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FACTORS INFLUENCING THE DIFFUSION OF PRODUCTS FROM SELECTED TECHNICAL AND VOCATIONAL COLLEGES IN SOUTHWESTERN NIGERIA

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ABSTRACT

This paper contributes to innovation studies by explicating the factors influencing the diffusion of products from selected technical and vocational colleges (TVCs) in Southwestern Nigeria. Two sets of questionnaire were designed and deployed for the study. A total of three hundred (300) copies of questionnaire were administered on 150 purposively selected students and 150 key instructors purposively selected from TVCs in Southwestern Nigeria. The statistical analyses used in this study were means, factor analysis and Analysis of Variance (ANOVA). The study concluded that from the perspective of instructors; lack of interest for local products, lack of access to finance, incessant power failure and lack of awareness of the TVC products were factors influencing the diffusion of products from the selected TVCs in Southwestern Nigeria. However, from the perspective of students; lack of access to finance, and incessant power failure were influencing the factors. The study recommends that TVCs that want to improve the level of diffusion of their products need to prioritize addressing issues such as lack of interest for local products from the end users, lack of access to finance, incessant power failure and lack of awareness of their products. Suggested strategies include product exhibition and utilizing angel investors for the products of TVCs among others.

Keywords: Diffusion; Technical Products; Technical and Vocational Colleges; Nigeria

1. Introduction

This paper contributes to the existing innovation literature by studying the diffusion of products from selected Technical and Vocational Colleges (TVC) in Southwestern Nigeria, using Rogers' (2003) Diffusion of Innovation Theory (DIT). The objectives of TVC in Nigeria are to provide technical skills necessary for agricultural, industrial, commercial and economic development (National Policy on Education, 2004). Furthermore, TVCs were established for training and improving the skills of entrepreneurs. This is expected to lead to the production of skilled personnel that will be self-reliant (National Policy on Education, 2004). Technical College education is a post-junior secondary instructional type of education and training programme in a broad area of occupational skills, such as industrial production, maintenance, construction work, and such service occupations as auto-mechanics; radio, television, refrigeration, and equipment repairers; and certain farming occupations among others (Aina, 2009).

The categories of technological products from the TVCs (see for example Oyebola *et al*., 2017 and Akinyele and Bolarinwa, 2018 among others) are in food, beverages and tobacco; chemical and pharmaceuticals; textile, and leather products; pulp and paper products, printing and publishing; electrical and electronics; basic metal, iron and steel fabricated products; information and communications technologies; energy/power generation and utilization; and building

construction. The diffusion of products from a TVC is indeed imperative to the growth and sustainability of graduate entrepreneurs. The mandate of TVCs is tandem with the Technology and Incubation Centre/Programmes (TIP).

The Technology and Incubation Centre/Programme is a popular economic development tool which has been used by both developed and developing economies to fast-track national economic development. Its policy trust is to pursue the commercialization of technologies and technical innovations to enhance the industrial and economic competitiveness of the Nation. The mandate of a TIC is to commercialize R&D results and related innovative efforts from research establishments in line with objectives of TIP (National Board for Technology Incubation (NBTI), 2014). The commercialization mandate of Technological Incubation Centers (TIC) will aid the diffusion of innovation in Nigeria's Innovation Ecosystem.

Innovation diffusion is the process by which an innovation is communicated through mass media as well as word-of-mouth in a specific market (Forlani and Parthasarathy, 2003; Deffuant *et al*., 2005; Hafeez *et al*., 2006). It is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983). Innovation diffusion is the spatial and temporal spread of new products and process technologies among different economic units.

Studies have shown the factors influencing innovation diffusion from developed and developing countries (Rogers, 1986; 2003; Geroski, 2000; Norazah, 2006; Dalla and Furlan, 2011; Dearing, 2009; Kinugasa *et al*., 2010; Hameed *et al*., 2012; Anthony and Mutalemwa, 2014; Olise *et al*., 2014)**,** innovation and commercialization from institutions in Nigeria (Oyewole, 2012; Ogunwusi and Ibrahim, 2014), the various categories of products from TVCs in Nigeria (Morakinyo 2001; Akinyele and Adu, 2003; Oyebola *et al*., 2017; Akinyele and Bolarinwa, 2018), and the challenges of technical and vocational colleges in Nigeria; (Egwu, 2009; Udoka, 2010; Odu, 2011; Nwogu and Nweanomi, 2011, Yusuf and Soyemi, 2012; Okebukola, and Okolocha, 2012; UNESCO, 2012; Akinyele and Bolarinwa, 2018)**.** Ogbimi (2007) noted that researchers and government have not given due diligence to technical education in Nigeria, which is a required strategy to set the pace for industrialisation. In addition to that, there is a dearth information on the factors influencing the diffusion of products from technical and vocational colleges in Southwestern Nigeria, especially from the comparative perspectives of instructors and students from the selected TVC. In the light of the foregoing, the study will examine the extent of innovation diffusion from the Nigerian TVC system and examine the factors influencing this.

2. Literature Review

2.1. Diffusion of Innovation Theory (DOI)

The process of adoption extends from awareness to acceptance of a product innovation (Rogers, 2003). There are five characteristics of an innovation that may influence the diffusion of an innovation. These are relative advantage, complexity, compatibility, trialability and observability of the innovation. The five characteristics can be considered the most important determinants of adoption rate of an innovation (Rogers, 2003). The five attributes are known as crucial factors concerning acceptance, usage and adoption behavior of latent adopters (Hameed *et al*., 2012).

The diffusion of innovation theory is composed of individual adoption decisions (Straub, 2009) which is typically very slow at first due to the fact that adoption means risk taking in an uncertain situation (Dalla and Furlan, 2011). The factors that aid the diffusion process are

relative advantage, compatibility, complexity, trialability, observability, trust and demographic factors (Rogers, 2003).

2.2.Factors influencing innovation diffusion

The adoption of new products over time follows an S-curve and diffusion speeds vary across products (Geroski, 2000). There are empirical studies that explain variation in the diffusion speeds for different products. For instance, Mansfield (1961) explained differences in diffusion speed across industry products using a simple linear model composed of profitability, investment, and other variables related to industry environment. Also, Van den Bulte (2000) confirmed that variation in diffusion speeds across consumer durables can be explained by product price and market environment. However, these studies took a static view of diffusing products and did not consider the effect of improving technological performance during the diffusion process on the diffusion speed.

Studies have shown that innovation attributes and opinion leadership variables are some of the best predictors of innovation diffusion rates (Goldsmith and Witt, 2005; Rogers 2003; Dearing, 2009). Although, perceived ease of use, perceived usefulness, perceived cost, perceived mobility, perceived trust and perceived expressiveness are the factors influencing the use of mobile payments in Tanzania (Anthony and Mutalemwa, 2014). Jegede *et al*. (2012) also examined the factors influencing innovation and competitiveness in the indigenous oil and gas servicing firms in Nigeria. The study concluded that educational qualifications, training and prior work experience of the heads of technical departments, number of R&D staff and training, innovation, R&D investment, interaction with competitors, consumers, suppliers and training institution influenced innovation performance in the selected firms.

In addition to that, Kinugasa et al. (2010) analysed a diffusion pattern of IPTV (Internet Protocol TV), based on the Technology Acceptance Model (TAM). Structural Equation Model (SEM) analysis was used on the survey conducted. The study concluded that "ease-of-use" is an important factor influencing adoption among non-IPTV users in both Japan and Korea, but that the path from "usefulness" to "adoption" was stronger for Japanese households. Although the Japanese were directly influenced on intention to use IPTV, the Koreans were not.

Furthermore, Olise *et al*. (2014) examined the determinants of ICT adoption for improved SME's performance in Anambra state, Nigeria. The study concluded that there is significant difference in the levels of awareness and adoption patterns of ICT facilities among SMEs. The study further concluded that capital base, turnover and asset value of the businesses have significant influence on ICT adoption and use in the study area.

2.3.Challenges of technical and vocational colleges in Nigeria

The challenges of technical and vocational colleges in Nigeria as stated by scholars are numerous. The identified challenges invariably have implications on the performance of both the instructors and students of technical and vocational colleges. Egwu (2009) noted that inadequate and obsolete infrastructure and equipment, inadequate collaboration between tertiary institutions and inadequate capacity in the institutions for internal/peer quality assessments are the challenges of technical and vocational colleges in Nigeria. In addition, Udoka (2010), and Yusuf and Soyemi (2012) noted that the major challenge of technical and vocational colleges in Nigeria is funding. Also, Odu (2011), Nwogu and Nweanomi (2011), and Okebukola and Okolocha (2012) opined that inadequate skilled manpower, poor funding, resource inadequacy, and shortage of equipment are the challenges of technical and vocational colleges in Nigeria. The

report from UNESCO (2012) corroborated earlier studies by concluding that technical and vocational colleges are facing numerous challenges despite the efforts of Government such as lack of efficient educational monitoring and evaluation procedures, poor funding, and rapid changes in technological paradigms. All the aforementioned studies are not recent. A recent study carried out by Akinyele and Bolarinwa (2018) noted that technical and vocational colleges are facing challenges of poor infrastructure, finance, inadequate resources, inability to meet up with daily advancement of technology among others are the challenges of technical and vocational colleges face in Nigeria.

Given all the reviewed studies on innovation, factors influencing innovation diffusion, and challenges of technical and vocational colleges in Nigeria, this study mined information on factors influencing the diffusion of products from the selected technical and vocational colleges (TVC) in Southwestern Nigeria.

3. Research Method

The research target for this study are technical and vocational colleges (TVC) in Lagos, Osun, Oyo, Ondo, Ogun and Ekiti States, Nigeria. As reported by the National Board of Technical Education (NBTE), there are 34 TVCs in Southwestern Nigeria. Five belong to the Federal Government, 28 to State Governments and one to a private operator. The study purposively selected three Federally owned, six State owned TVC and the only private TVC for broad representation of the study phenomena. The oldest TVC (year of establishment) was part of the criteria for the purposive selection of the TVCs in the study area. The criteria deployed for this study gave credence to the report of Kanfer and Ackerman (2004) that the "years of establishment and training of firms correlates with their performance". The selection techniques provide information for robust policy recommendations.

Two sets of questionnaire were designed for the study. The first set of the questionnaire was administered to 150 purposively selected final year students of the selected TVC. The second set of questionnaire was also administered to 150 purposively selected key instructors of the selected TVCs, making a total of 300 respondents of the selected TVCs. The two sets of questionnaire elicited information from the perspectives of instructors and students on the factors influencing the diffusion of products from the selected TVC in Southwestern Nigeria. The factors considered were lack of technical expertise of the instructors, inconsistent government policy support for Science & Technology (S&T), lack of interest for local products, non-availability of sufficient market for the products, lack of access to finance, low level of entrepreneurial skills, low level of linkages with other entrepreneurs outside the TVC, non-sufficient research & development (R&D), inappropriate marketing skills, poor industry-academia linkages, lack of basic infrastructural facilities, incessant power failure, lack of awareness of the products from the TVC and lack of in-house capability to commercialize. The identified factors were extracted from literature (Egwu, 2009; Udoka, 2010; Odu, 2011; Nwogu and Nweanomi, 2011; Yusuf and Soyemi, 2012; Okebukola, and Okolocha, 2012; UNESCO, 2012; Akinyele and Bolarinwa, 2018).

The variables were rated on a five-item Likert scale with one ranked as strongly disagree, and five (5) as strongly agree. Also, product diffusion of the selected TVC was captured with the extent of use of the product and rated on a three-point scale namely; 1 = no use, 2 = low use and 3 = high use. The extent of collaboration of TVC with Technological Incubation Centre (TIC) in Nigeria was rated on a three-item scale namely; 1 = no collaboration, 2 = low collaboration and, 3 = high collaboration. TVC level analysis were deployed for this study. Factor analysis was

deployed to reduce the dimension of factor variables and avert cointegration or multi-collinearity effects. The study further deployed ANOVA (Analysis of Variance) to test and make inference report on the effects of extracted factors on the diffusion of products from the selected TVC in Nigeria.

4. Results and Discussion

Table 1 shows the mean values of the factors influencing the diffusion of products from the perspectives of key instructors and students from the selected technical and vocational colleges. The study shows that the key instructors strongly agreed that lack of technical expertise of instructors (4.78), lack of interest for local products from Nigeria (4.62), lack of access to finance (4.62), low level of linkages with other entrepreneurs (4.71), lack of research and development (R&D), inappropriate marketing skills (4.60), poor industry-academia linkages (4.85), lack of basic infrastructural facilities (4.61), and incessant power failure (4.52) are the major factors influencing the diffusion of products of the selected TVC. Also, the instructors agreed that non-availability of sufficient market for products (3.45), lack of entrepreneurial skills of the students (4.22), lack of awareness of the products (4.17), and lack of in-house capability to commercialize (3.52) are the factors influencing the diffusion of products from the selected TVCs. This result implies that if proper attention is given to the identified factors, the products from the TVC will be more diffused than they currently are. The results of this study corroborate previous studies on the challenges that are hindering the activities of technical and vocational colleges in Nigeria (Egwu, 2009; Udoka, 2010; Odu, 2011; Nwogu and Nweanomi, 2011; Yusuf and Soyemi, 2012; Okebukola, and Okolocha, 2012; UNESCO, 2012; Akinyele and Bolarinwa, 2018). Although, the instructors disagreed that inconsistent government policy support for Science & Technology (S&T) is a factor influencing the diffusion of products from the selected TVC.

Table 1 also shows the perspective of students on the factors influencing the diffusion of products from the selected TVC in Southwestern Nigeria. The table shows that students strongly agreed that lack of technical expertise (4.58), lack of interest for local products (4.62), low level of linkages with entrepreneur outside their center (4.71), non-sufficient research & development (R&D) (4.54), inappropriate marketing skills (4.60), poor industry-academia linkages (4.85), lack of basic infrastructural facilities (4.61), and incessant power failure (4.52) affects the diffusion of products from the selected TVCs. The students further agreed that inconsistent government policy support for S&T (4.41), non-availability of sufficient market for their products (3.92), lack of access to finance (4.42), low level of entrepreneurial skills (4.34), lack of awareness of the products of the TVC (4.42) and lack of in-house capability to commercialise (4.11) are the factors influencing the diffusion of products from the selected TVCs.

Table 1: Factors Influencing the Diffusion of Products of the Selected Technical and Vocational Colleges (TVC)

Variables (Instructors' Perspective)	Mean
Lack of technical expertise	4.78
Inconsistent government policy support for Science & Technology (S&T)	2.31
Lack of interest for local product	4.62
Non-availability of sufficient market for their product	3.45
Lack of access to finance	4.62
Low level of entrepreneurial skills	4.22
Low level of linkage with another entrepreneur outside their centre	4.71
Lack of research & development **(R&D)**	4.54
Inappropriate marketing skills	4.60

Poor industry- academia linkage	4.85	
Lack of basic infrastructural facilities	4.61	
Incessant power failure	4.52	
Lack of awareness of the products	4.17	
Lack of in-house capability to commercialize	3.52	
Variables (Students' Perspective)		
Lack of technical expertise		4.58
Inconsistent government policy support for Science & Technology (S&T)		4.41
Lack of interest for local product		4.62
Non-availability of sufficient market for their product		3.92
Lack of access to finance		4.42
Low level of entrepreneurial skills		4.34
Low level of linkage with another entrepreneur outside their centre		4.71
Lack of research & development (R&D)		4.54
Inappropriate marketing skills		4.60
Poor industry- academia linkage		4.85
Lack of basic infrastructural facilities		4.61
Incessant power failure		4.52
Lack of awareness of the products		4.42
Lack of in-house capability to commercialize		4.11

Keys: 1= strongly disagree 2 = Disagree 3 = fairly disagree 4 = Agree 5 =Strongly Agree

Table 2 shows the results of the factor analysis. The extracted five factors from the instructors' perspective explains 71.595% variation in all the 14 factor variables. Likewise, the three extracted variables from the students' perspective explains 72.709% variation of all the fourteen factor variables. The extracted five variables (instructors' perspective) are lack of technical expertise (0.753), lack of interest for local products (0.637), lack of access to finance (0.886), incessant power failure (0.714), and lack of awareness of the products (0.829). Likewise, the extracted three variables (students' perspective) are lack of access to finance (0.872), incessant power failure (0.815), and lack of in-house capability to commercialise (0.627).

Table 2 Extracted Factors Influencing the Diffusion of Products of Technical and Vocational Colleges (TVC)

Extracted factors	Extracted values	Cumulative Variation value
Instructors' perspective		
Lack of technical expertise	0.753	26.306
Lack of interest for local product	0.637	47.397
Lack of access to finance	0.886	57.215
Incessant power failure	0.714	65.939
Lack of awareness of the products	0.829	71.595
Students' perspective		
Lack of access to finance	0.871	30.429
Incessant power failure	0.815	56.210
Lack of in-house capability to commercialize	0.627	72.709

Key: Extraction technique

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 3 shows the extent of diffusion of the products of the selected TVCs. The table shows that the perspective of the instructors from the selected TVC indicates that the selected TVCs have low a level of collaboration (1.53) with Technological Incubation Centre in Nigeria. Also, the extent of use of the products of the selected TVC in Nigeria was found to be low (2.14). Furthermore, the perspective of the students from the selected TVC seems to be in tandem with the perspective of their instructors. The students indicate that the selected TVC have low collaboration with Technological Incubation Centres in Nigeria (1.43), and the extent of use of the products of the selected TVC was low (2.43).

Table 3 Extent of Diffusion of the Products of the Selected TVC

Characteristics (Instructors' perspective)	**Mean**
Extent of collaboration of TVC with Technological Incubation Centre in Nigeria	1.53
Extent of use of the products of the selected TVC in Nigeria	2.14
Characteristics (Students' perspective)	
Extent of collaboration of TVC with Technological Incubation Centre in Nigeria	1.43
Extent of use of the products of the selected TVC in Nigeria	2.43

Scales
1 = no collaboration, 2 = low collaboration and 3 = high collaboration with TIC
1 = no use, 2 = low use and 3 = high use of the products

Table 4 shows the Analysis of Variance (ANOVA) of factors influencing the extent of diffusion of products of the selected TVC. From the instructors' perspective, the table shows that lack of interest for local products ($F= 4.694$; $p < 0.05$), lack of access to finance ($F = 21.104$; $p < 0.05$), incessant power failure ($F = 18.934$; $p < 0.05$) and lack of awareness of the products ($F = 27.686$; $p < 0.05$). From the perspective of students, the table shows that lack of access to finance ($F = 15.934$; $p < 0.05$) and incessant power failure ($F = 19.686$; $p < 0.05$) were factors influencing diffusion. These results corroborate previous studies that TVCs in Nigeria like in many other countries still faces a lot of challenges (Manfred and Jennifer; 2004) such as finance (Ejike, 1990; Manfred and Jennifer, 2004; Olakunri, 2006), basic infrastructure (World Bank, 2011), less attention (Oluwale *et al*., 2013), dearth of technical teachers, weak capital base, and poor technology (Manfred and Jennifer, 2004; Olakunri, 2006). However, it is highly imperative to curtail the identified barriers to diffusion of products from the selected technical and vocational colleges (TVC) in Southwestern Nigeria.

Table 4 ANOVA Table of Factors Influencing the Diffusion of Products from TVC

Instructors' Perspective	**F**	**Sig.**
Lack of technical expertise	0.918	0.107
Lack of interest for local product	4.694	0.016*
Lack of access to finance	21.104	0.000*
Incessant power failure	18.934	0.000*
Lack of awareness of the products	27.686	0.001*
Students' Perspective		
Lack of access to finance	15.934	0.000*
Incessant power failure	19.686	0.001*
Lack of in-house capability to commercialize	0.934	0.103

*Significant @ $P < 0.05$

5. Conclusion

The study concluded that from the perspective of instructors, the extracted five factors explained 71.595% of variations in the 14 factors influencing the diffusion of products from the selected TVC. Likewise, from the perspective of students, the extracted three factors explained 72.709% of variations in the 14 factors influencing the diffusion of products from the selected TVC. Meanwhile, the perspectives of instructors and students were unanimous on the level of use of products from the selected TVC was low, likewise the low collaboration of TVC with Technological Incubation Centres in Nigeria. However, from the perspective of instructors, the study concluded that lack of interest for local product, lack of access to finance, incessant power failure and lack of awareness of the products were significant factors influencing the diffusion of products from the selected TVC in Southwestern Nigeria. Also, from the perspective of students, the study concluded that lack of access to finance and incessant power failure were significant factors influencing the diffusion of products from the selected TVCs in Southwestern Nigeria.

The study recommends that TVCs that want to improve the diffusion of their products need to prioritizeproblem- solving; lack of interest for local products from the end users, lack of access to finance, incessant power failure and lack of awareness of their products by introducing product exhibition and angel investors among others for the products of TVC in the study area.

The study is biased towards factors influencing the products diffusion of the oldest TVCs in Southwestern Nigeria. Further studies may include the perspectives of the newly established TVCs in Southwestern Nigeria.

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