Chemistry Self-efficacy and Self-regulation as Predictors of Chemistry Students' Entrepreneurial Intentions in Secondary Schools in North-Central Nigeria

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Abstract

Entrepreneurship is considered a potent remedy to the unemployment challenges of developing countries. The current study investigated students' learning environment perception, self-efficacy and self-regulation as predictors of entrepreneurial intention among secondary school chemistry students in North-Central Nigeria. The correlational research involved a targeted population of 37,468 SSII chemistry students. A sample of 1,104 was drawn from the population using the multistage sampling technique. Three instruments were used to collect data, Secondary School Students' Chemistry Self-efficacy Questionnaire (SSSCSEQ), Chemistry Students' Self-Regulation Questionnaire (CSSRQ) and Chemistry Students' Entrepreneurial Intention Questionnaire (CSEIQ). The instruments were pilot tested and the scores were used to establish the reliability of the instruments. Cronbach's alpha values 0.91, 0.847 and 0.88 obtained for the instruments SSSCSEQ, CSSRQ and CSEIQ respectively indicated that four instruments had good reliability. Data collected were analyzed using linear and multiple regression analyses to answer research questions 1-3 and test null hypotheses 1-3 at $p<0.05$. The results showed that self-efficacy significantly predicted intention and self-regulation also predicted students' entrepreneurial intention. Multiple regression analysis also showed that learning environment perception, self-efficacy and self-regulation combined significantly predicted students' entrepreneurial intention. The study conclusions led to the recommendations that students' chemistry self-efficacy should be enhanced in classrooms, by outlining for students the potential of chemistry for innovation and economic growth, to nurture their entrepreneurial mindset, enhance the self-regulation ability of chemistry students to help develop their entrepreneurial interests for initiating and nursing their enterprise, embedding entrepreneurial education into chemistry curriculum, among others.

Keywords: Self-efficacy, Self-regulation, Entrepreneurial intention

Introduction

Entrepreneurship has currently been observed to occupy the attention of educators, researchers and students. More programs are now being considered to encourage students to become aware, and develop an aspiration that can promote entrepreneurial activities (Bjekić, *et al*., 2021). This stems from uncertainty of the future of youth because of rising statistics of unemployment, hence challenging students to focus their thinking toward creating rather than seeking unfilled job positions that are unavailable (Olorunfemi, 2021). Entrepreneurial activities are considered paramount in fostering or revitalizing the economic propensity of developing nations and creating new jobs (Adelowo, *et al*., 2021; Ezeh, *et al*., 2020).). In the field of chemistry, there is a growing recognition of the potential for chemistry students to

leverage their knowledge and skills to create new businesses and contribute to economic development (Anari, 2021) as many household goods such as soaps and detergents, mosquito repellants, disinfectants and sanitary materials are all products of chemistry which could be produced and sold to fetch financial benefits for students and graduates, also serving as a source of youth employment as entrepreneurs. Entrepreneurial intention, Donaldson (2019) avers, is an individual's consciously chosen prelude to start a business as a means of expressing his or her self-acknowledged intention to launch a commercial venture. It is a sentiment or feeling that expresses a person's desire and ambition to start or initiate a new venture (Bui *et al*., 2020). This intention predicts entrepreneurial behavior (Wu & Tian, 2022; Liu, *et al*., 2019). One strong factor needed to become successful as an entrepreneur is the intention. Unfortunately negative entrepreneurial attitude continues to force school leavers to seek jobs in both public and private sectors (Egrinya *et al*., 2022).

Self-efficacy as proposed by Bandura, is important in shaping individuals' beliefs in their capabilities to succeed in entrepreneurship. Highly efficacious students are more likely to perceive challenges as opportunities for growth, persist amidst setbacks, and explore resources to achieve entrepreneurial goals, as opposed to doubtful individuals who avert risks, and are reluctant to pursue entrepreneurship. Self-Regulation acts as a mechanism that enables one to manage their thoughts, emotions and behaviors towards achieving entrepreneurial intention. Effective self-regulation skills, such as goal setting, planning, self-monitoring and evaluation empower students to avoid distraction and stay focused on their entrepreneurial aspirations. Students are better equipped to navigate complexities of entrepreneurship, adapt to changing circumstances and sustain their enterprises despite challenges. Therefore enhanced self-efficacy combined with effective self-regulation abilities stimulates secondary school chemistry students' disposition to perceive entrepreneurship as a possibility thereby positively influencing their entrepreneurial intention.

Literature Review

The theory of planned behavior consolidates the idea that behaviors are best predicted by intentions. The theory of planned behavior (TPB; Ajzen,1991) models together five specific factors; attitude towards a behavior, subjective norms, perceived control, intent to engage in behavior, and, finally, the behavior itself. According to the TFB, attitude toward the activity, subjective norms, and perceived behavioral control may all be used to accurately predict the intention to execute any kind of behavior. Intention indicates the level at which people are willing to engage, and the extent they are willing or planning to expend for them to initiate

and uphold the behavior (Ajzen, 1991). The theory proposes that intentions are predicted by three factors, attitude towards behavior (ATB), perceived behavioral control (PBC), subjective norms (SN), and, the intentions predict behavior. The attitude towards behavior (ATB) points to the personal assessment of the individual's performance at a task or behavior. Perceived behavioral control points to an individual's perception of ease or difficulty in initiating and upholding behavior. Subjective norm (SN) points to the individual's perception of how other persons or groups' assessment of that individual affects his behavior. The theory also integrates the social cognitive theory of Bandura (1986). Social Cognitive theory posits that much of human learning and its outcomes results from reciprocal interaction of three factors, the environment, personal and behavioral factors. SCT highlights the influence of entrepreneurial characteristics, person's behavior and the individual's environment (in the case of students, the school or the classroom) on the students' outcome. The various environmental factors and students' self-efficacy enhance or undermine self-regulatory behavior. Self-regulation in terms of planning and evaluation influences self-efficacy. The school is a dynamic entity where multiple factors interplay to influence future entrepreneurial aspirations. Among these factors, self-efficacy (Otache, *et al*., 2022; Doanh and Bernat, 2019), and self-regulation (Tewal & Sholilah, 2019) stand out as critical determinants that significantly affect students' propensity toward entrepreneurial endeavors.

Self-efficacy: Zhou, *et al*., (2021) found that self-efficacy positively influences science students' entrepreneurial intention by increasing their propensity to identify opportunities, take risks, and increase their need to start their businesses. Saraih, *et al*., (2018) found that self-efficacy correlated with undergraduate engineering students' entrepreneurial intention. Ciuchta and Finch (2019) however found that self-efficacy is not a significant predictor of entrepreneurial intention. Chang, *et al*., (2020) found that self-efficacy influences the cyber-entrepreneurial intention of students. Also, Tantawy, *et al*., (2021) showed that self-efficacy predicted students' entrepreneurial intentions. In addition, the study by Chien-Chi *et al*., 2020 found self-efficacy significantly and positively correlated with the entrepreneurial intention of college students.

Self-regulated students tend to exhibit a more proactive approach toward their entrepreneurial careers by setting priorities, managing their behaviors, adapting to changes targeting success in their future business endeavors (Rahim, *et al*., 2021). Maghgoup *et al*., (2023) found self-regulation impacted on entrepreneurial intention of university students in Saudi Arabia.

A Profound look at the literature indicates that most studies conducted on entrepreneurial intention involved undergraduate and postgraduate students in tertiary institutions (Do Nguyen & Nguyen 2023) with a dearth of literature on the entrepreneurial intention of secondary school students (Wu & Tian, 2022; Mothibi & Malabena, 2019), which Ortuno-Sierra, *et al*., (2021) highlighted its significance in building a persistent and enduring interest in initiating and nursing a business. Fundamental gaps also exist in understanding predictors of entrepreneurial intention of secondary school students in chemistry classes.

In consideration of this premise, the current study investigates self-efficacy and self-regulation as predictors of the entrepreneurial intention of chemistry students in secondary schools in North-Central Nigeria. The study aimed to determine how each of the variables, individually, and combined predict entrepreneurial intention of students in chemistry classes. Because entrepreneurial intent has received less attention compared to undergraduate students, it is essential to examine these relationships since the findings can provide valuable information for educators, school administrators and policy makers on how to embrace and support the emerging trend of chemistry-related entrepreneurship. This is especially important in the Nigerian education system where the science and chemistry enrolment rate at the secondary level is still low and there is increasing need to enhance the creativity and innovation of young chemists as well as their inclination to undertake entrepreneurial activities.

Research Questions: The study answered the following research questions:

1. To what extent does senior secondary school students' chemistry self-efficacy predict their entrepreneurial intention?
2. To what extent does senior secondary school students' self-regulation predict their entrepreneurial intention?
3. To what extent does students' self-efficacy and self-regulation combined together predict chemistry students' entrepreneurial intention?

Hypotheses: Three null hypotheses were tested at 0.05 level of significance

$H0_1$: There is no significant relationship between senior secondary school students' chemistry self-efficacy and their entrepreneurial intention.

$H0_2$: There is no significant relationship between senior secondary school students' self-regulation and their entrepreneurial intention.

H_{03}: There is no significant difference in the predictive ability of Students' Chemistry Self-efficacy and Self-regulation on their entrepreneurial intention.

Method

The study adopted correlation research design, where data on variables collected are correlated for relationship between the variables. The study collected data on variables chemistry self-efficacy and self-regulation, and their relationship with students' entrepreneurial intention.

Participants

The population of the study was senior secondary school students enrolled in public schools in North-Central Nigeria comprising six states Benue, Kwara, Kogi, Nasarawa, Niger and Plateau states, and the FCT Abuja. The target population was 37,468 senior secondary two (SS2) students in 417 public senior secondary schools in Nasarawa, Niger State and FCT. The sample of the study comprised a total 1,104 (male=597; 54%; female=508 at 95% confidence level and 3% confidence interval based on Cohen *et al*., 2018 table for sample size) senior secondary two (SS2) students offering chemistry in public secondary schools in North-Central Nigeria. Multi-stage sampling was used to draw the sample from 36 public schools in 9 Educational zones in 2 states (Nasarawa and Niger States) and the Federal Capital Territory (FCT) Abuja. Participants' ages ranged from 15-24 years.

Instruments

Two instruments were used to collect data for the study; Chemistry Self-Efficacy and Self-Regulation Questionnaire (CSESQ), which assessed students' self-efficacy and self-regulation ability, and Chemistry Students' Entrepreneurial Intention Questionnaire (CSEIQ), 22 items which was used to assess students' entrepreneurial intention. The instruments have 4 response options (4= Strongly Agree, 3=Agree, 2=Disagree and 1=Strongly Disagree).

Validity and Reliability of Instruments

The instruments were content and construct validated by three experts in the Faculty of Technology Education, Abubakar Tafawa Balewa University, Bauchi. The instruments were pilot-tested with SS2 students of a private school in Kaduna, North-Western Nigeria. The reliability of the scores in the study was established using Cronbach's alpha. The alpha values of the instruments CSESQ and CSEIQ were 0.90 and 0.88 respectively which indicated that the instruments had good reliability.

Data Collection Procedure

The researcher obtained permission from school administrators before the instruments were administered one at a time. Participants were assured of confidentiality of their responses. The researcher read the instructions about completing the questionnaires and that students'

participation is voluntary, any student could withdraw from the exercise at will. The researcher with the aid of research assistants administered and retrieved the questionnaires on the same day. Each instrument took an average of 8 minutes to be completed.

Data Analysis

To answer research questions 1 and 2, linear regression analysis was used, multiple regression analysis was used to answer research question 3. In addition, null hypotheses were tested at ($p<0.05$). Decision based on Muijis (2022, p.102) guideline proposed that R^2 value for model fit (<0.1 is a poor fit; 0.11-0.3 modest; 0.31-0.5 moderate and >0.5 strong fit).

Results

Research Question 1: To what extent does senior secondary school students' chemistry self-efficacy predict their entrepreneurial intention?

Table 1: Regression Results on Relationship between Self-Efficacy and Entrepreneurial Intention

Model	R	R Square	Adjusted R Square	F	df	Sig.	Decision
1	.645[a]	.415	.415	473.317	1	.000	Significant

a. Predictors: (Constant), Self-Efficacy

Linear regression explored the relationship between chemistry students' self-efficacy and their intention for entrepreneurial intention. Table 1 shows the correlation of 0.645 with R Square of 0.415 indicates about 41.5% of variance in entrepreneurial intention can be explained by students' self-efficacy and the relationship is moderate (Muijis, 2022). This show that a higher chemistry self-efficacy could lead to a higher entrepreneurial intention of students.

Research Question 2: To what extent does senior secondary school students' self-regulation predict their entrepreneurial intention?

Table 2: Regression Results of Relationship between Self-regulation and Entrepreneurial Intention

Model	R	R Square	Adjusted R Square	F	df	Sig.	Decision
1	.546[a]	.299	.298	419.003	1	.000	Significant

a. Predictors: (Constant), Self-Regulation

Linear regression examined the relationship between self-regulation and entrepreneurial intention. Table 2 shows Sample correlation was 0.546 and R Square of 0.299 indicating about 29.9% of variance in entrepreneurial intention is explained by the variable self-regulation. This shows that there is a moderate relationship between self-regulation and entrepreneurial intention (Muijis, 2022).

Research Question 3: What is the extent to which students' chemistry self-efficacy and self-regulation combined together could predict their entrepreneurial intention?

Include the table

Table 3: Regression Results on the Relationship between Entrepreneurial Intention predicted by Combination of Chemistry Self-efficacy and Self-regulation

Model	R	R Square	Adjusted R Square	F	df	Sig.	Decision
1	.675[a]	.455	.454	460.005	2	.000	Significant

a. Predictors: (Constant), Self-Regulation, Self-Efficacy

Multiple regression examined how well the two variables combined together predict students' intention for entrepreneurship. Table 3 shows sample correlation showed of 675 and R Square 0.455 indicated 45.5% of variance in entrepreneurial intention of students is explained by the variables self-efficacy and self-regulation together. Therefore increased self-efficacy and self-regulation could result in increased entrepreneurial intention of students.

$H0_1$: There is no significant relationship between senior secondary school students' chemistry self-efficacy and their entrepreneurial intention

Table 4: Regression summary on Relationship between Self-Efficacy and Entrepreneurial Intention

Model	R	R Square	Adjusted R Square	F	df	Sig.	Decision
1	.645[a]	.415	.415	473.317	1	.000	Significant

a. Predictors: (Constant), Self-Efficacy

Table 5: Beta Coefficients

		Unstandardized Coefficients		**Standardized Coefficients**			**Decision**
		B	Std. Error	Beta	**t**	**Sig.**	
1	(Constant)	42.567	.967		44.042	.000	
	Self-Efficacy	.345	.016	.548	21.756	.000	S

a. Dependent Variable: Entrepreneurial Intention

Table 4 shows a summary of the regression model. R Square value was 0.415 indicating that about 41.5% of variance in entrepreneurial intention was explained by self-efficacy, and p-value was 0.000 which is significant. Beta coefficients reported in Table 5 showed that self-efficacy positively contributed to the regression model with standardized coefficient beta (β=.645) which is significant (p=0.000<0.05), therefore H_{02} was rejected.

$H0_2$: There is no significant relationship between senior secondary school students' self-regulation and their entrepreneurial intention.

Table 6: Regression Results of Relationship between Self-regulation and Entrepreneurial Intention

Model	**R**	**R Square**	**Adjusted R Square**	**F**	**df**	**Sig.**	**Decision**
1	.546[a]	.299	.298	419.003	1	.000	Significant

a. Predictors: (Constant), Self-Regulation

Table 7: Beta Coefficients

Model		**Unstandardized Coefficients**		**Standardized Coefficients**			**Decision**
		B	Std. Error	Beta	**t**	**Sig.**	
1	(Constant)	31.428	1.540		20.408	.000	
	Self-Regulation	.560	.027	.546	20.470	.000	S

a. Dependent Variable: Entrepreneurial Intention, S: Significant

To test H02, linear regression was used. Table 6 shows R Square value was 0.299 and the p-value of 0.000 was significant. Standardized coefficient regression weights (β) identified the contribution of predictor self-regulation to the variance of the dependent variable, entrepreneurial intention. Beta coefficients reported in Table 7 showed that self-regulation contributed positively to the regression model (β=0.546) which was also p=0.000<0.05), hence H_{02} was rejected.

$H0_3$: Senior secondary students' chemistry self-efficacy and self-regulation combined together does not predict their entrepreneurial intention.

Table 8: Regression Summary on the Relationship between Entrepreneurial Intention predicted by Chemistry Self-efficacy and Self-regulation

Model	R	R Square	Adjusted R Square	F	df	Sig.	Decision
1	.675[a]	.455	.454	460.005	2	.000	Significant

a. Predictors: (Constant), Self-Regulation, Self-Efficacy

Table 9: Beta Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			Decision
		B	Std. Error	Beta	t	Sig.	
1	(Constant)	23.211	1.347		17.228	.000	
	Self-Efficacy	.414	.023	.495	17.790	.000	S
	Self-Regulation	.252	.028	.249	8.965	.000	S

Dependent Variable: Entrepreneurial Intention, S: Significant, NS: Non-significant

To test H03, multiple regression was used. Table 8 reports that R Square value was 0.455 which indicated that about 45.5% of variance in entrepreneurial intention was explained by the 3 variables in combination. Standardized regression weights compare the best contributor to the variance of the criterion variable. As reported by Table 9, Beta coefficient value of Self-efficacy positively and significantly exert effect on entrepreneurial intention (β=0.495, p=0.000). Self-Regulation had positive effect on intention (β=0.249) which was significant (p=0.000<0.05). Therefore H_{03} was rejected. The regression model revealed that higher self-efficacy and self-regulation, a higher entrepreneurial intention, while lower self-efficacy and self-regulation, the lower entrepreneurial intention. In addition, self-efficacy was a better predictor of entrepreneurial intention with beta coefficient (0.495) than elf-regulation with beta coefficient (.249).

Discussion

The study also found that students' chemistry self-efficacy moderately predicted their entrepreneurial intention. The study of Iro-Idoro and Iro-Idoro (2015) agrees with the finding of this study which found self-efficacy as a significant predictor of entrepreneurial intention. The study by Kar, Subudhi and Padhy (2017) disagrees with the study stating that self-efficacy does not impact entrepreneurial intention. The study however is in agreement with the studies of Doanh and Bernat (2019) and Omar *et al*., (2019) who found self-efficacy as an effective predictor of students' entrepreneurial intention. The study also agrees with studies of Ahmed, Islam and Usman (2020) and Zhou, *et al*., (2021) who reported positive relationship between self-efficacy and entrepreneurial intention of students. The findings of this study imply that increasing students' self-efficacy or belief in their ability to complete academic tasks and ability to utilize learner support resources has substantial positive impact on their intention to initiate their chemistry-related business

The study also established that chemistry students' self-regulation moderately predicts their entrepreneurial intention. The finding is supported by the studies of Tewal and Sholihah (2020) and Anshori *et al*., (2021) who found self-regulation predicts entrepreneurial intention of students. The study of Maghgoup, *et al*., (2023) who reported that self-regulation significantly predicted entrepreneurial intention of students also agrees with this study. Kar, *et al*., (2017) found intent of female students is influenced by prior planning, evaluation of business idea, ability to measure performance in business. The implication of this finding is that teaching students to plan, monitor, and evaluate their learning can lead to a considerable increase in their intention to establish and grow their enterprise through self-regulation. Finally, the study revealed self-efficacy and self-regulation positively correlates with students' entrepreneurial intention. Elitha and Purba (2020) found self-efficacy in combination with self-regulation influence entrepreneurial intention of students. Tewal and Sholihah (2020) found self-regulation and self-efficacy significantly influence entrepreneurial intention. The results' implication is that enhanced self-efficacy and self-regulation abilities will enhance the entrepreneurial intention of chemistry students.

Conclusion

Based on the findings, it was concluded that Self-efficacy and Self-regulation were variables which predicted secondary school students' entrepreneurial intention. Raising self-efficacy of students moves students to perceive challenges as opportunities, persist amidst setbacks and explore resources to achieve entrepreneurial goals. Similarly, improving students' self-

regulation abilities by setting goals, choosing and implementing appropriate strategies, and, appraising the process and outcomes leads students to perceive more chances of success in entrepreneurial pursuits. Stakeholders in education should therefore consider interventions that enhance self-efficacy and self-regulation considering their role in influencing chemistry students' entrepreneurial intention.

Recommendations

The following recommendations were made:

1. students' self-efficacy for chemistry should be enhanced by teachers through outlining chemistry students' potential for innovation and economic growth, hence nurturing their entrepreneurial mindset.
2. students' self-regulation should be improved by encouraging students to set goals, providing viable and focused feedback to students and enable individuals appraise their outcome considering its influence on students' intention to create and manage business ventures.
3. career talks and career guidance services should be designed by schools as a means of social modeling and social persuasion to help students develop skills and goals that will lead to the successful career building.

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