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THE LINK BETWEEN CAREER OUTCOMES EXPECTANCY AND CAREER DECISION-MAKING SELF-EFFICACY OF STEM STUDENTS IN A SOUTH AFRICAN UNIVERSITY

ABSTRACT

The Social Cognitive Career Theory (SCCT), one of the highly researched career theories, suggested that outcomes expectance and self-efficacy are crucial factors in the career selection process. The result of career outcomes expectancy (COE) and career decision-making self-efficacy (CDSE) may be pivotal in an individual's shunning or being more inspired in their career behaviour. Both factors together are important in career decision-making. The aim of this study was to investigate the association among COE and CDSE of science, technology, engineering and mathematics (STEM) students at a South African university. The article is based on a quantitative study conducted among a sample of 322 STEM students, of which 203 responses were received. The career outcomes expectancy scale (COES) and career decision self-efficacy scale (CDSES) were used in the collection of data. Data were analysed with the IBM SPSS version 26 software and descriptive statistics, Pearson's correlation, linear regression and multivariate analytical tools were engaged. Findings show that age and race significantly associated with CDSE. Additionally, COE was found to have a statistically significant relationship with CDSE and that CDSE positively predicted COE. The environment of upbringing was also found to be influential in participants' CDSE and COE. In line with extant literature, the discussion of the findings is made to proffer recommendations that have implications for practice, policy and further studies.

Keywords: *STEM education; career selection; career outcomes expectancy; career decision-making; self-efficacy; career development.*

1. INTRODUCTION

Owing to the shortfall in the skills associated with science, technology, engineering and mathematics (STEM), educators and stakeholders in South Africa are seeking ways to improve enrolment as well as reduce attrition and poor performance among students. Achieving these could develop careers that should fill existing skill gaps and meet

the skills demand of the Fourth Industrial Revolution (4IR). Career development, perceived as a lifetime process, is an essential part of individual development and is a particularly vital aspect of psychosocial growth (Eryılmaz & Mutlu, 2017).

The term "career" describes a fusion of task roles individuals encounter in a lifetime (Super, 1980). It is a growth process that involves the totality of a person's tasks prior to their engagement in a profession, while in the profession and post exit from the profession (Kuzgun, 2000). Career growth involves every action that happens during a career (Baruch, Szűcs & Gunz, 2015). Throughout the process of career development, several variables play significant roles (Owusu *et al.,* 2019). The COE and CDSE are two of the variables that play fundamental roles.

Self-efficacy convictions involve mental processes that play influential roles in the acquisition or modification of behaviours. These processes demonstrate efficacy in individual competence expectations (Bandura, 1986). Individual competence expectation is concerned with convictions of fulfilling a behaviour and accomplishing results. Self-efficacy convictions could be associated with previous experiences and expectations for future learning achievement. People with strong degrees of self-efficacy convictions can determine consistent goals, show confidence in their ability to achieve the goals and activate the achievement of a given career task. Conversely, weak self-efficacy convictions may hinder an individual's ability to achieve goals (Komarraju & Nadler, 2013). COE refers to the actual, accessible ideas and career goals that a person wishes to achieve (Metz, Fouad & Ihle-Helledy, 2009).

Several career approaches have been propositioned to explain the career growth process and individual career behaviours. Since the 1980s, cognitive theories have been increasingly used in understanding behaviours associated with careers. These cognitive theories highlight a person's dynamic role in their career growth (Heslin, Keating & Minbashian, 2019).

2. THEORETICAL FRAMEWORK

The Social Cognitive Career Theory (SCCT) is one of the contemporary theories engaged to understand individual career behaviour. Lent, Brown and Hackett (1994) initially proposed the SCCT for the explanation of developmental processes and career behaviours from a cognitive viewpoint. It was proposed by Lent *et al*. (1994) as a framework to explain three features of career growth, namely career interest development, career choice and achievement, and sustenance in learning and employment. The theory stems from the general Social Cognitive Theory (SCT) propounded by Bandura (1986) to understand the complicated relationship between individuals, environment and behaviours. The SCCT also focuses on three distinct constructs, namely self-efficacy convictions, individual goals and outcome expectancies. It contends that the achievement of goals is largely influenced by a person's outcome expectancy and self-efficacy convictions. Lent (2005) reports that effectively concentrating on goals could enhance outcome expectancy and self-efficacy convictions in a constructive sequence. The extant literature discusses outcome expectancy and self-efficacy convictions generally as constructs in research that use SCCT in the explanation of career growth (Lent *et al*., 2017; Gushue *et al*., 2006).

When appraising career growth from the SCCT perspective, CDSE is considered a vital element in a person's objectives, career interests, options, achievements and experiences (Jo *et al*., 2016). Career decision refers to the act of selecting an option for a learning programme, profession, employment or academic institution (Doğan, 2014). Hence, CDSE denotes the

confidence that an individual exhibits in making a successful career decision and achieving positive results in their career growth tasks. These tasks comprise capabilities in respect to correct self-assessment, gathering data about professions, planning, setting targets and problem solving (Betz, 2000).

On the other hand, COE describes the convictions about long run results of an accomplishment (Betz & Voyten, 1997). It refers to people's expectations associated with the results of their chosen career. COE, according to Isik (2013), could be considered as an individual's convictions concerning the probabilities of experiencing main career attributes, for instance, earnings, status, efficiency and fame. Some of the items on the career outcome expectancy measure are: "the career that I choose will provide the income which I need" and "the career that I choose will support me to lead the life which I want to live" (Betz & Voyten, 1997)

Regarding SCCT, COE and CDSE are vital parts of career growth, selection, and decision-making. Tertiary institution periods are significant growth years when several modifications are encountered in learning, individual, social and employment areas (Newman & Newman, 2017). The period of transition experienced by students in tertiary institutions exposes them to decision-making regarding their perceived COE (Donald, Ashleigh & Baruch, 2018).

Previous research conducted within South Africa and elsewhere globally, suggests that issues experienced by students regarding career decision-making is similar among several cultures. Studies have been conducted in North Cyprus (Caliskan & Ozcan, 2017), Turkey (Kondakci, 2011) and among Korean and French learners (Sovet & Metz, 2014). Shumba and Naong (2012) found in a South African study that family background and teachers' influence significantly affected student career decision-making.

In this study, STEM students refer to undergraduate learners of a four-year study in STEM. In South Africa there is a growing need to grow the STEM career portfolio, especially in light of the shortage of skills in STEM as the world launches into the 4IR. STEM graduates are expected to be skilled and competent in their career (Odera *et al*., 2015). From the SCCT viewpoint, COE and CDSE are crucial for a positive future career among STEM students.

This study mainly investigated the link between COE and CDSE of STEM students. The review of extant literature shows that the number of studies investigating this link among STEM students is limited. Hence, there is a gap in this field especially in the province where this study is conducted. The findings of this study will be meaningful in designing career counselling initiatives, policy formulation as well as the research and practice of the associated fields of career education, which are important concepts to career growth (Enache & Matei, 2017). This is because COE and CDSE are crucial factors for a positive professional life. It is essential to understand the significance of these factors to grow and assist students in their career decisions. To achieve the aim of this study, the following research questions were asked:

1. Is there a significant link between COE and CDSE of STEM students?

2. Are CDSE convictions of STEM students significant predictors of their COE?

3a. Does gender significantly influence the COE and CDSE of STEM students?

3b. Does the environment of upbringing significantly influence the COE and CDSE of STEM students?

4. Do age, race and funding influence the CDSE convictions of STEM students?

5. Does COE of STEM students differ because of age, race, and funding?

3. METHOD

A descriptive survey model was used in this research, which purposed to investigate the link between COE and CDSE of STEM students at a university in South Africa. The descriptive survey model is a research technique that seeks to uncover and describe a phenomenon (Alisinanoğlu, Kesicioğlu & Mart, 2013).

3.1 Participants

A sample of 322 was drawn from a target population of 2000 undergraduate STEM students based on Krejcie and Morgan's (1970) table for determining sample sizes. Study participants were conveniently enlisted from undergraduate students in Science, Technology, Engineering, and Mathematics (STEM) at the university investigated in 2019 and were in their 1st, 2nd, 3rd, and 4th year of study, respectively. A total of 203 participants (63% response rate) responded to the survey. Data were collected within six months from undergraduate STEM students at a university in South Africa. A simple random sampling method was used in selecting participants. Table 1 below presents the demographic features of the respondents.

Table 1: Demographics of participating STEM students

Demographic characteristics	Description	*f*	%
Age	19–24	150	73.9
	25–30	38	18.7
	31–36	10	5
	37–41	2	1.0
	42–above	3	1.5
Gender	Male	88	43.3
Female	Female	115	56.7
Race	Black	146	71.9
	Coloured	3	1.5
	Indian	46	22.7
	White	6	3.0
	Other	2	1.0
Funding	Yes	128	63.1
	No	75	36.9
Environment of upbringing	Rural	73	36.0
	Semi-urban	46	22.7
	Urban	84	41.4

3.2 Measures

Demographic information: A demographic data form was used in collecting this information from participants. Questions asked comprised information regarding age, gender, race, environment of upbringing and parental level of education.

Career Outcome Expectancy Scale (COES): Betz and Voyten (1997) designed this scale to measure COE. It is a nine (9) item scale comprising statements such as: "I will make great progress toward being an expert in my career" and "I will make my family proud by my career decision". The items are each rated on a 4-point Likert scale ranging from (4) "strongly agree" to (1) "strongly disagree". Higher score indicates stronger degrees of expectancy with respect to career outcome. The Cronbach's Alpha and test-retest reliability reported by McWhirter, Crothers and Rasheed (2000) was .83 and .59, respectively. Additionally, the Turkish version of the scale, as reported by Isik (2013), demonstrated a test-retest reliability of .79 and internal coefficient reliability Cronbach's Alpha of .87. This study confirms the scale's high reliability of Cronbach's Alpha of .86.

Career Decision Self-Efficacy Scale (CDSES): Taylor and Betz (1983) originally designed the CDSES to evaluate CDSE. The CDSE shorter version (CDSE-SF) designed by Betz, Klein and Taylor (1996), is used for this study. It is a 25-item measure that assesses an individual's belief in completing requisite tasks to make successful career decisions (Betz & Taylor, 2006). This scale is made up of five subscales that associate with self-evaluation, collecting career information, selecting career goals, planning and problem solving. It is rated on a 5-point Likert scale ranging from (1) "no confidence" to (5) "complete confidence". Some examples of the statements captured in the scale are: "I can select one occupation from a list of potential occupations I am considering" and "I am able to determine the steps I need to take to successfully complete my chosen major". The Cronbach's Alpha for this scale as found in this study is an excellent reliability of.93.

3.3 Ethical consideration

This study was conducted at a university where the main author was conducting postdoctoral research. Authorisation to conduct the study was granted by the Registrar's office to access the STEM students via the university's website. Ethical clearance was granted by the university's research ethics committee.

3.4 Procedure

Upon obtaining the ethical certificate of clearance to commence the study, the questionnaire, consent form and copy of the gatekeeper's letter from the university's Registrar were posted online on the university's website for STEM students to access. The consent form offered the study's overview to the respondents, stating also that involvement in the study was voluntary and confidential. Only enrolled undergraduate STEM students at the university in South Africa were eligible to participate in this study. Participants needed thirty (30) minutes to complete the questionnaire.

3.5 Data analysis

Collected data was analysed using the IBM SPSS version 26. The statistical level of significance selected for this study was $p<.05$. Frequencies, ANOVA, correlation and regression analysis were conducted in analysing the data. Before conducting the multivariate analysis to test the influence of age, race, gender, environment of upbringing and funding on the CDSE convictions and COE of STEM students, Pearson correlations were performed between the two dependent variables.

4. FINDINGS

The findings of this study, which aligned to its main aim and objectives, are showcased in this section.

The findings show that the correlation between CDSE and COE of the STEM students are statistically significant at p = 000 i.e. p < .001. The Pearson correlation analysis tests the MANOVA assumption that the dependent variables would be correlated with each other in the moderate range (Gampst, Meyer & Guarino, 2006). The descriptive statistics found that CDSE had M = 92.10, SD = 15.03, and COE had M = 20.9, SD = 2.80. Table 2 shows a meaningful correlation pattern between the two dependent variables, thus presenting the answer to research question one (1) of this paper.

Table 2: Pearson correlations, means and standard deviations associated with the CDSE and CDOES

	1	2	M	SD	t	df
1. CDSE	1.0	.382**	92.10	15.03	-71.30	
2. COE	.382**	1.0	20.87	2.80		

Note: N = 203, correlations are statistically significant at the .0.01 level (2-tailed).

Furthermore, a simple linear regression was conducted to evaluate the influence of participants' CDSE on their COE. Preliminary analyses were performed to ensure there was no violation of the assumption of normality and linearity. A significant regression equation was found (F (1,200) = 34.24, p = .000) with an R^2 of .146 (about 15%) (see Table 3). This means that CDSE was a significant predictor of COE. Hence, an increase in CDSE of STEM students influences a positive increase in their COE (Baglama & Uzunboylu, 2017). This finding provides the answer to question (2) in this paper.

Table 3: Career decision-making self-efficacy predicts career outcome expectancy

Variable	R	R-Square	Adjusted R-Square	ANOVA *F (1,200) P*	SE	B	β	*t*
Constant				34.240 .000	.012	14.310		12.582
CDSE	.382**	.146	.142	.000	2.596	.071	.382	5.851

Note: p is significant at p <.001, two tailed (**)

To answer research question (3a), data was further analysed to ascertain whether the gender of the participants had significant influence on CDSE and COE using multivariate analysis. In the analysis, Box's M value of 9.85 which associated with a p value of .021 was found. Based on Huberty and Petoskey's (2000) guideline (i.e. p < .005), this finding was non-significant. Thus, the covariance matric between the groups were assumed to be equal for the purposes of MANOVA. Prior to conducting a series of follow-up ANOVAs, the homogeneity of variance assumption was tested for the dependent variables. Based on Levene's F tests, the homogeneity of variance assumption was satisfied because the p values are preferably acceptable when the test results are not significant (p > .05), and this study found (p > .05). Hence the Levene's assumption of equality of variances was not violated.

A one-way multivariate analysis of variance (MANOVA) was conducted to test the hypothesis that there would be mean differences between CDSE and COE among male and female STEM students. The MANOVA result (Table 4) shows that there was not a significant difference between males and females when the two variables were considered jointly; Wilk's Lambda (Λ) = .972, F (2, 199) = 2.9, p = .060, partial η^2 = .028 (where η^2 represents the univariate effect size). A separate ANOVA was conducted for each dependent variable, with each ANOVA evaluated at alpha level of .025. There was a significant difference between males and females on CDSE, F (1,200) = 5.46, p = .020, partial η^2 = .027, with males (M = 94.84) scoring higher than females (M = 89.91). The multivariate effect size (η^2) was .027, which implies that 2.7% of the variance in the canonically derived dependent variable was accounted for by CDSE. However, there was not a significant difference between males and females on COE, F (1, 200) = .172, p = .679, partial η^2 =.001.

Table 4: One-way ANOVAs with career decision self-efficacy and career decision outcome expectancy as dependent variables and gender as independent variable

	Levene's		ANOVA's			Male		Female	
	***F* (1,200)**	***P***	***F* (1,200)**	***P***	**η2**	**M**	**SD**	**M**	**SD**
CDSE	3.23	.074	5.46	.020	.027	94.84	13.33	89.91	15.9
COE	.947	.332	.172	.679	.001	20.95	3.08	20.79	2.58

Note: N = 203, η2 = Partial eta squared

To answer the question whether the environment of upbringing (rural, semi-urban and urban) had effects on CDSE and COE of STEM students, a between-groups ANOVA was conducted. The descriptive statistics across the three "environment of upbringing" groups are reported in Table 5 to answer question 3b. Participants in the "urban environment of upbringing" group were associated with the numerically smallest mean of student CDSE (M = 89.06) and COE (M = 20.45). On the other hand, the participants from the "rural environment of upbringing" group were associated with the numerically highest mean level of CDSE (M = 96.16) and COE (M = 21.62). Prior to performing the ANOVA, the assumption of normality was evaluated and determined to be satisfied as the three environmental groups' distributions were associated with skewness and kurtosis less than (2.0) and (9.0) respectively (Schmider *et al*, 2010), however the kurtosis for the semi-urban group in the COE was greater than (9.0). Additionally, the assumption of homogeneity of variance was tested and satisfied based on Levene's F test, F (2, 200) = 3.68, p = .027 for CDSE, and F (2,200) = 4.27, p = .015 for COE (see Table 5). The independent between-groups ANOVA yielded statistically significant effect, F (2,200) = 4.67, p = .010, η^2 = .045 for CDSE, and F (2,200) = 4.16, p = 0.17, η^2 = .040 for COE. Thus, the null hypothesis of no difference between the means was rejected, and 4.5% and 4% of the variance of the participant CDSE and COE respectively was accounted for by the participants' environment of upbringing.

Table 5: One-way ANOVAs with career decision self-efficacy and career decision outcome expectancy as dependent variables and environment of upbringing as independent variable

	Levene's		ANOVA's			Rural		Semi-Urban		Urban	
	F (2,200)	*P*	*F (2,200)*	*P*	η2	M	SD	M	SD	M	SD
CDSE	3.68	.027	4.67	.010	.045	96.16	12.40	90.96	16.73	89.06	15.50
COE	4.27	.015	4.16	.017	.040	21.62	2.19	20.46	3.28	20.45	2.88

To evaluate the nature of the differences between the three means further, the statistically significant ANOVA was followed with Tukey HSD post-hoc tests. The result (see Table 5) revealed that there was a statistically significant difference at p < .05 level in COE scores for the three "environment of upbringing" areas: *F* (2,200) = 4.3, *p* = .02. Despite reaching statistical significance, the actual difference in mean scores between the groups was quite small. The effect size calculated using eta squared was .040 (see Table 5). Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group COE (Rural) (M =21.62, SD = 2.19) was significantly different from Group Urban (M = 20.45, SD = 2.88) at *p* <.05. Group Semi-Urban (M = 20.46, SD = 3.28) did not differ significantly from either Group 1 or 3 at p >.05.

Research question 4 was answered using multiple linear regression to determine whether the independent variables (race, age and funding) predict participants' CDSE. A significant regression equation was found *F* (3, 198) = 6.46, *p* = .000., with an R^2 of .089 (see Table 6). This means that the model predicted 9% of the variance and that the model was a significant predictor of CDSE. While race and age contributed significantly to the model (B = -3.403, p = -002; B = 3.223, p = .028) respectively, race made a greater contribution, but funding did not contribute to the model. The final predictive model was:

CDSE = 94.837 + (-3.403* Race) + (3.225* Age).

Table 6: Race, age and funding as predictors of career decision-making self-efficacy

Variable	R	R^2	Adjusted R^2	ANOVA *F (3,198) P*	B	SE	β	*t*	*p*
Constant	.299**	.089	.075	6.464 .000	94.837	3.400		27.895	.000
Race					-3.403	1.092	-.226	-3.115	.002
Age					3.225	1.461	.163	2.208	.028
Funding					-1.294	2.362	-.042	-.548	.584

To ascertain whether race, age and funding were significantly contributory in the COE of the participants and provide an answer for question 5, a linear multiple regression was calculated. Although a significant regression equation emerged F (3, 199) = 2.297, p = 000, with an R^2 of .033, the model predicted just 3.3% of COE (see Table 7). Among race, age and funding, only race made a significant contribution to the model (B = -.479, p = .023). The final predictive model was:

COE = 22.032 + (--.479 Race) + (-.100 Age) + (-.189).

Table 7: Race, age and funding as predictors of career outcome expectancy

Variable	R	R-Square	Adjusted R-Square	ANOVA *F (3,199) P*	B	SE	β	*t*	*p*
Constant	.183	.033	.019	2.297 .079	22.032	.650		33.889	.000
Race					-479	.209	-.171	-2.285	.023
Age					-.100	.280	-.027	-.355	.723
Funding					-.189	.453	-.033	-.418	.677

Note: p is significant at p <.001, two tailed (**)

5. DISCUSSION OF FINDINGS

The main goal of this study was to investigate the association between CDSE and COE of STEM students at a South African university. The study investigated the variables based on the demographic factors presented by the participants to ascertain whether differences exist among them. A review of extant literature showed that several studies had concentrated on various facets of CDSE. Scholars have examined the association among CDSE and career indecision (Vasoula & Loucia, 2020), career exploration (Rumalutur & Salim, 2020), vocational outcome expectations (Baglama & Uzunboylu, 2017) and socio-economic status (Shin & Lee, 2018). Other studies investigated the link between CDSE and career options (Park *et al*., 2019). Middleton (2017) examined the mediating influence of career aspirations and CDSE on self-differentiation, career identity and career indecision. Additionally, career salience and locus of control (Taylor & Popma, 1990) were investigated.

The present study examined the link between CDSE and COE to ascertain whether CDSE predicted COE among STEM students at a university. The findings show that a positively strong level of correlation exists among the two variables and that CDSE had predictive implication on COE. Woo *et al.* (2017) and Baglama and Uzunboylu (2017) obtained a similar result. This predictive implication of CDSE on COE means that when STEM students believe that they can skilfully make career decisions, their expectation of success in their chosen professional life will be increased. In their study, Taylor and Popma (1990) found that only CDSE was statistically significant in its association with career indecision among other variables such as locus of control and career salience.

This study also investigated gender. Numerous studies that examined the influence of gender on CDSE reported different results. Although Choi *et al*. (2012) found that gender was significantly influential on CDSE, Middleton (2017) confirmed that female participants showed higher CDSE scores when compared to their male counterparts. Conversely, Shin, Lee and Seo (2019) reported that the males scored higher on the CDSE scale used in their study. However, other scholars stated that no gender difference was found among male and female participants concerning CDSE (Shin & Lee, 2018; Baglama & Uzunboylu, 2017). The findings of Shin *et al*. (2019) are validated by the present study, showcasing that male STEM students at a South African university demonstrated higher levels of CDSE than their female counterparts. With respect to COE, the present study results offer some support to the findings of Baglama and Uzunboylu (2017), Buldur and Bursal (2015) and Gushue *et al*. (2006), that gender, among other demographic variables, was statistically not significant in determining the COE of participants.

This study also examined the environment of upbringing for its effect on CDSE and COE of STEM students at a university in South Africa. Although the influence of the environment of upbringing on both variables was statistically significant, the effect size was quite small. CDSE explained most of the variance. A review of the literature on the influence of the environment of upbringing on CDSE and COE yielded little or no results. Incidentally, environment of upbringing is notably not examined as a demographic variable in most research in this area.

Furthermore, CDSE and COE of STEM participants were examined for the effect of age, race and funding. Scholars have confirmed participants' gender and age significantly influence career choice behaviour ((Agarwala, 2008; Ferry, Fouad & Smith, 2000). It is also reported that age was a determinant of career aspirations of learners in a South China college (Guan *et al*., 2016) and Bacanli (2012) confirmed that CDSE was significantly influenced by age among students in a Turkish university. The present study found that the results regarding COE did not follow closely with the assumptions as CDSE did. The examination of the demographic factors viz, age, gender, race and funding showed no statistical significance with respect to COE. This result offers support to findings by scholars (Buldur & Bursal, 2015; Gushue *et al.,* 2006).

Race, age and gender contributed significantly to CDSE. The finding supports reports that race was influential in career behaviours (Mau, Perkins & Mau, 2016). According to Baglama and Uzunboylu (2017), studies investigating the link between age and CDSE are few. Hence, it is envisaged that the findings of the present study will offer new insights for the STEM field of study with respect to theory and practice.

Several studies examined COE, CDSE and career growth among students in universities. McCabe, Lubinski and Benbow (2019) examined whether individual differences evaluated at the beginning of students' graduate school career were linked with becoming a STEM leader 25 years later. Minor to significant gender disparities in abilities, interests and lifestyle preferences were reported. Van Tuijl and Van der Molen (2016) investigated study choice and career development in STEM fields and found that career choice was rooted in early childhood but did not report on any effect of gender in their review of the literature. However, Taylor and Popma's (1990) study examining the association between CDSE, career importance, locus of control and career indecision among tertiary students found that CDSE only had a statistically significant association with career indecision.

Scholars have found that students who have challenges with making career decisions and pessimistic COE are prone to seeking assistance in the process of selecting a career (Vertsberger & Gati, 2016). Furthermore, STEM students need assistance in getting to understand the world of work, adjusting from learning life into career work, planning and stress management (Güneri, Aydın & Skovholt, 2003). For instance, studies that investigated students to understand the way they felt about finding gainful employment after graduation, found that most students were fearful, hopeless, anxious, depressed, stressed and uncertain (Yasar & Turgut, 2020; Yanik *et al*., 2016). This suggests that STEM students need career counselling.

When STEM graduates are confident in what to expect and how to handle the world of work post-graduation, they will be productive and loyal organisational citizens committed to their profession and employer (Hendri, 2019). Therefore, these findings have implications for the design and implementation of career guidance and counselling interventions/initiatives to support incoming and/or graduating students. Also, they should be beneficial in aiding STEM students in South Africa with their career decision-making.

Furthermore, ascertaining the variables that affect thoughts and behaviours associated with careers of STEM students can result in the controlling of these variables and aiding the learners. Since it is important to offer career aid, it implies that the present study will be of value-adding benefit to address the need for support. As stated previously, many studies have examined the processes of learners' career decision-making elsewhere globally, but it is expected that the present research will offer a distinct cultural viewpoint from results obtained elsewhere globally. Scholars from other parts of Africa and the world such as Turkey, Cyprus, France and Korea, could find the results from this study useful (Shumba & Naong, 2012; Sovet & Metz, 2014).

6. CONCLUSION

This study aimed to investigate the link between CDSE and COE of STEM students in a South African university. There is a vital need to comprehend and unveil the perceptions of STEM students since they define the potential approach and behaviours of STEM students in their forthcoming professional endeavours. The findings of this study offer adequate information regarding STEM students' perceptions about these variables. Generally, this study confirmed that STEM students possess strong degrees of CDSE and COE. Stakeholders in STEM education need to be more perceptive of the individual dissimilarities that accompany new developments and practices in STEM education to supply the educational needs of learners. STEM students would be more prepared for their study and productive for their employers once their CDSE and COE is strong.

7. RECOMMENDATIONS FOR FUTURE RESEARCH AND LIMITATIONS

Because of the scarcity of empirical studies on the career growth of STEM students in South African universities, this primary exploratory research purposely examined a simple model. Therefore, it is possible that other higher-up factors not incorporated in this study's design could account for the variation reported earlier. Further research is required to collect more data concerning the variables examined in the present study (i.e. precursors to self-efficacy, differences in individual expectations) and other variables influencing the career growth of STEM students in South Africa. Additional inquiry is necessary to explore the complexities of South African students' career development, for example, one of the limitations of this study is that within-group dissimilarities by races was not investigated. Since the South African population comprises a variety of racial subgroups, it should be imperative for further research to examine the dissimilarities among these subgroups and the way in which these dissimilarities may affect career development of undergraduates. This is because dissimilarities in racial identity might possibly have significant implications on career growth. Lastly, the present study did not take into consideration the role that real-world challenges such as poverty, gender bias and racism could have on the career development of the participants. Some of the students' career choice could have been influenced more by factors such as marginalisation or financial necessity rather than self-efficacy or career expectation. This study was conducted among STEM students in one university in South Africa, hence the findings cannot be generalised to every student in all universities in South Africa.

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