-QUAL explanatory sequential mixed methods research design, fifteen ex-offenders were conveniently sampled for the quantitative part of the data, and three of them were sampled for the qualitative part of data, from three selected Correctional Centre facilities within the province of KwaZulu-Natal. Henceforth, they [ex-offenders] were enrolled for AET programmes, which entail Mathematics and Science education during the period of their incarceration. Participants were informed of anonymity and confidentiality.

The researchers also indicated to the participants that their participation was purely voluntary and that they were not deprived of their right to withdraw their participation at any given time should they wish to do so. Likewise, all participants signed forms, indicating their consent to participate in the study. Data were collected through structured questionnaires and semi-structured interviews. Prior to the

¹⁶ Syahrina' Adliana Abdul Halim et al., "Exploring The Relationship between Learning Approaches and Vroom Motivation AMONG Undergraduate Learners at Malaysian Universities," 2023.

collection of data, the researchers requested to record the proceedings using a tape recorder. Permission to record a semi-structured interview and assess ex-offenders’ responses from structured questionnaires were obtained from participants.

Data was analysed both thematically and by SPSS. The guidelines set by Braun and Clarke were used as the basis for the thematic analysis and guidelines were used as the foundation data for the analysis of quantitative data through SPSS.¹⁷

PRESENTATION AND DISCUSSION OF FINDINGS

Quantitative results

Test of normality

When normality assumptions do not hold, it is impossible to draw accurate and reliable conclusions about the reality of data.¹⁸ In this study, the Shapiro-Wilk test was performed to determine whether the data from ex-offenders questionnaires were normally distributed or not. Furthermore, the Shapiro-Wilk test was done to determine whether the comparison should be done using a parametric or non-parametric test.

For the Shapiro-Wilk test, the determinant of data normality is the alpha value greater than .05 ($p > .05$). The null hypothesis (H_0) was that the negated questionnaire scores and the non-negated questionnaire scores were normally distributed. The p -value in the normality table below was used to determine the normality of the data and to determine whether the null hypothesis should be accepted or rejected.

Table 4: The tests of normality table

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Scores from negated questionnaires	,149	15	,200*	,975	15	,923
Scores from positive questionnaires	,149	15	,200	,975	15	,923

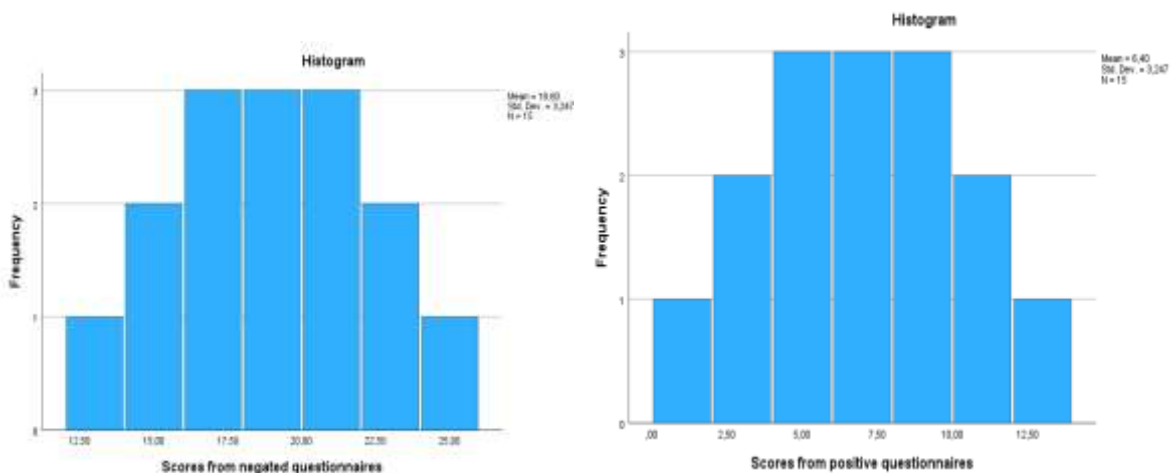


Figure 6: The frequency-test histograms

According to the tests of normality table, for both positive and negated questionnaire scores, there were no statistically significant values between the scores and normality, that is, the data were normally distributed (the p -value is 0.923, which is greater than 0.05; for both positive and negated questionnaire scores). Again, the frequency histograms for both positive and negated questionnaire scores are bell-shaped, which denotes the normal distribution of data.

¹⁷ Virginia Braun and Victoria Clarke, “Using Thematic Analysis in Psychology,” *Qualitative Research in Psychology* 3, no. 2 (2006): 77–101.

¹⁸ Perry R. Hinton, Isabella McMurray, and Charlotte Brownlow, *SPSS Explained* (Routledge, 2014).

Paired Sample T-Test Which Was Run for negated and positive questionnaires.

The hypothesis for the paired sample t-test was as follows:

The null hypothesis: The difference between the paired sample means is equal to zero (that is, the positive and the negated mean scores are the same).

$H_0: \mu_1 - \mu_2 = 0$

The alternative hypothesis: The difference between the paired sample means is NOT equal to zero (that is, the positive questionnaire score mean differs significantly from the negative questionnaire score mean).

$H_1: \mu_1 - \mu_2 \neq 0$

The following paired samples test was used to observe if the ex-offenders' positive and negative responses were significantly different or not.

Table 5: The paired samples test

		Paired Differences					T	Df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	Scores from negated questionnaires – scores from positive questionnaires	12,2000	6,49395	1,67673	8,60377	15,79623	7,276	14	<.001	<.001

According to the paired samples Table 5, the difference between the negated questionnaire mean and the positive questionnaire mean is positive, which implies that the negated questionnaire scores were higher than the positive questionnaire scores. To find out if this mean difference is statistically significant, the *t*-value has to be greater than the critical value of 2,045. From the paired samples test, the *t*-value is 7,276, which is greater than the critical value of 2,045.

$7,276 > 2,045.$

Qualitative Findings and Discussion

During the process of thematically analysing the data, three prevalent themes emerged. The themes might appear to be individually distinct from one another. Nonetheless, the interlink between the three themes was discernible (see Figure 7 below). Furthermore, it is worth noting that, even though the three themes might seem to be diverse, the convergence point, where they all co-ordinate is the fact that, they all addressed the question which animates the study: **What is the discernible role of offender mathematics and science education in the post-incarceration context?**

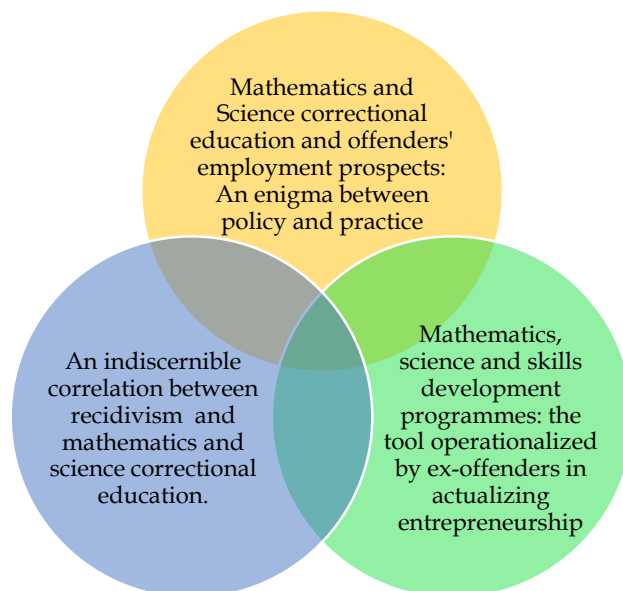


Figure 7: The themes and the interlink thereon

Theme one: Mathematics and Science Correctional Education and Employment Prospects of Offenders: An Enigma between Policy and Practice.

The findings, which emanated from the study indicated that even though mathematics and science correctional education aim at equipping the offenders with the necessary skills to function effectively in the corporate world, and the world of skilled trade the rate of ex-offenders employment is particularly low.¹⁹ From the perspectives of adult offenders, theoretically, mathematics and science correctional education is one way of completing the “rehabilitation cycle” of each offender. Nonetheless, the instrumentality of mathematics and science correctional education post-incarceration is, arguably obscure (hence the higher negated questionnaire scores on the effectiveness of mathematics and science correctional education) particularly because the employment prospects of ex-offenders are hindered by the criminal record(s) attached to their names. According to ex-offender A, whose words are presented verbatim below, there is no positive correlation between correctional mathematics and science education and the employment prospects of ex-offenders. Amongst other various factors, ex-offender A exhibits the criminal record attached to each ex-offender post-incarceration as the controlling variable.

Ex-offender A

Mathematics and science education is offered in all correctional centres, as far as I know. Adult offenders are taught mathematics literacy through the AET programme, and the juvenile offenders learn pure mathematics and other science-related subjects [which presumably entail Natural Sciences, Technology, Agricultural Sciences, Physical Sciences and Life Sciences] which are similar to those offered for the National Senior Certificate. I also enrolled for AET level four, because prior incarnation, I had attained formal schooling until standard eight [which, according to the recent curriculum, is equivalent to the tenth grade]. I also did Civil Engineering until N6. But, all that kind of education is not helping me because I have a criminal record, and I will only be eligible for the application to have the criminal record removed after ten years. Even after ten years, the application might not be successful. I am currently unemployed, will all that kind of education, because once employers discover that you have a criminal record, they do not consider you for employment. I am an adult, with a family of my own, but I am unemployed. (the words, presented verbatim above, were translated from the isiZulu language)

From the words of Ex-offender A, formal education in mathematics and science, as well as the skills development programmes, even though offered to offenders as a means to preparing them for the

¹⁹ Amy K. Lopez, “The Impact of Career and Technical Education Program Outcomes in the Windham School District on Offender Post-Release Employment Status” (Sam Houston State University, 2020).

world of skilled trade, do not aid in widening the employment prospects in the “post-incarceration” context. The claim made by Ex-offender A can further be strengthened by the report from the Prison Policy Initiative, which indicates that 60% of ex-offenders are unemployed (see graph in Figure 8 below).²⁰ Although the report does not clarify whether the unemployed ex-offenders are the representation of those [ex-offenders] who had received mathematics and science education during the period of their incarceration, it [the quantitative representation of the unemployment of ex-offenders] can be used to hypothesise the uncorrelation between offender rehabilitation (with mathematics and science education included as the subset of the offender rehabilitation programme) and employment prospects. Furthermore, even though the Prison Policy Initiative was conducted in the United States, its findings [according to the indications made by ex-offender A] are representative of the state of ex-offender unemployment in the South African context.

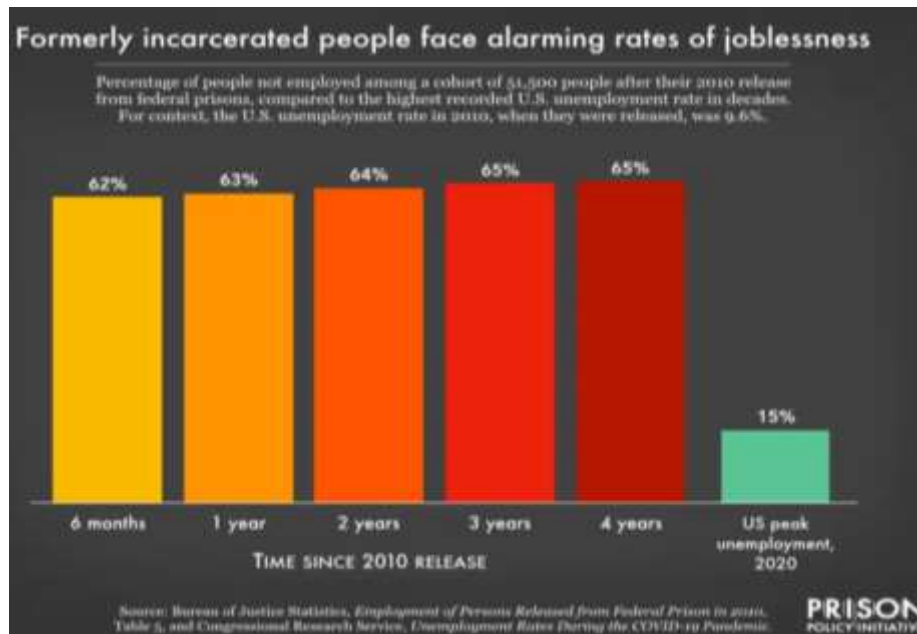


Figure 8: Percentage of ex-offenders unemployed after their release in 2010 in the United States

According to Ex-offender B, there is an enigma between policy and practice, as far as offender mathematics and science education and employment prospects are concerned. The policy stipulates that formal education (inclusive of mathematics and science education) is the approach for and towards holistic offender rehabilitation (and this is further strengthened by the scholarly works, nonetheless, this rehabilitation is not quite evident, and [it] cannot be fully practicalized and operationalized because the employment prospects of ex-offenders are narrowed by the criminal record attached to each offender.²¹ The words from Ex-offender B are presented verbatim below.

Theoretically, mathematics and science education is meant to correct our behaviour, help us solve societal problems, enhance critical thinking and broaden the employment prospects after incarceration. However, in reality, even though our behaviour is rehabilitated, the government and even some private companies cannot employ us because we have criminal records. This creates confusion because we are taught mathematics and science to get employment, but, in reality, you cannot get employment if you have a criminal record. I have a matric, with good grades in Mathematics and Physical Sciences. I also have an Electrical Engineering Higher Certificate. But no company can employ me because I have a criminal record. (the words, presented verbatim above, were translated from the isiZulu language)

Ex-offender B acknowledges that among the benefits of learning mathematics and science in correctional centre facilities is the development of critical thinking and problem-solving skills. As a matter

²⁰ Patrick Filipe Conway, “Getting the Debate Right: The Second Chance Pell Program, Governor Cuomo’s Right Priorities Initiative, and the Involvement of Higher Education in Prison,” *Harvard Educational Review* 90, no. 4 (2020): 598–616.

²¹ Danielle Newton et al., “The Impact of Vocational Education and Training Programs on Recidivism: A Systematic Review of Current Experimental Evidence,” *International Journal of Offender Therapy and Comparative Criminology* 62, no. 1 (2018): 187–207.

of fact, the findings of the study, which were conducted by Bozick et al., indicate that the operationalization of ²²levels of cognitive demand (in mathematics) supports students' mathematics critical thinking and problem-solving abilities (see the graph in Figure 9 below).²³ The levels of cognitive demands of Stein and Kaufman (2010) are parallel to the cognitive demands stipulated in the Mathematics Curriculum and Assessment Policy Statement for grades R-12. Furthermore, the CAPS document is also used as the guideline for the teaching, learning and assessment of mathematics correctional education. Therefore, critical thinking skills are bound to advance for offenders doing mathematics as much as they [critical thinking skills] advance owing to the learning mathematics in the "normal education setting."

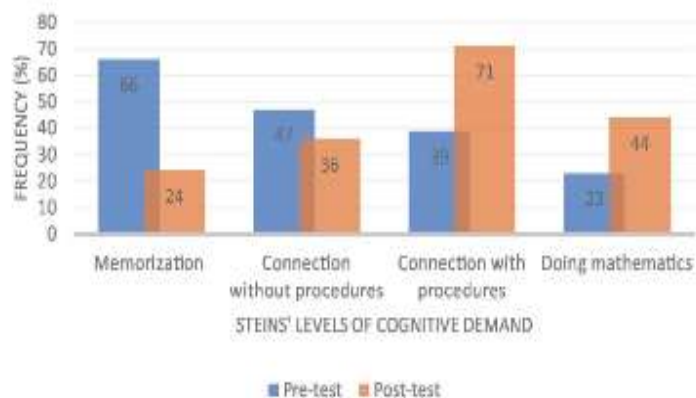


Figure 9: Students' responses to Stein's levels of cognitive demand in mathematics

What is worth noting, however, is that, with the advancement of critical thinking and problem-solving skills, there is not an apparent corporate space for ex-offenders to apply such problem-solving skills and critical thinking. Their employment prospects are limited because they have criminal records.

From Vroom's Expectancy theoretical stance, it is apparent that offenders enrol for mathematics and science correctional education and perform significantly better because they subsequently get enrolled for the skills development programmes (Effort expectancy). Furthermore, they are rehabilitated, and their critical thinking and problem-solving skills advance (performance instrumentality). However, they do not see the value of the expected outcome because they cannot operationalise their qualifications and their mathematics and science education to get employment in the post-incarceration context.

Theme two: An indiscernible correlation between recidivism and mathematics and science correctional education

The findings, which emerged from this data, exhibited a limited correlation between recidivism and mathematics and science education (this explains the higher scores of negated questionnaires over positive questionnaires in the quantitative data). In other words, the participants' responses showed that they see an insignificant direct proportion between the fact that they were taught mathematics and science during the period of incarceration and the chances of them recommitting similar or different offences and subsequently getting re-incarcerated. Mathematics and science correctional education is offered for two distinct, yet intertwined purposes; to rehabilitate offenders and to reduce the offenders' prospects of recommitting offences.

²² Stein, Mary Kay, and Julia H Kaufman. "Selecting and Supporting the Use of Mathematics Curricula at Scale." *American Educational Research Journal* 47, no. 3 (2010): 663-93.

²³ Robert Bozick et al., "Does Providing Inmates with Education Improve Postrelease Outcomes? A Meta-Analysis of Correctional Education Programs in the United States," *Journal of Experimental Criminology* 14 (2018): 389-428.

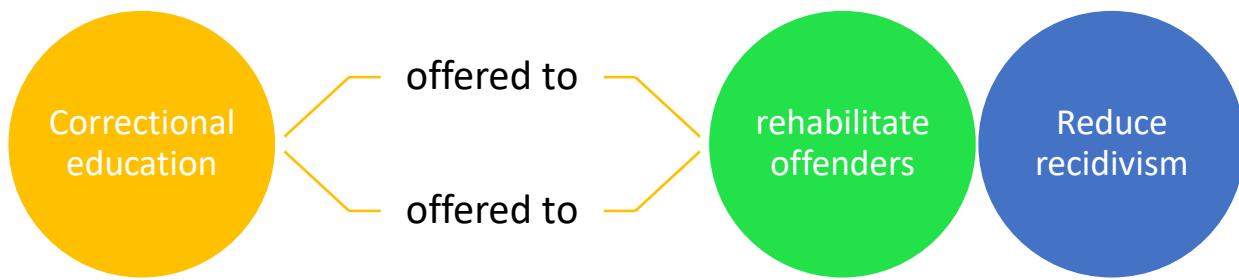


Figure 10: Two distinct purposes of offering formal mathematics and science education

Contrary to the claim made by the latter scholars, Ex-offender D indicated that he has attained mathematics and science correctional education, and learnt that the two subjects teach, amongst other aspects and reasoning. Nonetheless, in Ex-offender D’s opinion, the logic and reasoning skills seem inapplicable post-incarceration because, due to unemployment (as indicated in theme one), he had to find “alternative methods” of making a living, which led him back to the correctional facility.

Ex-offender D

I learnt mathematics and science in prison. I will not lie, these subjects teach and develop reasoning skills, logic, and critical thinking skills. However, these skills did not help me significantly post-incarceration because, due to unemployment, I had to make money through illegal means. Those means led me back to prison, having learnt the subjects that are intended to develop logic and critical thinking. If you have no means of making money, logic and critical thinking do not apply, unless applied in illegal activities. (the words, presented verbatim above, were translated from the isiZulu language)

What is illuminated by Ex-offender D can further be strengthened by data presented by the National Re-Offending Statistics of 2021 as cited by ²⁴ (see the graph in Figure 11 below). Even though the statistics were collated by the Ministry of Justice in England and Wales, it exhibits that the recidivism rate is higher on offences that are economically driven (such as fraud and theft), presumably because ex-offenders cannot find employment. Nonetheless, in the literature and according to the findings presented in this paper, there is no correlation between re-committing offences and mathematics and science education. What is the common factor, particularly between theme one and theme three is that the unemployment rate is significantly higher for ex-offenders because of criminal records, and hence, they end up re-committing offences.

²⁴ Jakub, Drapal, "Using Re-Conviction Data to Measure Re-Offending: Incorporating Seriousness and Frequency into a Single Non-Binary Measure." *Charles University in Prague Faculty of Law Research Paper No* (2021).

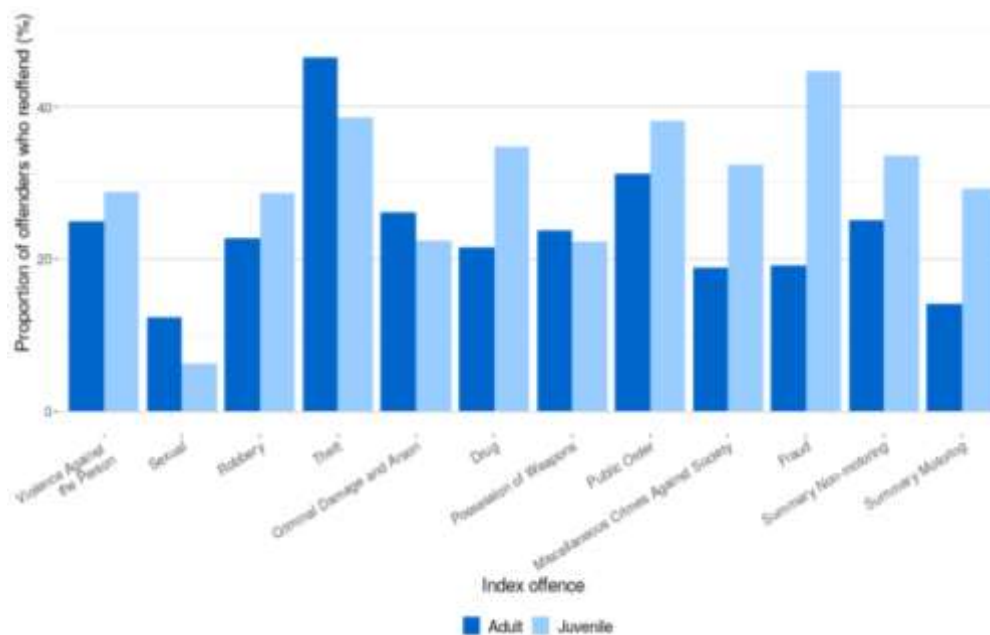


Figure 11: The proportion of offenders who re-offend and the nature of re-offences.

Theme three: Mathematics, science, and skills development programmes: the tool operationalized by ex-offenders in actualizing entrepreneurship.

According to the responses from the ex-offenders, the correlation between mathematics and science education and post-incarceration employment prospects is highly insignificant. Furthermore, the indication from ex-offenders revealed the inverse proportionality relation between the two variables (mathematics/science education and post-incarceration employment prospects). Nonetheless, ex-offender C revealed the direct proportionality relation between mathematics, science, skills development programs and offenders’ entrepreneurship.

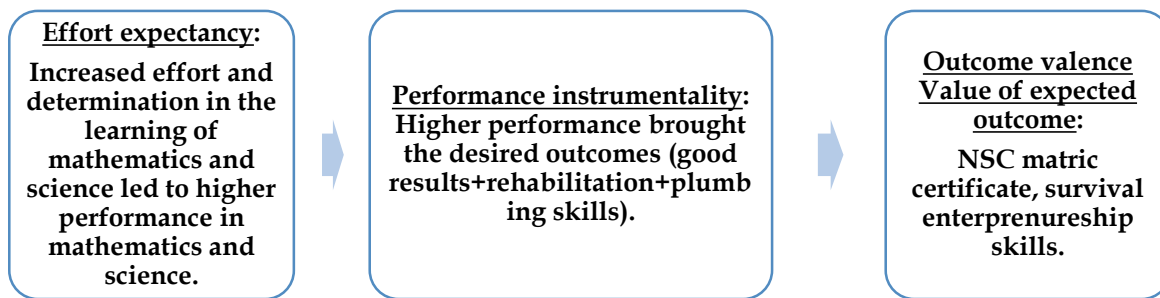
$$\text{Mathematics and science education} \propto \frac{1}{\text{offender employment prospects}}$$

$$\text{Mathematics and science education} \propto \frac{\text{offenders' entrepreneurship}}{1}$$

Ex-offender C

Learning mathematics and science in prison does not guarantee employment after release. This is because of a number of reasons. Firstly, in the period that we are in, there are no jobs, even for highly qualified people, who are not ex-offenders. The situation worsens for ex-offenders, who are carrying the criminal record around. Unless you get out of prison to start your own business, using mathematics and science knowledge, you will not get employment anywhere. In fact, I know a lot of ex-offenders who are self-employed, myself included. When I got incarcerated, my matric results were not so good, hence, I upgraded in mathematics and physical sciences. After I got released, I started my own plumbing business, which is going quite well. I used all that education to start my own business. (the words, presented verbatim above, were translated from the isiZulu language)

From the theoretical lens of Vroom’s expectancy theory, the response of Ex-offender C reveals that increased effort and determination in formal education and mathematics/science correctional education led to higher performance (because he obtained good results in mathematics and science while he was incarcerated. Furthermore, higher performance brought about the desired outcome because he got the plumbing skills (which he operationalizes post-incarceration) and behavioural rehabilitation. For the outcome valence value of the expected outcome, he attained survival entrepreneurship, which he has used to date.



The indication given by Ex-offender C reveals that mathematics and science education hones ex-offenders' entrepreneurship skills. In other words, the role of mathematics and science education in reducing recidivism and in broadening ex-offenders' employment prospects is not clearly discernible, but its [mathematics and science correctional education] is arguably highly significant in preparing and in aiding ex-offenders to start their Small, Medium and Micro Enterprises. There is a learning area (in the AET programme) which specifically focuses on teaching offenders how to start and operate their own SMME. This learning area, together with mathematics and science correctional education, becomes (according to the researchers' subjective views) the resource and instrument to and for helping ex-offenders to start their businesses.

The importance of Mathematics and science correctional education cannot be completely nullified because of its insignificant role in creating employment prospects for ex-offenders and in reducing recidivism. In fact, mathematics and science correctional education is, to some degree, pivotal in enhancing the development of SMMEs post-incarceration.

RECOMMENDATIONS

Mathematics and science correctional education is a recommended rehabilitation strategy for honing and developing the entrepreneurship skills of ex-offenders. The researchers further recommend that employers consider offenders' incarceration and (or) correctional education as the rehabilitation approach, and baulk from using the criminal record as the delimiter for ex-offenders' employment prospects. The researchers recommend the intervention from the South African legal framework, to reduce the criminal record duration of ex-offenders so that their employment prospects will be broadened.

CONCLUSION

The paper sought to explore the role of mathematics and science correctional education from ex-offenders' perspectives. According to the findings of the study, mathematics, and science offender education correlate insignificantly with ex-offenders' employment prospects and reduced recidivism. Furthermore, the paper also revealed that mathematics and science offender education improves and develops the entrepreneurship prospects of ex-offenders. The researchers recommend the reduction of the duration of the criminal record, and the view of incarceration and correctional education from the prism of behavioural rehabilitation, as opposed to the delimiter of the delimiter of ex-offenders' employment prospects.

BIBLIOGRAPHY

- Alexander, Melissa. "Applying Implementation Research to Improve Community Corrections: Making Sure That New Thing Sticks." *Fed. Probation* 75 (2011): 47.
- Balfour, Gillian. "Searching Prison Cells and Prisoner Bodies: Redacting Carceral Power and Glimpsing Gendered Resistance in Women's Prisons." *Criminology & Criminal Justice* 18, no.2(2018):139–55.
- Bozick, Robert, Jennifer Steele, Lois Davis, and Susan Turner. "Does Providing Inmates with Education Improve Postrelease Outcomes? A Meta-Analysis of Correctional Education Programs in the United States." *Journal of Experimental Criminology* 14 (2018): 389–428.
- Braun, Virginia, and Victoria Clarke. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3, no. 2 (2006): 77–101.
- Conway, Patrick Filipe. "Getting the Debate Right: The Second Chance Pell Program, Governor Cuomo's Right Priorities Initiative, and the Involvement of Higher Education in Prison." *Harvard Educational Review* 90, no. 4 (2020): 598–616.

- Daouk-Öyry, Lina, and Hadi El-Farr. *Vroom's Expectancy Theory*. SAGE Publications, Inc., 2023.
- Drápal, Jakub. "Using Re-Conviction Data to Measure Re-Offending: Incorporating Seriousness and Frequency into a Single Non-Binary Measure." *Charles University in Prague Faculty of Law Research Paper No* (2021).
- Halim, Syahrina'Adliana Abdul, Julizaerma Mohamad Khudzari, Nor Ezrine, Sharifah Faatihah Syed Mohd Fuzi Yusoff, Siti Hajjar Mohd Amin, and Noor Hanim Rahmat. "Exploring The Relationship between Learning Approaches and Vroom Motivation AMONG Undergraduate Learners at Malaysian Universities," 2023.
- Hinton, Perry R, Isabella McMurray, and Charlotte Brownlow. *SPSS Explained*. Routledge, 2014.
- Lokman, Asmidar, Farihah Hassan, Yus Aznita Ustadi, F A A Rahman, Z M Zain, and Noor Hanim Rahmat. "Investigating Motivation for Learning via Vroom's Theory." *International Journal of Academic Research in Business and Social Sciences* 12, no. 1 (2022): 504–30.
- Lopez, Amy K. "The Impact of Career and Technical Education Program Outcomes in the Windham School District on Offender Post-Release Employment Status." Sam Houston State University, 2020.
- Mbatha, Siphellele. "The Role of Translanguaging in Teaching Mathematics at Adult Correctional Centre Classrooms in South Africa." *E-Journal of Humanities, Arts and Social Sciences* 5, no. 6 (June 4, 2024): 825–34. <https://doi.org/10.38159/ehass.2024563>.
- McGuire, James. "'What Works' to Reduce Re-offending: 18 Years On." *What Works in Offender Rehabilitation: An Evidence-based Approach to Assessment and Treatment*, 2013, 20–49.
- Mnisi, Nomalanga Ellen, and Marelize Schoeman. "An Analysis of Offender Social Reintegration Programmes Delivered by Non-Governmental Organisations." *Acta Criminologica: African Journal of Criminology & Victimology* 36, no. 3 (2023): 1–20.
- Mokoele, Matata. "Correctional Sentence Plan: A Pathway to Adult Correctional Education." *Adult Learning* 27, no. 2 (2016): 87–89.
- Mokoele, N J, M J Masenya, and K I Makalela. "Performance Management as a Mechanism to Effective Public Service Delivery in South Africa." *African Journal of Public Affairs* 10, no. 4 (2018):106–18.
- Netto, Nicholas Raphael, James Michael Carter, and Christopher Bonell. "A Systematic Review of Interventions That Adopt the 'Good Lives' Approach to Offender Rehabilitation." *Journal of Offender Rehabilitation* 53, no. 6 (2014): 403–32.
- Newton, Danielle, Andrew Day, Margaret Giles, Joanne Wodak, Joe Graffam, and Eileen Baldry. "The Impact of Vocational Education and Training Programs on Recidivism: A Systematic Review of Current Experimental Evidence." *International Journal of Offender Therapy and Comparative Criminology* 62, no. 1 (2018): 187–207.
- Spaull, Nicholas. "Poverty & Privilege: Primary School Inequality in South Africa." *International Journal of Educational Development* 33, no. 5 (2013): 436–47.
- Spaull, Nicholas, and Janeli Kotze. "Starting behind and Staying behind in South Africa: The Case of Insurmountable Learning Deficits in Mathematics." *International Journal of Educational Development* 41 (2015): 13–24.
- Spaull, Nicholas, Elizabeth Pretorius, and Nompumelelo Mohohlwane. "Investigating the Comprehension Iceberg: Developing Empirical Benchmarks for Early-Grade Reading in Agglutinating African Languages." *South African Journal of Childhood Education* 10, no. 1 (2020): 1–14.
- Stein, Mary Kay, and Julia H Kaufman. "Selecting and Supporting the Use of Mathematics Curricula at Scale." *American Educational Research Journal* 47, no. 3 (2010): 663-93.
- Subramanian, Arvin, A Seetharaman, and Koilakuntla Maddulety. "Critical Review Of Binge Watching Behaviour Through The Prism Of Vroom's Expectancy Theory." *Academy of Marketing Studies Journal* 24, no. 3 (2020): 1–11.
- Vandala, Ntombizanele Gloria. "The Transformative Effect of Correctional Education: A Global Perspective." *Cogent Social Sciences* 5, no. 1 (2019): 1677122.

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