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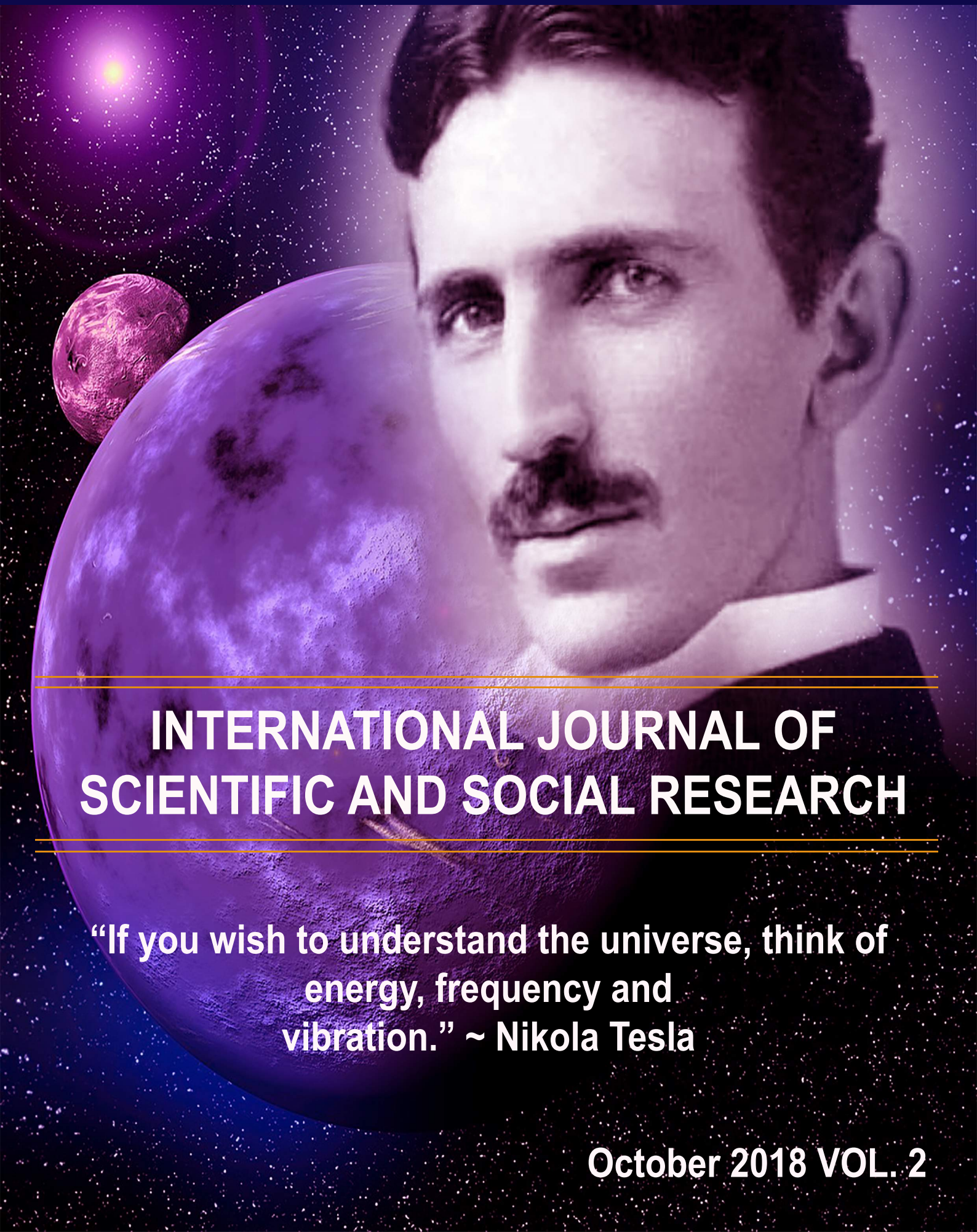

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"If you wish to understand the universe, think of energy, frequency and vibration." ~ Nikola Tesla

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CONTENT

Mobile Learning for Differentiated Learning and Assessment: A systematic review of empirical studies

Kieran McCartney

Introduction

Robinson indicates there is a need to transition from an education system that is based upon an industrial model i.e. where students are viewed as empty vessels to be filled with knowledge towards a more responsive and individualised curriculum that recognises the learner's differing skills and diverse needs (Robinson, 2014). Attempts to transcend traditional education practices requires a reconciliation between academic prowess and 'human ecology' i.e. the ability of humans to build relationships with their natural, social and built environments as part of a learning process.

The proliferation of devices that can be used to facilitate m learning has also changed. The Global m-Education Market 2016-2020 indicates that an increase in the market share of mobile learning (M learning) of 21% between 2016 and 2020 is predicated (ReportBuyer, 2015). This coincides with Ipsos-mori that indicates 71% of the United Kingdom (UK) population owns a smart phone and ownership of a tablet has risen to 47% (Ipsos-mori, 2016). Further, accessing the Internet from a smart phone has risen to 69% in the quarter one of 2016 from 34% from quarter three of 2011. The Ipsos-mori report indicates that the most common uses of portable technology such as smart phones and tablets that includes the use of email, Internet browsing and social networking are also reflected in less portable technology such as personal computers (PC's). Therefore, the advantage of mobile learning M learning is *not* always centered on its ability to provide access to existing services or to replace or add to tasks that can already be completed on a non-portable device such as reading text. The tasks we complete in education have not changed but the *functionality* of the tools we use to complete the tasks set have improved learners ability to co-collaborate, co-construct and reflect.

Defining M Learning

Sharples et al characterised M learning as "learning across multiple contexts, through social and content interactions, using personal electronic devices" (Sharples, Taylor and Vavoula, 2007). In this definition *context* incorporates learning that is a learner initiated and/or teacher

initiated; further it may be informal or formal (Sharples, 2009). One of the key challenges with this definition is that it has not been identified at which point, in the learning *and* assessment process, M learning acts as the intermediary that facilitates the 'personalization' of technology for human use and enhancing the educational experience (Darling-Hammond, 2014). However, in my view these definitions are narrow and failed to take account of the ecological relationship between humans and technology. Therefore I consider M Learning as an individual or collaborative activity devoid of temporal or geographical constraints and can be integrated into the lifestyle of the learner. The flexibility afforded as a result of a lack of temporal or geographical constraints facilitates learning that can involve acquiring information and understanding its relevance using *real world experiences*. This interaction with the real world enables contextualisation of knowledge using software, in the form of mobile applications, or Apps', that are responsive to the user's learning needs and contained on a portable technological device.

Facilitating responsiveness to the learner's needs brings with it the opportunity to facilitate a curriculum that adapts and is individualised to the needs of the learner. The creation of a curriculum that is individualised can be connected with the concept of differentiation where the differing skills and diverse needs of students are accounted for in what has been termed 'instructional differentiation' (Mills et al., 2014). It is M learning's ability to facilitate learning across various contexts along the intersecting axes of geography and time that affords the opportunity for a personalised curriculum. Thus, M learning brings with it the opportunity to allow learners to take ownership of their learning and individualise this according to their needs (Song et al., 2012). However, even this concept has not given rise to the consideration of both instructional differentiation and differentiated assessment. Therefore, the ecology between humans and technology within education and the impact that one may have upon the other in relation to learning and both instructional differentiation and differentiated assessment is an area that requires investigation.

The pedagogical evolution of M Learning

What follows is a critical exploration of the predominant pedagogical changes that have occurred as the relationship between technology and education has evolved since the 1970s. Charting the development of these pedagogical changes is important in order to understand how technology currently influences 'human ecology' i.e. the ability of humans to build

relationships with their natural, social and built environments. Additionally, M learning's potential to transform education and to facilitate differentiated learning and assessment can only be viewed in light of technological change and the parallel evolving pedagogies associated with this change. The review is influenced by a critical examination of Crompton's historical review of M Learning and considers the evolving educational pedagogies, as they relate to technology and learning (Crompton, 2013). Further, this examination considers these evolving pedagogies in light of education metaphors that clarify and facilitate comparison with learning behaviors'.

The evolution and changing definitions of M learning can, historically, be linked to the predominant educational pedagogies that have developed in conjunction with popular theories of learning. For instance, Bruner's recognition of discovery learning was superseded, in the 1980s by constructivist learning espoused by Piaget) *and* constructionist learning approaches such as those outlined by Papert and Seymour (Bruner, 1966), (Piaget & Jean, 1957)and (Papert & Seymour, 1980). The monolgical and dialogical approaches presented by discovery and constructivist learning theories, respectively, are clarified through the Acquisition and Participation Metaphors (Sfard, 1998). In the presence of the acquisition metaphor (AM), learning is synonymous with cognitive education i.e. remembering and understanding. Here, the learner acts as an *individual* vessel where knowledge is placed. The intention is to improve how the mind operates by transmitting information from the teacher to the learner leading to a development of knowledge (Sfard, 1998). For example, Lee's traditional review charts the progress of Computer-Assisted Language Learning (CALL), during the 1970s, and was based upon the behaviourist stimulus response teaching method which included grammar instruction and translation tests (Lee, 2000). This discovery type learning, that encouraged students to deduce concepts in their own mind, was monological in nature and reflective of the AM.

The progression from discovery learning towards dialogical interaction as a method to improve the learner experience was reflective of the constructivist and constructionist learning approaches espoused by Piaget and Papert which was prevalent in the 1980s (Piaget & Jean, 1957)and (Papert & Seymour, 1980). For example, Dossett and Hulvershorn's primary study identified that the mean training time, using computer assisted instruction, was significantly reduced for military personnel who engaged with peer to peer learning than when compared with those who were trained on an individual level (Dossett & Hulvershorn, 1983). This study demonstrated that in the presence of computer technology social interaction proved superior as

a learning methodology than when compared with the monological approach identified in Lee's study that related to language acquisition teaching in the 1970s. In this constructivist approach, the acquisition of knowledge occurred when learners actively shared knowledge implicitly and explicitly through social interaction (Lee, 2000). This epistemology did not negate the importance of social interaction, context, prior experience and the learner's experience of education and thus were more reflective of the participation metaphor (Sfard, 1998).

The constructionist approach, that was present in the latter stages of the 1980s, was deemed more efficacious as a method for learners to socially construct knowledge. For instance, Scardamalia and Bereiter indicate that a move towards a 'distribution model' of education in the latter 1980s and early 1990s witnessed the use of computer-supported intentional learning environments (CSILE) (Scardamalia & Bereiter, 1994). Using CSILE learners' were not collectively exposed to the same knowledge but rather each learner knew something of the topic but, *crucially*, did not have access to all of the subject material. The advantage of this constructionist approach to learning over constructivism was that CSILE encouraged the creation of new knowledge as students explored each other's understanding, through discourse. Where the ecological relationship between humans and computers were concerned advances in computers was now facilitating human to human interaction via an electronic medium and could be closely identified with the socio-constructivist theories of learning.

The socio-constructivist theories and associated pedagogy was based upon the axiom that group interactions led to intellectual improvement. This acted in concert with the Problem based learning (PBL) presented by Koschmann and Others that recognized the role of technology in collaborative PBL within medicine (Koschmann & Others, 1994). PBL was akin to the socio-constructivist theories represented in Vygotsgy and evident in the early 1990s (Vygotsky, 1978). Here, the focus was upon reversing the role of the teacher and student. As a result, small groups of students would work critically and creatively to solve problems. PBL shared many similarities with 'expansive learning' that was characterised by Engeström who observed that in order to learn recipients must be allowed to question and influence the application of the knowledge as opposed to being involved in learning that is primarily one directional. Therefore the teacher moves towards a role that is characterised by facilitation (Engeström, 2001).

As interactions between humans could now be facilitated by technology that enabled audio, visual and text communication new metaphors that explained how these connections could be explored in education began to develop. One such metaphor espoused by Brown et al was 'situated cognition', where a learners ability to contextualise their learning and to bridge the chasm between learning and real world practice defined success (Brown et al., 1989). The 'situation cognition' metaphor mirrored the socio-constructivist theories represented in Vygotsgy's work that became a common pedagogical approach of the mid to latter 1990's evidenced by Lintern (Vygotsky, 1978) and (Lintern, 1995). In Lintern's study the premise of situation cognition i.e. learning is ineffective if the learner is removed from the context, was verified through an ethnographic methodological design that considered the effectiveness of flight instruction within the aviation industry. One of the challenges outlined by the study was that integrating technology into pilot training was only achievable within the aviation industry as a result of investment in technology that would facilitate apprenticeship style learning. Thus the challenge, for education, was in repeating a successful transfer of learning by conveniently linking education to technology and avoiding a 'breach between education and practice'.

Viewing the various education metaphors, theories and pedagogies in isolation of each other prevents a fuller understanding of the evolution of M Learning that was first defined by Laouris and Eteokleous (Laouris & Eteokleous, 2005). Indeed it is only when viewing the various tenets of these educational theories *collectively* that the role and importance of M Learning to facilitate differentiated learning and assessment is realised. In fact, as Sfard suggests a "Dictatorship of a single metaphor" or indeed the dictatorship of a single learning theory should be avoided (Sfard, 1998). In order to facilitate a responsive curriculum the role of M learning must be considered in relationship to the differing learning needs of students that are influenced by the various learning theories, metaphors, learning styles and intelligences that have been identified above.

Gaps in the research

An opportunity to investigate M Learning and the correlations that may exist between this pedagogy's ability to facilitate differentiated learning and differentiated assessment has not been fully explored. Therefore, the influence of the experiential learning model/learning style inventory (Kolb, 2007); learning styles (Honey, P. and Mumford, 1989); Visual, Aural, Read/write, and Kinesthetic (Fleming, N and Mills, 1987); multiple intelligences (Gardner &

Hatch, 1989) and more recently the brain hemispheric theories of learning (McGilchrist, 2009) in relation to M learning must be examined.

Materials and Methods

Priori

The purpose of this review is to establish if M Learning has been used to facilitate differentiated learning and differentiated assessment within education. It is anticipated that this review will address the key aspects of the effectiveness of M Learning by considering if M Learning can lead to greater improvements in learning when compared with traditional learning and assessment?

Eligibility

Studies were deemed eligible for review based upon the following criteria;

The use of mobile learning was evident and formed part of an experimental or quasi-experimental design that incorporated a control group in the study. And, the study used quantitative methods to assess the relationship between m learning and improvements in learning. Further, the study considered the role of a variety of learning sources upon student performance that either implicitly or explicitly sought to account for either/and/or differentiation in learning, learning style, multiple intelligences, brain dominance or inclusive learning.

Selection of Studies and risk of bias

Studies were selected using the following protocol. (1) Screening the titles of the articles; (2) viewing the abstract of the relevant article and (3) finally, if the paper had not provided sufficient information the entire article was reviewed.

Use of the AMSTAR guidelines were adhere to you in order to improve the methodological processes established within this paper (Shea et al., 2007). nVivo software (version 11.3.1.777) was used to code data that subsequently led to the creation of study characteristics to enable an analysis of the research that was investigated under the following headings, number of participants; age of participants; Device used; Subject Area; Type of Study; Methods; Hypothesis; Statistical Measurement and Result/Outcomes.

Search strategy

A search strategy was conducted during July 2016 in three databases i.e. The Science Direct database, British Education Index (BEI) database and the Education Resources Information Centre (ERIC) database. Table 1 identifies the search strategy that was employed for each database.

Table 1: search strategy employed within the Science Direct Database, British Education Index (BEI) Database and Education Resources Information Centre (ERIC) Databases'

	Science Direct Database	**British Education Index (BEI) Database**	**Education Resources Information Centre (ERIC) Database**
BOOLEAN Search Criteria	Mobile learning AND learning style OR multiple intelligence OR differentiation OR inclusive learning OR whole brain	(TI+mobile+learning) +OR+(KW+mobile+learning) +AND+(KW+learning+style) +OR+(KW+multiple+intelligence) +OR+(KW+differentiation) +OR+(KW+inclusive+learning) +OR+ KW whole brain	(TI+mobile+learning) +OR+(KW+mobile+learning) +AND+(KW+learning+style) +OR+(KW+multiple+intelligence) +OR+(KW+differentiation) +OR+(KW+inclusive+learning) +OR+ KW whole brain
Further Search Criteria			
Publication Date	January 2006- July 2016	January 2005- July 2016	January 2005- July 2016
Limit to	Refined to Journals - Computers in Human Behavior. Computers & Education. Learning and Individual Differences.	Academic Journals Full text articles	Academic Journals Full text articles
Total Selected	**18** **4**	**66** **4**	**255** **12**

Results

Number of participants

From the 20 studies selected within this review nine had been conducted where the researcher had direct involvement with the learners. Five of the studies identified have over 100 participants (Rashid and Asghar, 2016), (Yang, Li and Lu, 2015), (Su and Cheng, 2015), (Wennersten, Quraishy and Velamuri, 2015), (Khazaie and Ketabi, 2011). Of these five studies one had a number of participants that exceeded 1000 i.e. [3327] (Wennersten, Quraishy and Velamuri, 2015). This was largely as a result of the geographically expansive area in which the study took place.

Age of participants

Four of the 20 studies identified provided a mean average age of the participants that aided in identifying at what level the students were being educated at (Rashid and Asghar, 2016), (Yang, Li and Lu, 2015), (Yin et al., 2013) and (Azabdaftari and Mozaheb, 2012). Eight studies provided age ranges for the participants within the studies that indicated those who were using mobile learning were aged between 10 and 22 years of age (Melero, Hernández-Leo and Manatunga, 2015), (Hwang et al., 2013), (Su and Cheng, 2015) (Alemi, Sarab and Lari, 2012), (Fattah, 2015), (Khazaie and Ketabi, 2011), (Zhang, Song and Burston, 2011), (Hung et al., 2012). One study identified the participants as graduates therefore no age could be clearly identified (Garcia-Cabot, de-Marcos and Garcia-Lopez, 2015). The remaining studies included did not clearly state the age of the participants that were involved and this prevented an analysis of the effectiveness of the learning in relation to the age range.

Devices used

All the studies identified used a mobile device in order to facilitate learning. Five of the studies identified used a personal digital assistant (PDA) in order to facilitate learning (Hwang et al., 2013), (Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012), (Yin et al., 2013), (Hung et al., 2012) (Chen, Kao and Sheu, 2005). 10 of the 20 studies identified used a mobile phone or smart phone as part of the teaching process (Melero, Hernández-Leo and Manatunga, 2015), (Rashid and Asghar, 2016), (Yang, Li and Lu, 2015), (Su and Cheng, 2015), (Wennersten, Quraishy and Velamuri, 2015), (Alemi, Sarab and Lari, 2012), (Azabdaftari and Mozaheb, 2012),

(Basoglu and Akdemir, 2010), (Fattah, 2015), (Zhang, Song and Burston, 2011). The remaining studies used iPads or laptops with only one using a variety of mobile devices as part of the teaching process (Krivoruchko et al., 2015). One study used a mobile device that was specific to medicine and therefore was not widely available (Wu et al., 2012).

Subject area studied

The studies identified taught a wide variety of educational subjects that included engineering, language, art, ecology and mathematics. Eight studies included a review of the effectiveness of teaching elements of English language or grammar (Wennersten, Quraishy and Velamuri, 2015), (Alemi, Sarab and Lari, 2012), (Azabdaftari and Mozaheb, 2012), (Fattah, 2015), (Khazaie and Ketabi, 2011), (Krivoruchko et al., 2015), (Zhang, Song and Burston, 2011), (Basoglu and Akdemir, 2010). Only one study did not clearly identify which area of study the learners were participating in (Rashid and Asghar, 2016).

Theoretical stance

One of the studies identified indicated that there theoretical stance was non-experimental (Krivoruchko et al., 2015). However, a review of this paper clearly indicates that an experimental approach was adopted. Further, two papers identified their theoretical stance as that of quasi-experimental (Wennersten, Quraishy and Velamuri, 2015), (Khazaie and Ketabi, 2011). The remaining papers were clearly experimental studies and were identified as such by the researchers.

Location of study

From the studies identified non-were located in the United Kingdom or Ireland. The majority of studies i.e. 7, were located in Taiwan (Hwang et al., 2013), (Su and Cheng, 2015), (Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012), (Yin et al., 2013), (Hung et al., 2012), (Wu et al., 2012), (Chen, Kao and Sheu, 2005). The remaining studies were based in Iran (2); Spain (2); Saudi Arabia (2); China (2); India (1); Kazakhstan (1); Turkey (1) and United States of America (USA) (1). (Garcia-Cabot, de-Marcos and Garcia-Lopez, 2015), (Melero, Hernández-Leo and Manatunga, 2015), (Rashid and Asghar, 2016), (Yang, Li and Lu, 2015), (Wennersten,

Quraishy and Velamuri, 2015), (Alemi, Sarab and Lari, 2012), (Azabdaftari and Mozaheb, 2012), (Basoglu and Akdemir, 2010), (Fattah, 2015), (Khazaie and Ketabi, 2011), (Kiger, Herro and Prunty, 2012), (Krivoruchko et al., 2015), (Zhang, Song and Burston, 2011). Appendix A represents an outline of the studies investigated.

Methodology

A review of the studies indicates that an experimental approach was adopted by all the researchers to determine the effectiveness of mobile learning upon learning outcomes. In all cases the effectiveness of learning was determined via the application of a post-test assessment process. In three studies learners were assessed prior to the intervention and following the intervention (Rashid and Asghar, 2016), (Wu et al., 2012), (Chen, Kao and Sheu, 2005). Only one study considered the effectiveness of mobile technology taking account of the preferential needs/learning styles of learners by considering the role of graphical, video or text as teaching tools using mobile technology (Yang et al., 2015). The remaining studies applied an experimental approach whereby the experimental group was introduced to mobile learning that incorporated either text or graphical representations of teaching materials. Control groups were given that the same teaching materials however these were not presented on mobile technologies.

Measurement of statistical result

11 of the studies presented used a parametric statistical test to determine the impact of teaching strategies following an intervention (Melero, Hernández-Leo and Manatunga, 2015), (Hwang et al., 2013), (Su and Cheng, 2015), (Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012), (Alemi, Sarab and Lari, 2012), (Azabdaftari and Mozaheb, 2012), (Basoglu and Akdemir, 2010), (Fattah, 2015), (Zhang, Song and Burston, 2011), (Yin et al., 2013), (Hung et al., 2012). Four studies used descriptive statistics to analyse the results which undermined the ability to determine the effectiveness of the interventions that they applied (Wennersten, Quraishy and Velamuri, 2015), (Khazaie and Ketabi, 2011), (Kiger, Herro and Prunty, 2012), (Krivoruchko et al., 2015). Two studies used analysis of variation to determine different factors that may have impacted upon learning other than the use of mobile technologies (Wu et al., 2012), (Chen, Kao and Sheu, 2005). One study used a nonparametric test to determine the effectiveness of the intervention (Garcia-Cabot, de-Marcos and Garcia-Lopez, 2015). Further,

one study applied a parametric test to correlate the relationship between the intervention and its effectiveness (Yang, Li and Lu, 2015). One study applied a multiple regression technique, as part of a system of parametric tests, to determine the effectiveness of intervention (Rashid and Asghar, 2016).

Results of the studies

From the studies reviewed 3 of the 20 studies did not prove their hypotheses to be correct (Yang, Li and Lu, 2015), (Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012) and (Alemi, Sarab and Lari, 2012). Of the studies, one had considered the relationship between concentration, the presentation mode of learning materials and academic achievement (Yang et al., 2015). The remaining two studies had considered the effectiveness of M learning when teaching Local Area Network Planning and Implementation and English spelling and grammar (Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012), (Alemi, Sarab and Lari, 2012).

Several studies also considered the role of satisfaction or enjoyment as part of the learning process. Those studies that considered satisfaction or enjoyment among the learners demonstrated that mobile learning had a positive impact upon learner satisfaction (Yang, Li and Lu, 2015) and (Hwang et al., 2013). Results of the studies are outlined in appendix B.

Teaching and assessment methods

A review of all the studies indicates that although the teaching methods varied by either using mobile technology to facilitate access to learning materials or using mobile learning as part of active participation in learning there is no indication that a similar approach was adopted during the post test assessment procedures. Therefore, whilst text, graphical or video learning materials may have been provided during the learning process there is no information to suggest that the post test assessment followed a similar pattern of facilitating differentiated learning with differentiated assessment or used mobile learning as part of the assessment process.

Discussion

An analysis of the papers that have been reviewed indicates that mobile learning provides clear benefits in relation to improving the effectiveness of teaching strategies. In the majority of cases mobile learning was used to replicate teaching and learning materials that would have normally been presented via traditional teaching methods that had already been employed. In one instance, mobile learning was used as the sole teaching methodology where differences in the effectiveness of the teaching was determined as a result of the format of the delivery of the teaching materials i.e. where they delivered in a text format, graphically presented or presented via a video. This approach was more reflective of the learning concepts of differentiated teaching associated with the learning style inventory (Kolb, 2007); learning styles (Honey, P. and Mumford, 1989); Visual, Aural, Read/write, and Kinesthetic (Fleming, N and Mills, 1987); multiple intelligences (Gardner & Hatch, 1989). However, the effectiveness of these theories that categorise learners according to preferences and styles of Learning has been criticised by Greenfield for lacking empirical evidence from the field of neuroscience (Henry, 2007).

15 of the 20 studies presented used parametric statistical tests to assess their interventions that gave greater credibility to the results of their research. Of those interventions it is clear from the statistical test used i.e. t-test that the effect of the application of mobile learning *on its own* was considered and not as part of other factors that may have affected the learning process (Melero, Hernández-Leo and Manatunga, 2015), (Hwang et al., 2013), (Su and Cheng, 2015), (Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012), (Alemi, Sarab and Lari, 2012), (Azabdaftari and Mozaheb, 2012), (Basoglu and Akdemir, 2010), (Fattah, 2015), (Zhang, Song and Burston, 2011), (Yin et al., 2013), (Hung et al., 2012).

Within those papers that had considered the role of other factors that may have affected the learning, learner satisfaction, format of the delivery on the mobile learning device as well as concentration levels were considered as aspects of the investigation that would have affected learning outcomes (Rashid and Asghar, 2016) and (Yang, Li and Lu, 2015).

Four of the studies presented had considered the effectiveness of learning using non-parametric statistical tests and had not considered the importance of the relationship between the changes in the results and a statistical significance between the experimental group and the control group. As a result the research, whilst important, could have been more conclusive

(Wennersten, Quraishy and Velamuri, 2015), (Khazaie and Ketabi, 2011), (Kiger, Herro and Prunty, 2012), (Krivoruchko et al., 2015).

Conflict-of-interest

I declare that I have no conflict of interests in relation to the research and authorship of this paper.

Strengths and Limitations

I have outlined how this systematic review has met the AMSTAR guidelines, an eleven point checklist tool to measure the quality of systematic reviews, and considered the strengths and limitations of this systematic review below with the associated AMSTAR guidelines in parenthesis (Shea et al., 2007).

This systematic review has adopted a priori design with clear inclusion and exclusion criteria (1). The comprehensive literature review of databases relevant to educational research and technology was established (3); clear links to those studies that were included and excluded (via the use of available URLs) and a clear methodology has been made available (5) (Appendix C); characteristics of included studies were outlined and further the quality of the studies presented were considered when an experimental group formed part of the methodological design process and further included statistical measurement (6, 7). Suggestions' regarding the use of more appropriate methodological approaches has been considered (8). Given that this systematic review has not included a meta-analysis no evidence has been presented to establish homogeneity or heterogeneity among the studies reviewed, neither was publication bias considered (9, 10). I have declared that no conflict of interest is evident in relation to my research and authorship of this paper (11). The paper would benefit from an independent researcher reapplying the research methodology outlined within this systematic review (2). Additionally, the presence of 'grey literature' was not considered in order to ensure that research reviewed provided comprehensive information regarding the methodologies adopted (4).

Limitations and directions of future research

It is clear from the review of the papers reviewed that mobile learning has, among 17 of the 20 papers reviewed, demonstrated a positive impact in relation to improving learning effectiveness. Within the 17 papers it is also evident that mobile technology was used to impart teaching and learning materials that *were not* different from the traditional materials provided to the control groups within the empirical research. Additionally, none of the researchers indicated that the assessment process reflected the differentiated approach adopted during the learning process. All the studies investigated afforded differentiated learning however the assessments of learning were conducted using methods that were standardised and uniform in nature and therefore not differentiated.

Therefore an incongruence exists between the teaching and learning and assessment strategies. I contend that in order for learning to be fully effective differentiated learning must have corresponding differentiated assessment. Thus opportunities for future investigation exist in order to establish if M learning can be used to facilitate both differentiated learning and differentiated assessment in order to take account of the differing skills and diverse needs of students (Mills et al., 2014). Further, as part of this exploration the relationship between enjoyment and learning effectiveness should also be explored

Appendices

Appendices

Appendix A: characteristics of studied included within the review

Source	n	Age	Location of Study	Device Used	Subject Area	Type of Study
(Garcia-Cabot et al., 2015)	**30**	Graduate students	Spain	Mobile Device	Web Engineering	Experimental
(Melero et al., 2015)	**76**	Between 14 and 16 years old	Spain	Smart Phone	Art	Experimental
(Rashid & Asghar, 2016)	**761**	20.79 yrs (Mean)	Saudi Arabia	Smart Phone	Unclear	Experimental
(Yang et al., 2015)	**258**	18.96 years (Mean)	China	Smart Phone	Geography, Biology, and Chemistry.	Experimental
(Hwang et al., 2013)	**56**	Aged Between 11 to 12	Taiwan	PDA	Local Culture	Experimental
(Su & Cheng, 2015)	**102**	Aged Between 10–11 years old	Taiwan	Smartphone	Natural Science and Life Technology	Experimental
(Wennersten et al., 2015)	**3,327**	Unclear	India	Mobile Phones	English and Science	Quasi-Experimental
(Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012)	**86**	Unclear	Taiwan	PDA	Local Area Network Planning and Implementation	Experimental
(Alemi et al., 2012)	**45**	Aged between 18- 21.	Iran	Mobile Phones	General English course	Experimental

Source	n	Age	Location of Study	Device Used	Subject Area	Type of Study
(Azabdaftari & Mozaheb, 2012)	**80**	20.5 (Mean)	Iran	Mobile Phones	English literature and Translation at BA level	Experimental
(Basoglu & Akdemir, 2010)	**60**	Unclear	Turkey	Mobile Phones	Undergraduate Compulsory English Preparatory Program	Experimental
(Fattah, 2015)	**30**	20 to 35 years old	Saudi Arabia	Smart Phone	Essay writing	Experimental
(Khazaie & Ketabi, 2011)	**158**	Aged Between 19-23	Iran	Mini-laptop	English recognition and recall	Quasi-Experimental
(Kiger et al., 2012)	**87**	Unclear	USA	iPod touch devices	Mathematics	Experimental
(Krivoruchko et al., 2015)	**82**	Unclear	Kazakhstan	Mobile phones and laptops, net-books. Tablets.	English	Non-Experimental
(Zhang et al., 2011)	**62**	Aged Between 18-22	China	Mobile phones	English	Experimental
(Yin et al., 2013)	**41**	Mean age of 22	Taiwan	PDA's	Computer algorithms	Experimental
(Hung et al., 2012)	**49**	11-12 Years Old	Taiwan	PDA's	Ecology	Experimental
(Wu et al., 2012)	46	Unclear	Taiwan	Mobile device (Specific to Medicine)	Knowledge of the respiratory system	Experimental
(Chen et al., 2005)	**24**	Unclear	Taiwan	PDA	Ecology	Experimental

Appendix B: findings of studies included within the review

Source	Hypothesis	Statistical Measurement	Result	Hypothesis Proved Correct?
(Garcia-Cabot et al., 2015)	"Does mobile learning adaptation impact on learning performance?"	Mann Whitney	The experimental group obtained statistically significantly results i.e. (Mdn = 8.24), U=162.0, p =0.40 compared with the control group i.e. (Mdn = 7.71), U=162.0, p =0.40) indicating the experimental group outperformed the control group.	Yes
(Melero et al., 2015)	Will group work as part of mobile learning lead to improvements in achievement than when compared with non-mobile learning techniques?	T-test	Post test results for those who were part of the experimental group i.e. M learning, indicated statistically significant results than compared with those in the control group (t=2.253, p=<0.05).	Yes
(Rashid & Asghar, 2016)	Does the use of mobile learning, when compared with other techniques, result in greater learning achievement?	Three separate multiple regression	The use of social media, that is incorporated into the learning process as part of mobile learning, had a positive impact upon academic performance (b ¼ 0.14, p < 0.01).	Yes

Source	Hypothesis	Statistical Measurement	Result	Hypothesis Proved Correct?
(Yang et al., 2015)	*Is there* a relationship between mode of learning, interest levels and level of achievement when comparing the use of text, graphical and video content within mobile learning?	Pearson's r	The use of text format in learning is unsuitable for students with high concentration levels similarly video format are unsuitable for those with medium to low concentration levels. Significant yet weak correlations were established between level of interest and concentration (Pearson's r ¼ 0.280, p < 0.01) as well as between concentration and post-test (Pearson's r ¼ 0.206, p < 0.01).	No
(Hwang et al., 2013)	Enquiry-based mobile learning have an effect upon learning achievement and learning attitude?	T-test and ANCOVA	Learning achievement of the experimental group (M learning) was considerably better than that of the control group i.e. F ¼ 4.36 and p 5 0.05.	Yes
(Su & Cheng, 2015)	Will different learning strategies i.e. the use of mobile learning, result in different learning achievements?	T-test and ANCOVA	A large difference was evident in post-examination achievement (p = 0.000) favouring M learning as a more effective teaching strategy.	Yes
(Wennersten et al., 2015)	Will the use of a mixture of subtitled stories, songs, live-action videos, animations and diagrams as a teaching tool in mobile learning result in different learning achievement among learners?	Descriptive statistics	Students who formed part of the experimental group outperformed their counterparts in control schools by an average of 7.92 percentage points.	Yes

Source	Hypothesis	Statistical Measurement	Result	Hypothesis Proved Correct?
(Yen Lee, C, Chen, I, & Jung-Chuan Yen, C, 2012)	Will a difference be evident in the learning achievement of students who use image-based concept mapping compared with text based concept mapping as part of mobile learning?	T-test	No significant differences were found between the teaching methodologies applied and the assessment outcomes ($t = 0.155$, $p = 0.877$). However, there were significant differences between the two groups in relation to the level of understanding ($t = -2.303$, $p = 0.024$) and creating ($t = -2.145$, $p = 0.035$).	No
(Alemi et al., 2012)	"Is there any difference between university students' learning of academic vocabulary items provided via SMS and those learnt by using a dictionary?"	T-test	There was no significant difference between the experimental group and the control group ($t=1.48$, $p= .42$).	No
(Azabdaftari & Mozaheb, 2012)	"Which strategy of vocabulary learning (e.g. flashcards vs. m-learning) is more effective in terms of learning the newly-introduced vocabularies for Iranian EFL learners?"	T-test	The mean calculated for the experimental group was statistically higher than the mean of the control group ($t = 6.99$, $p<0.05$).	Yes
(Basoglu & Akdemir, 2010)	"Is there a difference between the vocabulary learning level of the students using vocabulary learning program in mobile phones before and after the study?"	T-test	The results indicated that there was a statistically significant difference between use of M learning and traditional methods ($t= -7.6$, $p<0.05$).	Yes

Source	Hypothesis	Statistical Measurement	Result	Hypothesis Proved Correct?
(Fattah, 2015)	What is the effectiveness of using 'WhatsApp' i.e. in mobile learning, as a technique to developing students' writing skills?	T-test	The experimental group indicated significant differences in achievement during the assessment process (t= 7.36, P=0.01).	Yes
(Khazaie & Ketabi, 2011)	With the delivery of learning materials via mobile learning that incorporates verbal and visual learning result in differences between participants of learning achievement?	T-test	The use of mobile technology as a learning platform improved learning outcomes for those learning English when audio and visual methods were used together. More importantly, the study revealed that learners with low visual and verbal abilities who were not given text annotation as part of the learning process scored lower than those who received both visual, verbal and textual learning cues during assessment (p=0.000).	Yes
(Kiger et al., 2012)	Does the use of mobile learning result in greater learning achievement than compared with traditional methods?	Descriptive statistics	The mean results for M learning students indicated that more items were answered correctly on the post intervention multiplication test (M = 54.5, SD = 14.8) than the Comparison students (M = 46.3, SD = 12.5).	Yes

Source	Hypothesis	Statistical Measurement	Result	Hypothesis Proved Correct?
(Krivoruchko et al., 2015)	Can the use of multimedia sources as a tool within mobile learning be more effective than compared with traditional methods?	Descriptive statistics	Test results indicated an average improvement of language ability, pre-and post test, of 17.25% for the experimental group and 7.06% for the control group.	Yes
(Zhang et al., 2011)	Can vocabulary teaching on mobile technology be more effective than compared with traditional methods?	T-test	A significant difference existed between the post test results of the experimental group and that of the control group ($t=2.45$, $p<.05$). The significance of this result increased following a delayed test to assess longer-term learning i.e ($t=.47$, $p>.05$).	Yes
(Yin et al., 2013)	Can the use of mobile designed learning systems be more effective as a teaching tool than when compared with face-to-face teaching methods?	T-test	The results indicate that when assessing improvements in conceptual understanding of computer algorithms the experimental groups results were statistically significant ($t = 9.73$, $p < 0.01$).	Yes

Source	Hypothesis	Statistical Measurement	Result	Hypothesis Proved Correct?
(Hung et al., 2012)	Will the learning achievement of students who use PDAs differ from those who use traditional methods?	ANCOVA	Post-test score of the science inquiry ability assessment was greater than the control group ($F(24, 25)=4.72$, $P<0.05$).	Yes
(Wu et al., 2012)	Can the use of mobile learning lead to greater improvements in learning outcomes than compared with traditional methods?	ANCOVA	A significant difference existed between the results of the assessment process for both groups in favour of those participating in M learning ($F=45.26$, $p=0.00<.05$).	Yes
(Chen et al., 2005)	Will independent mobile learning, that is scaffolding at in a six stage process, result in greater improvements in learning achievement than compared with traditional methods?	ANOVA and ANCOVA	Latter stages of the scaffolding process i.e. stages 3 to 6, indicated significant differences between those using M learning and those using traditional methods i.e. stage 3 ($F = 5.343$, $p < 0.05$), stage 4 ($F = 8.515$, $p < 0.01$), stage 5 ($F = 7.250$, $p < 0.01$), and stage 6 ($F = 17.950$, $p < 0.01$).	Yes

Appendix C

The Locations of the BOOLEAN searches conducted in this systematic review are identified below.

The search Strategy used in the ERIC database

http://web.a.ebscohost.com.libezproxy.open.ac.uk/ehost/results?sid=11bc904d-a7c7-4931-89a0-1da61f91aa77%40sessionmgr4010&vid=0&hid=4112&bquery=((TI+mobile+learning)+OR+(KW+mobile+learning)+AND+(KW+learning+style)+OR+(KW+multiple+intelligence)+OR+(KW+differentiation)+OR+(KW+inclusive+learning))+OR+(KW+whole+brain)&bdata=JmRiPWVyaWMmY2xpMD1GVCZjbHYwPVkmY2xpMT1EVDEmY2x2MT0yMDA1MDEtMjAxNjAxJnR5cGU9MSZzaXRlPWVob3N0LWxpdmUmc2NvcGU9c2l0ZQ%3d%3d

The search Strategy used in the British education Index

http://libezproxy.open.ac.uk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bri&bquery=((TI+mobile+learning)+OR+(KW+mobile+learning)+AND+(KW+learning+style)+OR+(KW+multiple+intelligence)+OR+(KW+differentiation)+OR+(KW+inclusive+learning))+OR+(KW+whole+brain)&cli0=FT&clv0=Y&cli1=DT1&clv1=200501-201612&type=1&site=ehost-live&scope=site

The search Strategy used in the Science Direct database

http://www.sciencedirect.com.libezproxy.open.ac.uk/science?_ob=ArticleListURL&_method=list&_ArticleListID=-1035530511&_st=17&filterType=&searchtype=a&REC_ARTLIST_ID=-1035528337&originPage=rslt_list&_origin=related_art&_mlktType=Journal&md5=6ae95db4e8b72e47b7a6210c66c05be3

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The ethics of responsibility: the philosophical proposals of Hans Jonas and its critical appraisal towards environmental ethics for a technological age

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ABSTRACT

*The late modern views that the environment is simply there for the use and benefit of the human person without value persist to this day. The purpose of this article**, The Ethics of Responsibility: The Philosophical Proposals of Hans Jonas and its Critical Appraisal towards Environmental Ethics for a Technological Age,** is to add to the growing discussion which seeks to reconnect the environment and the human person through an exploration of the views offered by Hans Jonas. The imperative of responsibility serves as a guide to an establishment of an ethics for the future. This ethics guided by general principles of authentic dialogue unfolds an important relationship between those theories concerning our view and the use of the environment and human activities championed by modern technology.*

The significance of this study rests on the fact that the environmental crisis has become so urgent and leaves no one unaffected. The global environmental challenges, especially in our technological era, present serious ethical difficulties. For these reasons this work seeks to examine and evaluate the environmental ethics of Hans Jonas. He presents the dangers that will come to the environment if an ethics of responsibility is not taken towards the environment and further generations. At the same time we want to propose what could be solutions to the present day environmental crisis.

The investigation concludes that the environment and the human person share essentially the same scope. Both lead to an understanding of that reality and truth which underline all that occupy human interest.

INTRODUCTION

Among the many urgent contemporary worries, such as bioethical issues, is what has been called the environmental crisis or the ecology crisis. Environmental crisis has to do with the problem of environmental destruction caused by the human person. The global environmental crisis has challenged philosophers to develop a new system of ethics. This new ethics which was also stimulated by social issues has eventually flourished into theories of different variations. In order for this new environmental ethics to be a cure for present environmental problems, a notion of the environment needs to be developed. Today the greatest destruction of the environment is attributed to modern technological advancement. If anthropocentrism is the problem, then perhaps non-anthropocentrism is the solution. To some authors the environment is "all the external factors influencing the life and activities of people, plants and animals."[1] Here the environment is understood to be the reality which acts on an organism from outside. This calls for a judicious use of the environment if we envisage a 'future generation.'

At the same time there is the high tendency to produce material goods with little regard for the by-products of industrial technology that serve to pollute and degrade the environment. Also, today, there is the tendency to 'develop' the land with little regard for the preservation of endangered plants and animal species. This inclination to exploit natural resources with little regard for future generations has been identified as part of the environmental crisis. The depletion of the ozone layer, environmental hazards caused by pollution, high industrial and technological advancement with little or no respect for the environment indicate a serious crisis. G. B. Tangwa, in *Some African Reflections on Biomedical and Environmental Ethics,* describes the harm caused by technology to the environment in these words:

Global pollution (of air, water and soil); global warming and consequent erratic and unpredictable changes in global weather system, massive risks to plants, animals and humans from toxic industrial wastes and from sophisticated weapons, conventional, nuclear, chemical and biological; risks of upsetting nature's ecological balance; risk of accidentally triggering the collapse of the very foundation of life via gene technology. These hazards are urgent for all human beings in all parts of the world.[2]

[1] J. FEINBERG, "The Rights of Animals and Unborn Generation" in *Philosophy & Environmental Crisis*, WILLIAM T.BLACKSTONE, University of Georgia Press, Georgia 1974, 43.

[2] G. B. TANGWA, "Some African Reflections on Biomedical and Environmental Ethics," in *A Companion to African Philosophy*, Kwasi Wiredu (ed.), Blackwell Publishing, Australia 2004, 393..

The environmental problem, therefore, deals with the question of how human beings relate to the natural environment in their pursuit of happiness and well-being. Today, more than ever before the problem has become very urgent. The very activities that occupy the human person are meant to enhance human life but at the same time the human person has been endangered in this quest. Our interaction with nonhuman forms of life and with the environment as a whole has raised a number of moral problems. This has led to what is today known as "Environmental Ethics."[3]

This is why Hans Jonas [4] in his book *The Imperative of Responsibility: in Search of an Ethics for the Technological Age,* attempts to provide some solutions to the environmental crisis in what he calls "the ethics of the future."[5] H. Jonas's position about the environment is very practical and relevant in the sense that most of the environmental problems he grapples with arise from, or are related to, human problems. He questions modern technology that has 'raped' nature.[6]

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[3] S. BLACKBURN, Oxford *Dictionary of Philosophy*, Oxford University Press, Oxford 1996,121. Most of ethics deal with problems of human desires and needs: the achievement of happiness, or the distribution of goods. The central problem specific to think about the environment, is the independent value to place on such things as preservation of species, or protection of the wilderness. Such protection can be supported as a means to ordinary human ends, for instance when animals are regarded as future sources of medicines or other benefits. But many would want to claim a non-utilitarian, absolute value of the existence of wild things and wild places; it is in the very dependence of human lives that their value consists. They put us in our proper place, and failure to appreciate this value is not only an aesthetic failure but one of due humility and reverence, a moral disability. The problem is one of expressing this value, and mobilizing it against utilitarian arguments for developing natural areas and exterminating species more or less at will.

[4]Cfr. R. WOLIN "Ethics After Auschwitz: Hans Jonas's Notion of Responsibility in a Technological Age" in *The Legacy of Hans Jonas; Judaism and the Phenomenon of Life*, 1. Hans Jonas is a German – American Jewish philosopher, born in M ̈nchengladbach in 1903. By the age of thirty Jonas had experienced in *extremis*, the full array of early twentieth - century European cultural and political turmoil: World War I (albeit as a Civilian) He studied philosophy at Marburg University under the famous twentieth century philosopher Martin Heidegger. This period of studies presented a crisis that stems from the self-destructive nature of modern reason under the influence of modern natural science. He also learned from Heidegger that philosophy had the task of showing the limits of modern natural science by returning to ancient philosophy. He accused his teacher of nihilism (that is the view that the good is an invention of the human will not a reality existing by nature). In 1933, he left Germany with the rise of Nazism to power. In 1934, in light of escalating levels of anti-Semitic persecution Jonas wisely decided to emigrate to Palestine. At the same time, he pledged that he would only return to Germany as part of a conquering army. As it turned out, his vow proved prophetic. In 1939 he joined the British army's Jewish Brigade, reintering his for mer homeland along with victorious allies in 1945. Three years later, in 1948, Jonas would don military garb again to fight in Israel's war of independence. He later returned to Germany where he had lost his mother in Auschwitz concentration camp like many other Jews. The Second World War experiences deeply affected or altered his outlook on life. In 1949 he moved to Montreal and in 1951 moved to Ottawa in Canada where he began a distinguished career as a university professor. He died in 1993. Among his many works we have "*The Imperative of Responsibility," In Search of an Ethics for Technological Age*, which will be our primary source, *Philosophical Essays : From Ancient Creed to Technological Man; Mortality and Morality: A Search for the Good after Auschwitz* and *The Phenomenon of Life*: *Towards a Philosophical Biology*.

[5]H. JONAS, *The Imperative of Responsibility: In Search of an Ethics for the Technological Age*, Trans. H. JONAS-D.HERR, The University of Chicago Press, Chicago 1984, 27.

That technology is focused only on success, no matter the consequences, without a consideration for its by-products is not correct. The philosophical contributions of H. Jonas to the environmental crisis are very important.

The concept of the environment has presented a serious difficulty in terminology. Thinkers on the environment use words that seemingly look the same. Some use 'nature' for the environment while others use 'ecology', ecosystem and 'climate change' interchangeably. However, nature is broader in scope than the other concepts. H. Jonas holds that there has been a danger of overstraining nature. In a vivid way he describes human activities on nature as the 'raping of nature' as we have stated above, caused by the overpowering of human beings. Nature has been made vulnerable by human technological intervention and the self-propagation of the technological change. Technology has turned into an infinite forward-thrust with the dynamic pride of achievement. H. Jonas's major attempt is to ground his ethics of responsibility in metaphysics even though he ends up rejecting the foundation of metaphysics and instead gives a privileged position to the human person at the detriment of the environment.

STATEMENT OF THE PROBLEM

The main problem that will occupy us in this research is: "why should we care about the environment, or the future." To do this we need to find out if it makes sense to talk about rights of the 'unborn generation' or a future generation that does not even exist by protecting and preserving the environment? And if yes, how do we talk of a right to an entity that has no corresponding duty like the environment? What is the relationship between the human person and the environment? How do we ascertain the sustainability of the environment in relation to the human person?

A big issue in environmental ethics is whether the environment is intrinsically valuable, or merely useful to human beings. When people argue about environmental ethics - as with other fields of ethics - they can go round and round in circles because both sides have made different assumptions. While W.G. Smith and M. Benjamin see the environment as a tool to provide human beings with food and resources, others such as Peter Singer believe that the environment

[6]*Ibid*. 2. "The raping of nature and the civilizing of man go hand in hand. Both are in defiance of the elements, the one by venturing into them and overpowering their creatures, the other by securing an enclave against them in the shelter of the city and its laws. Man is the maker of his life qua human, bending circumstances to his will and needs, and except against death he is never helpless."

has its own interests and needs to be considered in its own right.[7] H. Jonas bridges the gap between these two views by establishing an ethics of responsibility and considers these opinions in relation to technology. Environmental ethics is that part of ethics which examines the moral basis of our responsibility towards the environment.

PURPOSE OF THE STUDY

This work seeks to present H. Jonas's environmental ethics as comprehensively as possible, to analyze his ethical proposal, that is, the imperative of responsibility and to critically evaluate his proposals for a technological age. The world today is struck by an environmental crisis, which strictly speaking, is a moral crisis. This crisis is championed by the fact that the human person has deviated from the objective value of reality. The human person has indulged in some form of simplistic approach to reality. Anthropocentricism has become the criteria for evaluating existence. Is the human person for the environment or is the environment for the human person? The environment has been relegated and manipulated upon by modern technology in the quest for fame, economic value and success at all cost.

For these reasons we want to undertake this study to examine and evaluate the environmental ethics of Hans Jonas within the context of an ethics of responsibility in a technological age. H. Jonas presents the dangers that will come to the environment if an ethics of responsibility is not taken seriously towards the environment and future generations. At the same time we want to propose what could be a solution to the present day environmental crisis.

STATEMENT OF THE HYPOTHESIS

Two assumptions can be made here: that we ought to care for the 'future' and that it makes sense to speak of the rights of the 'unborn generation'. We have the moral obligation to conserve our environmental inheritance for the future generation. G. B. Tangwa argues that "human beings have putative moral responsibility towards inanimate objects, plants, and the "lower" animals."[8] We have practical obligations towards the posterity of a distant future, and a

[7]Cfr. W. G. SMITH, "The Value of Wilderness" in *Social Ethics, Morality and Social Policy, 496*
[8]G. B. TANGWA, "Some African Reflections on Biomedical and Environmental Ethics," 388.

principle of decision in present action. P. Singer contends that we can be sure that future generations will appreciate the "wilderness."[9] He says:

> Perhaps they will be happier sitting in air-conditioned shopping malls, playing computer games more sophisticated than any we can imagine? That is possible. But there are several reasons why we should not give this possibility too much weight. First, the trend has been in the opposite direction: the appreciation of the wilderness has never been higher than it is today, especially among those nations that have overcome the problems of poverty and hunger and have relatively little wilderness left. Wilderness is valued as something of immense beauty, as a reservoir of scientific knowledge still to be gained, for the recreational opportunities that it provides, and because many people just like to know that something natural is still there, relatively untouched by modern civilization.[10]

The value that future generations will give to the environment is up to us now. We must create a culture of preservation now. This can only be done, thanks to an ethics of responsibility, as prescribed by H. Jonas. This is the argument we shall strongly push in this work.

According to many contemporary environmental philosophers, organisms do not have any rights or responsibility. M. Benjamin argues that organisms have value only in relation to man.[11] This argument begins with the philosophy of Aristotle. It is the dominant Western tradition.[12] We disagree with this dominant Western tradition. It is no longer a popular opinion. "To claim that humankind is the apex of biological existence, as we know it, has sometimes been dismissed as an arrogant speciecist claim."[13] Actually, most people like J. Passmore and J. Feinberg[14] are agreed that we should not damage the environment irreparably. But H. Jonas, our

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[9]Note that the environment, nature and wilderness are used here interchangeably. By wilderness we mean that part of our planet that is unaffected by human activity, perhaps it is already too late; there may be no wilderness left anywhere on our planet.

[10]P.SINGER, *Practical Ethics*, 271.

[11]Cfr. M. BENJAMIN., "Ethics and Animal Consciousness," in *Social Ethics, Morality and Social Policy*, A.MAPPES-JANE S.ZEMBATY (eds.), McGraw-Hill Pub. Company, New York 1987, 482.

[12]P. SINGER, *Practical Ethics*, 271. (According to the dominant Western tradition, the natural world exists for the benefit of human beings. God gave human beings dominion over the natural world and God does not care how we treat it. Human beings are the only morally important members of this world. Nature itself is of no intrinsic value, and the destruction of plants and animals cannot be sinful unless by this destruction we harm human beings.)

[13]G. B.TANGWA, "Some African Reflections on Biomedical and Environmental Ethics," 388.

[14]John Passmore is a professor of philosophy at Australian National University (Canberra, Australia). His published works include; Hume's Intentions(1952),A Hundred Years of Philosophy(1957), Philosophical Reasoning(1961) Science and its Critics(1978), Man's Responsibility for Nature(that concerns us directly in our research)(1974). Joel Feinberg is a professor of philosophy at the University of Arizona. His works include; Doing or Deserving(1970), Social Philosophy(1973), Reason and Responsibility(ed.) (1973) moral Concepts(1969), Coeditor of Philosophy of Law(1975), many articles i.e. "The Rights of Animals and Unborn Generation," in Philosophy and Environmental Crisis, W.T Blackstone (ed.) University of Georgia Press, Georgia 1974 43-68.

author, does not only highlight difficulties involved in environmental ethics but goes beyond difficulties to propose solutions.

SIGNIFICANCE OF THE STUDY

Although many have critically evaluated the ethical proposal made by Hans Jonas about the environmental crisis caused by technology from different points of view, there is still a need to comprehend his theory in its entirety. His ethics of responsibility needs to be analysed with its intrinsic relation to other elements of his earlier philosophical reflections. *The Phenomenon of Life: Towards a Philosophical Biology,* is very essential to his ethical considerations of the environment. There is also need to analyse systematically the enormous critique his ethics has generated. Such an analysis could help to overcome the criticism levied against his ethics and critically evaluate his contributions. However, the impact of his ethics is still in the initial stage but his predictions are already being felt. It is the relevance of such a critical analysis that prompted us to take on this research on Hans Jonas's ethics of responsibility towards the environment.

METHODOLOGY

This research on Hans Jonas's ethical proposal and its critical appraisal employs basically a philosophical method. We shall explore the thoughts of H. Jonas especially his contributions to environmental problems but at the same time analyzing and criticizing his metaphysics of life which is the foundation of his ethics of the environment. Environmental considerations today, in relation to the unlimited quest for technology, must be based on an ontology that proposes a more meaningful ethics. The ethics of the environment must be developed. We shall try to understand H. Jonas's concept of nature, environment and technology. His environmental ethics is drawn largely from his understanding of the anthropocentric nature of philosophy flowing from living organisms. To do this we shall make recourse to H. Jonas's main works as indicated in the select bibliography as well as other subsidiary sources that are closely connected to his philosophy. Our work will be analytic and synthetic. We will make recourse to critical appraisal of his ethical considerations towards the environment.

SCIENTIFIC INTEREST

Technology has been a welcome relief in resolving many human difficulties but in the bid to do this it has done a lot of harm to the environment. Besides the good produced by technology there has been untold harm to the environment. Therefore, there is need to refocus our obligation towards the environment. Our interest therefore is to raise awareness about the environmental crisis and propose some solutions by joining H. Jonas in his *Ethics of Responsibility*: *in Search of an Ethics for the Technological Age* which holds that the environment has intrinsic value and ought to be handled with care. Something is of intrinsic value if it is good or desirable in itself. This is opposed to instrumental value, which is value as a means to some other end or purpose. Our research work serves as a caution to the architects of technology who are violating this intrinsic value of the environment.

HANS JONAS'S ETHICS OF RESPONSIBILITY TOWARDS THE ENVIRONMENT

H. Jonas presents an ontological foundation of his ethics of the environment. This is evident in his philosophical biology. We have seen that the rejection of metaphysics starting with the distinctions made by R. Descartes has serious consequences. This Cartesian dualism destroyed the holistic understanding of nature. The distinction between *res extensa* and *res cogitans* could not adequately explain the phenomenon of life. Metabolism stands at the centre of H. Jonas's philosophical biology. According to H. Jonas metabolism enables the organism to exchange matter with the environment. Metabolism distinguishes between organic and inorganic life. We also saw that the central core to metabolism is needful freedom. The concept of needful freedom demonstrates a distinguishing characteristic between living organism and dead matter. In this chapter, therefore, we shall present H. Jonas's ethics of responsibility towards the environment.

THE CONCEPT OF RESPONSIBILITY

The concept of responsibility according H. Jonas is presented in his work *The Imperative of Responsibility: A Search for an Ethics for the Technological Age*. According to H. Jonas responsibility is understood as "being accountable 'for' one's deeds whatever they are and responsibility 'for' particular objects that commit an agent to particular deeds concerning them."[15]

V. Hösle affirming the importance of this work observes that "*The, Imperative of Responsibility* became for many of my generation the source of a new moral and political orientation."[16] To H. Jonas this ethics is new in that it is the "ethics of the future."[17] H. Jonas himself affirms that "nature as a human responsibility is surely a novum to be pondered in ethical theory."[18] He further states:

> As a *moral* proposition, namely a practical *obligation* towards the posterity of a distant future, and a principle of decision in present action, it is quite different from the imperative of the previous ethics of contemporaniety; and it has entered the moral scene only with our novel powers and range of prescience.[19]

This shows that we have all it takes to determine what lies in the future through the choices we make now. It also means that we can determine what the future generation should look like because the actions we carry out now will affect the distant future. It calls for responsibility in the choices we make now.

According to C. Mitcham "Responsibility" is a term that is often polymorphously employed to "ethicize" any human activity, including the activities of science and technology."[20] D. Nikulin on the other hand observes:

> The new ethics is not that of virtue (as in Plato, Aristotle and the Stoics), not of happiness (as in Utilitarian), not of duty (as in Kant), but an ethics of responsibility, an ethics implying a specific duty of humans towards humans and towards the non –human world.[21]

By responsibility here we mean accountability for the actions we carry out towards the environment and the future generation. H. Jonas's environmental ethics is about assessing and limiting human power over the natural world and expanding the human ethical concern to the non-human world.[22] This responsibility lies on the human person towards the environment and not the environment towards the human person. H. Jonas is of the view that:

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[15]H. JONAS, *The Imperative of Responsibility,* 90.
[16]V. HÖSLE, "Ontology and Ethics in Hans Jonas" in *Graduate Faculty Philosophy Journal*, 32.
[17]Cfr. H. JONAS, *The Imperative of Responsibility,* ,27.
[18]*Ibid.*7.
[19]*Ibid.* 10.
[20]C. MITCHAM "Philosophical Biology and Environmentalism" in *The Legacy of Hans Jonas Judaism and the Phenomenon of Life.* 507.
[21]D. NIKULIN, Reconsidering Responsibility: Hans Jonas' Imperative for a New Ethics" in *Graduate Faculty Philosophy Journal*, 101.
[22]Cfr. L.TROSTER, "Caretaker or Citizen: Hans Jonas, Aldo Leopold, and the Development of Jewish Environmental Ethics" in *The Legacy of Hans Jonas Judaism and the Phenomenon of Life,* 375. Jonas's environmental ethics arises from the fear of the destruction of humanity from the need to create a philosophical basis for humans' responsibility

> We intuitively recognize in the ontological distinction of man – his capacity for responsibility- not only its *essentiality* but also a *value*. The appearance of this value in the world does not simply add another value to the already value–rich landscape of being but surpasses all that has gone before with something that generically transcends it. This represents a qualitative intensification of the valuableness of *Being as a whole*, the ultimate object of our responsibility.[23]

The imperative of responsibility, therefore, is addressed and can only be addressed to and by human beings. Only human beings are capable of responsibility. If the presence of human beings in the world is a necessity and is constantly threatened by human beings themselves, then human beings have the duty and responsibility of preserving this present world into the future. They have the duty of saving the world for themselves not through their elimination but through their continual preservation.

According to H. Jonas this can only be done through this new Ethics. The main purpose of Jonas' ethics of responsibility is to provide an ethics whose validity is not cut off from an ontological foundation. If the environment is such that it has an objective purpose then the claim that it also has an intrinsic value may be justified. But if the environment has no value then it has no purpose. H. Jonas affirms:

> What is true of the particular purpose - namely, that the fact of it comes first, and the validity of "good" and "bad" relative to it comes second, determined by the first (*de facto*), but not legitimized by it (*de jure*) – is also true of "purposiveness" itself, as an *ontological* characteristic of an entity.[24]

The purpose of the environment is life and life is only life when it is existent.

> That there ought to be through all future time such a world fit for human habitation, and that it ought in all future time to be inhabited by a mankind worthy of the human name, will be readily affirmed as a general axiom or a persuasive desirability of speculative imagination.[25]

The danger posed on life by technology as we have seen above must lead us towards a certain responsibility to save themselves and the planet. His response to the environmental crisis is most fully elucidated in his book, *The Imperative of Responsibility*. In his work, Jonas argued that the environmental crisis emerged from the impact on the natural world, which is better and more far – reaching than in any previous age. This unique and novel power comes from modern technology, which is also radically different from the technologies of previous ages.

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[23]H. JONAS, "Towards an Ontological Grounding an Ethics for the Future, in *Mortality and Morality : A Search for the Good after Auschwitz*, 106.
[24]H. JONAS, *The Imperative of Responsibility*, 80.
[25]*Ibid.* 10.

THE RESTRICTED NATURE OF TRADITIONAL ETHICS

According to Jonas traditional ethics is limited. It considers only the present and individual actions. But due to the modern situation starting with technological development, there is need for reconsideration of the application of ethics. Jonas emphatically states that "our actions have opened up a whole new dimension of ethical relevance for which there is no precedence in the standards and canons of traditional ethics."[26] He states that "modern technology has introduced actions of such novel scale, objects and consequences that the framework of former ethics can no longer contain them."[27] We need principles that will help us to deal with issues that mankind has never known or had to deal with before. "This is not because former ethical principles were necessarily wrong, but because they were not designed to cope with the current ethical challenges."[28] H. Jonas proposes an ethics that should have consequences even to an unforeseeable future. New technologies have emerged that threaten species of life. H. Jonas says:

> All traditional ethics reckoned only with noncumulative behavior of the basic situation between persons, where virtue must prove and vice expose itself, remains always the same, and every deed begins afresh from this basis. The recurring occasions which pose their appropriate alternatives for human conduct – courage or cowardice, moderation or excess, truth or mendacity, and so on – each time reinstate the primordial conditions from which action takes off. These were never superseded, and thus moral actions were largely "typical," that is, conforming to precedent. In contrast with this, the cumulative self-propagation of the technological change of the world constantly overtakes the conditions of its contributing acts and moves through none but unprecedented situations, for which the lessons of experience are powerless.[29]

Today new challenging issues like the environment are presenting new ethical challenges that traditional ethics did not take into consideration. In chapter one, we saw the meaning of traditional or previous ethics according to H. Jonas. The fact is that every previous moral endeavour of philosophy dealt with the relationship between human beings. The relationship of human beings and the environment was never the object of ethical consideration.

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[26]H. JONAS, *The Imperative of Responsibility,* 1.
[27]*Ibid.* 6.
[28]P. TAKOV, *Deriving "Ought" from "Is" According to Hans Jonas*, 48.
[29]H. JONAS, *The Imperative of Responsibility*,7.

ETHICS OF RESPONSIBILITY

The ethical axiom which validates the rule according to H. Jonas is "never must the existence or the essence of [human being] as a whole be made at stake in the hazards of action."[30] Global technology threatens not only the present but also a distant future. Therefore "moral responsibility demands that we take into consideration the welfare of those who without being consulted will later be affected by what we are doing now."[31] But the question is, on what grounds do we have to protect a future that is not yet there or existing? According to H. Jonas it should be "on ontological grounds."[32] He argues that ethics without metaphysics is not possible. Metaphysics or ontology must underpin ethics.

Ontological grounding is based on the quality that belongs inseparably to being. We must bridge the "what is" and the "what ought to be" in order to propound any future ethics. Ethics for the future contains an imminent claim on reality that it is better for value to be than not to be. Because technology is doubled faced, that is able to lead to either good or evil, its good has the potential of turning into something bad due to its sheer growth. Knowledge of the good must be derived from the essence of what is human.[33] It is ontology that gives us evidence of what the environment ought to be and calls for responsibility in its usage. H. Jonas says:

> Therefore, the capacity for responsibility per se obliges its respective bearers to make existence possible for future bearers. In order to prevent responsibility from disappearing from the world–so speaks its immanent commandment – there ought to be human beings in the future… our responsibility to see that the capacity for responsibility survives in the world involves not only the existence of future human beings but also the way they exist; we must make sure the conditions of their existence do not cause this capacity (which depends on the freedom of the subject) to disappear.[34]

The above considerations lead us to the conclusion that responsibility here is personified. It is our responsibility to be responsible. By capacity Hans Jonas is referring to "man's ontological

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[30] L. VOGEL, "Does Environmental Ethical Need a Metaphysical Grounding?" in *Hasting Centre Report*, 37.
[31] L. VOGEL, "Editor's Introduction Hans Jonas, Exodus, from German Existentialism to Post Holocaust Theology" in *Mortality and Morality*, 99. Cfr. L VOGEL, "Does Environmental Ethical Need a Metaphysical Grounding?" in *Hasting Centre Report*, 37.
[32]*Ibid*. 100.
[33]*Cfr*. L VOGEL, "Does Environmental Ethical Need a Metaphysical Grounding?," 103.
[34]H. JONAS, "Towards an Ontological Grounding of an Ethics for the Future," in L VOGEL, Editor's Introduction Hans Jonas, Exodus, from German Existentialism to Post Holocaust Theology in *Mortality and Morality*, 106.

capacity to choose knowingly and willingly"[35]what we ought to be as moral agents with moral obligations. Our ethics for the future must be based on the responsibility to see that the world survives. "The [human person] is the only being known to us who can assume responsibility."[36] There is something worthwhile about him and it is that our existence is worthy of a future. There is always a new chance to develop our potentials for the good. Only ontology can inform us why the human person ought to be at all, why he must not bring about his own disappearance from the world or allow this to happen. This we can do by assuming responsibility or care for the environment.

ETHICS FOR THE FUTURE

"An ethics for the future" means a contemporary ethics concerned with a future we seek to protect for our descendants from the consequences of our actions in the present."[37] Because we are axiological beings, we are drawn towards an end. "The destruction of the world with beings that strive for ends (organisms) and beings that can reflect on ends (human beings) would be a serious crime."[38] The ethics of responsibility appeals mostly to the preservation of human life whose existence Jonas presupposes as part of a general teleological order.

THE ETHICS OF FEAR

Motivated by a sense of imminent catastrophe, the "heuristics of fear" suggests that our technological interventions must be tempered and guided by a comparative futurology. It is fear not hope that is the strongest motivation in Jonas ethics, what he calls the "heuristics of fear."[39] It is also known as "Ethics of Caution"[40] or the "sterner ethic of responsibility,"[41] which does not

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[35]L. VOGEL, "Editor's Introduction Hans Jonas, Exodus, from German Existentialism to Post Holocaust Theology," in *Mortality and Morality,* 101.
[36]*Ibid.*
[37]H. JONAS "Toward an Ontological Grounding of an Ethics for the Future" in *Mortality and Morality,* 99.
[38]*Ibid,* 39.
[39]H. JONAS, *The Imperative of Responsibility,* 26.
[40]L. TROSTER, "Caretaker or Citizen: Hans Jonas, Aldo Leopold, and the Development of Jewish Environmental Ethics" in *The Legacy of Hans Jonas Judaism and the Phenomenon of Life,* 387. This ethic of caution is also found in the precautionary principle, an ethical theory which states that an action, particularly one resulting from the introduction of a new technology, should be deemed by valid scientific opinion to have a high risk of being negative from an ethical point of view. The principle states that, when results cannot be determined with some kind of precision, action which might lead to significant harm should be delayed or shunned. According to the precautionary principle, new technology should be assessed for indication of harm. The onus of safety is on those who create the technology. Also see TIMOTHY O'RIORDAN and JAMES CAMERON, (eds.), *Interpreting Precautionary Principles*, Earthscan Publications, London, 1994.

provide a positive suggestion for concrete action. H. Jonas emphasizes that "as long as the danger is unknown we do not know what to preserve and why."[42]

> The position based on the heuristics of fear is always safe to maintain because if the worst happens, one can always say, 'I have warned you but you did not listen, hence the result. If the worst does not happen, one can either say that the worst did not yet happen or that it did not happen at all exactly because of the anticipation of the worst.[43]

The fear mentioned above is caused by the unprecedented nature of modern technology. In the ethics of responsibility the very notion of responsibility appears to be translated into the feeling of fear. L. Troster holds that:

> It can be said that environmental ethics has arisen out of a sense of fear and a sense of tragedy. The fear comes from the growing realization of the human cost of environmental destruction; the tragedy comes from the realization of how humanity is bringing about the extinction of so many other species and has irrevocably damaged the biosphere.[44]

The fear that the incredible power of the human person over nature which results from the dualistic change of categories might have bad consequences is what preoccupies the environmental ethics of H. Jonas. This change of categories occurred at the beginning of modernity and may end in a catastrophe for humanity and the future. Therefore "environmental ethics attempts to reassess the relationship of humanity to the natural world in order to stem human environmental damage and provide a hopeful vision of a renewed more sustainable future for all life on earth."[45]

THE NEW IMPERATIVE

In the formulation of this new ethics H. Jonas makes reference to Kant's Categorical Imperative. Kant's theory of ethics was developed initially in *Groundwork of the Metaphysics of Morals* and in the *Critique of Practical Reason*. When reflecting on the experience of moral obligation, he found that morality implied a categorical imperative which he states as follows: "so act that the maxim of your will could always hold at the same time as a principle establishing

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[41]L. VOGEL, "Does Environmental Ethical Need a Metaphysical Grounding?" in *Hasting Centre Report,* 38.
[42]H. JONAS, *The Imperative of Responsibility,* 27.
[43]L. TROSTER, "Caretaker or Citizen: Hans Jonas, Aldo Leopold, and the Development of Jewish Environmental Ethics" in *The Legacy of Hans Jonas Judaism and the Phenomenon of Life,* 375.
[44]Ibid.
[45]L. TROSTER, "Caretaker or Citizen: Hans Jonas, Aldo Leopold, and the Development of Jewish Environmental Ethics" in *The Legacy of Hans Jonas Judaism and the Phenomenon of Life,* 375.

universal law."[46] This form of the categorical imperative therefore provides a simple logical test. If you are content that someone else should be bound by the same principle upon which you are acting, then what you are doing is logically consistent and therefore right. If, on the other hand, what you want to do would involve a contradiction, or be self-defeating, even if everyone followed that same maxim, then it is wrong. Jonas on the contrary formulates a new imperative that reads:

> Act so that the effects of your action are compatible with the permanence of genuine human life; or expressed negatively; Act so that the effects of your action are not destructive of the future possibility of such life or simply: "Do not compromise the conditions for an indefinite continuation of humanity on earth." In your present choices, include the future wholeness of [the human being] among the objects of your will.[47]

According to this imperative a person acts morally and responsibly not only for the sake of others but also for the sake of the environment. This imperative is represented unconditionally. The ethics for the future obliges human beings to accept a certain minimal requirement toward their own action in the context of an indefinite future even when the effect of this action is still unknown.

The Imperative of Responsibility unlike Kant's Categorical Imperative that deals with the act here and now is different in that it appeals to a future generation that is not yet there. Kant's Categorical Imperative does not take into consideration the existence of the future generation. But Jonas propagates an ethics that does not appeal only to human beings but the environment as well. His ethics does not only take care of the now but also a distant future:

> It means that in the final analysis we consult not our successors' wishes (which can be of our own making) but rather the "ought" that stands above both of us. To make it possible for them to be what they ought to be is the true crime, behind which all frustration of their desires, culpable as they may be, takes second place. This means, in turn, that it is less the *right* of future men (namely, their right to "happiness," which, given the uncertain concept of "happiness," would be a precarious criterion anyway) than their *duty* over which we have to watch, namely, their duty to be truly human: thus over their *capacity* for this duty.[48]

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[46]I. KANT, "Fundamental Principles of the Metaphysics of Moral," in *Kant's Critique of Practical Reason and other works on the Theory of Ethics*, Trans. T.K. ABBOTT, Longmans, London 1909, 175. A maxim is a principle or a general rule governing the action of a rational person. It takes the form, 'whenever **A** happens, I consider it right to do **B**.' Maxims are crucial in Kant's moral theory, because they show the basis upon which the good will is operating. M THOMPSON, Ethical *Theory*, Hodder Murray, London 2005, 97.

[47]H. JONAS, *The Imperative of Responsibility, 11*.

[48]H. JONAS, *The Imperative of Responsibility,* 41-42.

While the Kantian imperative is centered on the now, H. Jonas on the other hand, considers his ethics to include nature as a whole. In as much as we have responsibility towards others, we also have responsibility towards the environment. Just as we depend on others so too we depend on the environment in one way or the other.

THE QUESTION OF RIGHT

The whole concept of the environment hinges on one thing, "right". Is it biologically, metaphysically or ethically, justified to hold that the environment has the right to be or to be preserved for its own sake or for the sake of the human person? Facing the environmental crisis Jonas is confronted with two very important questions. In the first place, why do we have the duty to preserve the environment for the future human generation so that they can live on? Secondly, is the environmental crisis morally relevant only because it endangers the future human generation or because the environment has an intrinsic value? T. A. Mappes argues that "in speaking of duties to future generations, we imply that future generations have rights which we are morally obligated to respect."[49] Many proponents of environmental ethics have argued that it makes sense to talk about the rights of the environment as well as that of the future generation. Prominent among them is Joel Fienberg, in *The Right of Animals and Unborn Generations,* who maintains that plants and animals may be said to have rights.[50]

The answers provided linger around the question of right. How can persons who do not yet exist have rights? Can we accord this right to the environment? Joel Fienberg thinks that "to have a right is to have a claim to something and against someone, the recognition of which is called for by legal rules or, in the case of moral right, by the principles of an enlightened conscience."[51] By this premise it is clear that it is absurd to speak of the environment or nature as having "rights" because they are unworthy of rights. J Fienberg maintains that:

> We have in our power now, to make the world a much less pleasant place for our descendants than the world we inherited from our ancestors. We can continue to proliferate in ever greater numbers, using up fertile soil at an even greater rate, dumping our water into rivers, lakes and oceans, cutting down our forest, and polluting the atmosphere with noxious gases. All thoughtful people agree that we ought not to do these things. Most would say we have a duty not to do these things, meaning not merely that conservation is morally required (as opposed to merely desirable) but also that it is something due our descendants, something to be done for their sakes. Surely we owe our

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[49] T. A. MAPPES, "Animals and the Environment" in *Social Ethics: Morality and Social Policy*, 468.

[50] J. FEINBERG, "The Nature and Value of Rights" in Journal *of Value Inquiry* 4, Winter(1971), 263.

[51] *Ibid*

> future generations to pass on a world that is not a used up garbage heap. Our remote descendants are not yet present to claim a livable world as their right, but there are plenty of proxies to speak now in their behalf. These spokesmen, far from being mere custodians, are genuine representatives of human interest. Why then deny that the human beings of the future have rights which can be claimed against us now in their behalf? Some are inclined to deny them present rights out of a fear of falling into obscure metaphysics, by granting rights to remote and unidentifiable beings who are not yet even in existence. Our unborn great-great grandchildren are in some sense "potential" persons, but they are far more remotely potential, it may seem, than fetuses. This, however, is the real difficulty.[52]

This long quotation gives us a summary of our present day state of affairs regarding the various arguments presented either in favour or against predicating rights of the environment and future generation.

So far we have presented the views of H. Jonas from the ontological foundation of organic life championed by metabolism and needful freedom as well as his ethics of responsibility and related implications. The problem of modern technology has been highlighted as well as the usefulness of the environment suggested by some environmental philosophers.

CONCLUSION

This research was undertaken with a desire to present H. Jonas's ethics of the environment as well as to analyze his ethical proposals for the preservation of the environment for future generations. The ethics of responsibility towards the environment have provoked many reactions among thinkers and many have dared to ask; what is the role of philosophy today? Can philosophy change the world? These are serious questions that have constantly been asked. Philosophy can help to educate people so that they can develop an understanding of the long term effects of human action. The task remains for philosophy to keep watch over human action by means of which we are trying to avert a serious catastrophe.

Hans Jonas's vision of the environment, especially of life, has been described in detail in this work in order for us to understand the central idea behind his ethics. Its starting point is the actual world historical situation in which the human prospect appears increasingly dark caused by modern technology. His thought especially on the practical ethical problems posed by the unprecedented nature of modern technology and scientific innovations, becomes a prophetic call

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[52] J. FIENBERG, "The Right of Animals and Unborn Generation" in Social *Ethics: Morality and Social Policy,* 492.

on the face of the danger that looms in the air not only about the future but the now. There is serious need for a call for moral wisdom. H. Jonas, a true philosopher does not satisfy himself with warnings but he recognizes the fact that the central point is partially the result of some incorrect ethical assumptions blurred by Cartesian dualism and the existential interpretation of nature. He sees the necessity for new ethical ideas 'the imperative of responsibility,' in order to overcome the actual threat. H. Jonas died a few years back, yet we are already witnessing environmental hazards caused by modern technology and a greater threat coming from the proliferation and use of nuclear weapons.

The human activities are increasingly and, constantly taking more and more living space away from other plants and animal species. Is this development morally acceptable even if it does not endanger the human person? Is the environmental crisis morally relevant only because of its endangerment of human generations or do plants and animals have an intrinsic value? H. Jonas in *The Imperative of Responsibility,* even though more anthropocentric in thought on the basis of his philosophical biology, certainly provides a metaphysical foundation for ethics.

The analysis of the ethics of responsibility has demonstrated that the environment and modern technology cannot be seen as isolated realities. The existential interpretation of the environment, the teleological understanding of organisms, and the ontological grounding of the ethics of the environment knit together the concept of responsibility on human beings for present and future generations and for nature on the whole.

One recommendation that we can make from the environmental ethics of H. Jonas is what we will refer to as the philosophy of sacrifice. Unless we sacrifice now, we will not only put ourselves into the danger of extinction but the life of the future generation will be jeopardized.[53] The imperative of responsibility can be summarized as a call for sacrifice on the part of human beings. Without this the ethics of responsibility will not be different from the previous ethical prescriptions.

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[53]Cfr.,H. JONAS, *The Imperative of Responsibility,* 10. There *ought* to be through all future time such a world fit for human habitation, and that it ought in all future time to be inhabited by a mankind worthy of the human name, will be readily affirmed as a general axiom or a persuasive desirability of speculative imagination(as persuasive and as undemonstrable as the proposition that there being a world at all is "better" than there being none): but as a moral proposition, namely, a practical obligation toward the posterity of a distant future, and a principle of decision in present action, it is quite different from the imperative of the previous ethics of contemporaneity: and it has entered the moral scene only with our novel powers and range of prescience.

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Capital Structure and Firm Financial Performance

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Abstract

Capital structure is important in the business affairs of any going concern entity as is it the overall source of finance used by a company in financing its operations and has been considered as one of the most important factors in firm financing policy due to its crucial role in corporate performance. The study sought to examine the effect of capital structure on the financial performance of firms in Nigerian manufacturing sector. The population of the study was all the listed manufacturing companies listed on the Nigerian Stock Exchange, a sample of 10 listed companies was selected. The research design adopted was ex-post facto using four models to analyse the impact of capital structure on firms' performance. The study used balanced panel data of 100 observations from the 10 listed companies for the periods ranging from 2007 - 2016. Descriptive statistics and regression were used as tools of analysis. The study reveals that there are statistically significant and non-significant effects of capital structure on performance variables. Finally, the study recommends that manufacturing companies should adopt balanced capital structure strategy that will optimise company's performance and corporate value.

Keywords: Capital Structure, Shareholders' Wealth, Firms Performance, Profitability, Manufacturing Companies.

1.0. INTRODUCTION

The capital structure of a firm has an important tool in the survival of the firm because it goes a long way in determining its growth, development and sustainability over time. The capital structure is the overall sources of finance used by a company in financing its operations ranging from retained earnings to equity and debt finance. Capital structure has been considered as one of the most important factors in firm financing policy due to its crucial role in corporate performance (Gambo, Ahmad & Musa, 2016). According to Akintoye (2016) Capital structure decision is important for any business establishment arising from the need to maximize the wealth of business stakeholders and because of the fact that such decision has a significant impact on the firms' ability to compete in the competitive atmosphere (Gambo, Ahmad & Musa, 2016, Salawu, 2009).The capital structure is a framework which depicts how equity and debt are employed for financing the firm's operations to yield optimum returns for the stakeholders to maximise firms returns given a level of risk (Dada & Ghazali, 2016). The performance of management is often measured regarding profitability which reflects managers' ability to earn optimum returns on assets at their disposal over a period. Profitability according to Owolabi and Obida (2012) is the ability of a business to make returns higher than the cost of financing their core operations to ensure the continued survival of the company. This implies that profitability is the ability of a company to make a profit from its operating, investing and financing activities to maximise the values and wealth of the shareholders. Often, listed companies in the Nigerian do found it difficult to make a profit; this does affect their performance which may be attributed to inadequate finance or where the finance is available at a cost too expensive (Akintoye, 2016; Lambe, 2014; Akinyomi & Olagunju, 2013; Salawu, 2009).

The problem of capital structure, therefore, arises from determining the quantum of each source of finance that will yield optimum return with little risks (Akintoye, 2016; Dada & Ghazali, 2016; Gambo et al., 2016).From the above, it is apparent that the exact effect of capital structure on performance is yet to be established and it is calling for further investigation within the Nigerian context. Also, most of the studies have not adopted recent data in their studies and where researchers have considered recent data, they have not included variables that relate to shareholders wealth like dividend per share and market price per share in recent years. These constitute the gaps to be filled by this study. This study, therefore, is organized into five sections, section one gives brief introduction to the reason for the study, in section two, extant literature was reviewed, we present the methodology adopted in section three, the results and discussion of findings were done in section four while section five presents the summary and recommendation of the study. The primary objective of this study is to investigate the impact of capital structure on the performance of listed Manufacturing firms in Nigeria, while the specific objectives are to:

2.0. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Numerous definitions exist on capital structure. Nirajini and Priya (2013) define capital structure as the way in which an organisation has financed a combination of long-term capital (ordinary shares and reserves, preference shares, debentures, bank loans, convertible loan stock and so on) and short-term liabilities such as a bank overdraft and trade creditors. Also, Lambe (2014), Akinyomi and Olagunju (2013), Salawu (2009); Brealey and Myers (2003) opined that capital structure is the mix of different securities utilized by a company in financing its profitable ventures. What is common to the above definition is that capital structure reflects each component of finance from equity to debt that a company uses in financing its operations. There are numerous measures adopted by a firm in gaging its financial performance and arising from this; there is lack of consensus as to the measure or variable which should be used in measuring the performance of the firm. Different measures that can be used in measuring performance and which have been used by different authors on capital structure and performance include the return on asset, return on equity, and earnings per share. The measures are used to determine the contributions of the managers towards the growth and sustainability of the company. Performance is usually measured regarding profitability. Profitability according to Owolabi and Obida (2012) is the ability of a company to make profits from all its operations (operating, investing and financing activities). For a firm to make a profit, it must be able to generate revenue more than the direct and indirect costs incurred in generating the revenue. The wealth maximisation of shareholders is the ability of a company to witness growth and stable dividend payment or capital gain arising from appreciation in the market value of the company's shares. The shareholder's wealth is very important as it determines the investment decisions of the shareholders and as such proper attention should be paid to it by management (Olowe, 2018).

Empirical Review

Empirical review entails and appraisal of other authors studies on a subject matter with the aim of identifying gaps and filling them appropriately. Literature is replete with capital structure and performance but has often produced conflicting findings. This section groups the literature into studies done in developed and developing countries as well as in Nigeria

Empirical Evidence from Developed Countries

A study by Jaworska and Nehrebecka (2015) was achieved by using correlation analysis to conclude that debt has a negative relationship with profitability. Also, a study by Iavorskyi (2013) revealed that negative relationship exists between leverage and performance in Ukraine.

Fosberg and Ghosh (2006) utilised regression analysis to establish the relationship, carried out separately on America Stock Exchange (AMEX) companies and New York Stock Exchange (NYSE) companies. Results concluded that the there is little or no relationship between profitability and the amount of debt in the AMEX firms' capital structure. Nonetheless, the strong negative relationship was proved to exist in the case of NYSE firms.

Empirical Evidence from Developing Countries

Ali, Zia and Razi (2012) analysed the impact of capital structure on the profitability of companies in the petroleum sector of Pakistan while controlling for the size of the company. They carried out a regression analysis on the data of 12 randomly selected companies for a period of 10years. They found that there is a significant and positive impact of capital structure on the profitability of the petroleum sector. The study by Getahun (2016) corroborated the findings by Ali et al. (2012) by finding among others that leverage has a significant impact on performance. Salamba (2015) conducted a study using the primary and secondary source to obtain data and utilising regression as analytical technique discovered that capital structure had a negative impact on SMEs profitability in Tanzania. This finding is consistent with that of Salim and Yadav (2012) which revealed that firm performance, which is measured by return on asset (ROA), return on Equity (ROE) and earnings per share (EPS) have negative relationship with short-term debt (STD), long-term debt (LTD), total debt (TD), an independent variable.

Empirical Evidence in Nigeria

In Nigeria, the study of Gambo et al. (2016) was limited to debt finance by using descriptive, correlation and regression analysis and discovered that there is a statistically significant effect between long and short-term liability on Return on Assets (ROA) and Return on Equity (ROE). Similarly, a study by Odi (2014) which employed quantitative research design and regression analysis and ordinary least square in carrying out this study. The results of the study revealed that capital structure of firms in Nigeria has a long run relationship with the growth and development of Nigerian economy. Moreover, Study by Gambo et al. (2016) which utilised descriptive statistics, correlation and regression as analytical technique reveals that there is statistically significant effect between long and short-term liability on Return on Assets (ROA) and Return on Equity (ROE). Also, David and Olorunfemi (2010) used panel data analysis to analyses capital structure and corporate performance in Nigeria petroleum industry. They found that a positive relationship exists between earning per share and leverage ratio on the one hand and positive relationship between dividend per share and leverage ratio on the other hand. Olokoyo (2013) examined the impact of leverage on firm's performance in Nigeria using fixed-effect estimation, random-effect estimation and a pooled regression model. The author found that all the leverage measures have a positive and highly significant relationship with the market performance measure (Tobin's Q).

However, a study by Nwude, Itiri, Agbadua and Udeh (2016) revealed from the regression estimations showed that debt structure has a negative and significant impact on the performance of Nigerian quoted firms within the period under review. The findings by Oladeji, Tolulope, Ikpefan and Olokoye (2015) also conclude that a negative relationship exists between leverage and firm performance. With the above reviews, it is evident that the area of interest to this study has not be considered by scholars in this field hence the aim of this study to examine the effect of capital structure on the financial performance of firms in Nigerian manufacturing sector.

3.0. RESEARCH METHODS

Theoretical Framework and Model Specification

The tradeoff theory model is traceable to the debate over the M&M's theorem(When the corporate tax was added to the original irrelevance proposition of M&M, a benefit for debt is observed that serves to shield earnings from taxes (Getahun, 2016). This theory states that the optimal capital structure is the trade-off between the benefits of debt (the interest tax shields) and the costs of debt (the financial distress and agency costs) (Getahun, 2016; Brigham, Foster & Houston, 2004).

Unlike the trade-off theory, the pecking order theory does not assume an optimal level of capital structure. It states that companies prioritise their source of financing, from internal financing to equity financing, according to the principle of the least resistance, preferring to raise equity as a financing means of last resort. So, the pecking order theory claims that internal funds are used first, and only when all internal finances have been depleted, firms will opt for debt. When it is not sensible to issue any more debt, they will eventually turn to equity as a last financing resource (Olowe, 2018). Pecking Order Theory is also known as Asymmetric Information Theory which is based on minimum effort principle, and a well-known theory in analysing the financial behaviour of firms was propounded by Myers & Majluf (1984). They suggested that firms will not seek external finance at the capital markets until the reserve of retained earnings is exhausted. Then, then the debt market is called on first, and only as a last resort will companies raise equity finance. In contrast to the Trade-off Theory which considers interest tax shields and the potential threat of bankruptcy to be only of secondary importance. Gearing ratios are adjusted when there is a need for the external fund which results from the imbalance between internal cash flow, net of dividends, and real investment opportunities. Only firms whose investment needs exceeded internally generated funds would borrow more debt. Myers (1984) concludes that each firm's debt ratio, therefore, reflects its cumulative requirement for external financing and that profitable companies with limited growth opportunities would always use their cash surplus to reduce debt rather than repurchasing shares.

According to the theory, a firm with high profitability will not need external fund. However, a firm prefers external financing over share issue since it does not perform sufficient fund-raising and debt is less costly compared to share (Lambe, 2014; Odi, 2014; Nirajini, &Priya, 2013; Salawu, 2009).

Model Speciation

Arising from the theoretical and literature review, the models for this study are specified below:

$ROAit = \beta 0 + \beta 1lEQit + \beta 2LTDit + \varepsilon it$ ---------- (1)

$EPSit = \beta 0 + \beta 1lEQit + \beta 2LTDit + \varepsilon it$ ---------- (2)

$DPSit = \beta 0 + \beta 1lEQit + \beta 2LTDit + \varepsilon it$ ---------- (3)

$MPSit = \beta 0 + \beta 1lEQit + \beta 2LTDit + \varepsilon it$ ---------- (4)

Where:

ROA = Return on Asset of Frimi in period t, EPSit = Earnings Per Share of Firm i in period t,

DPS = Dividend Per Share of Firm i in period t, MPSit = Market Price Per Share of Firm i in period t, LEQit = Log of Equity of Firm i in period t, LTDit = Log of Total Debt of Firm i in period t, εt = the error term

The models above are consistent with the models of (Lambe, 2014; Odi, 2014; Nirajini, &Priya, 2013; Salawu, 2009).

Research Design

This study employed ex-post facto research design. The population of study consists of all one hundred and eighty-six (186) (Equities - Main Board) Companies listed on the floor of Nigeria Stock Exchange as at December 31, 2017. Equities are listed under 12 industry sectors including (i) Agriculture; (ii) Conglomerates; (iii) Construction/Real Estate; (iv) Consumer Goods; (v) Financial Services; (vi) Healthcare; (vii) ICT; (viii) Industrial Goods; (ix) Natural Resources; (x) Oil and Gas; (xi) Services; and (xii) Utilities. (NSE Q4 2016 Fact Sheet). Of all these industry sectors, only companies under “Consumer Goods” sub-sector is considered in this study while others were excluded. This is because companies operating under “Consumer Goods” sub-sector have some characteristics of manufacturing with sample frame of 20 companies. Ten (10) of the listed manufacturing companies in Nigerian were selected as sample of the study. Data were collected from annual reports and accounts of the sampled companies for the period of ten years (10) years from 2007 – 2016.

The data were analysed using E-views 9 where a summary of descriptive statistics and multiple regressions results were obtained and analysed to determine the effect of capital structure on firm financial performance in the listed Nigerian companies. This study used two sets of variables; dependent and explanatory variables. The dependent variables were returned on the asset, earnings per share, dividend per share and market price per share while the independent variables are a log of equity and log of total debt. Descriptive and inferential statistics were used to analyse the results and finding from the data analysis were presented in tables. This enabled the researchers to explain the physical attributes of the data collected while the hypotheses were tested at 5% significance level using both t-statistics and F-statistics.

4.0 RESULTS AND DISCUSSION

Table 1: Descriptive Statistics

	LTD	LEQ	ROA	EPS		
Mean	16.14538	16.43700	0.620362	9.217115	8.718333	137.8359
Median	16.78599	17.14591	0.125924	4.420000	3.485000	45.12500
Maximum	18.90233	19.47067	15.99676	95.00000	95.00000	1201.000
Minimum	9.419953	8.523374	-0.02	-1.34	0.010000	1.200000
Std. Dev.	2.194669	2.139660	2.158969	16.54624	16.64714	235.3727
Skewness	-1.572411	-1.407206	5.686257	3.701498	3.720266	2.917129
Kurtosis	5.057810	5.305790	37.50005	17.32734	17.35567	11.34556
Jarque-Bera	45.90456	43.02215	4288.660	845.2502	849.7021	336.9827
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	1259.340	1282.086	48.38824	718.9350	680.0300	10751.20
Sum Sq. Dev.	370.8761	352.5173	358.9083	21080.90	21338.79	4265825.
Observations	100	100	100	100	100	100

The table1 on the descriptive statistics show that all the variables have a positive mean. Log of total debt is 16.14538, a log of equity is 16.43700, return on asset is 0.620362, earnings per share are 9.217115, dividend per share is 8.718333 and market price per share is 137. 8359.

Market price per share has the highest maximum value of 1201 and ROA has the lowest maximum value of 15.99, a log of total debt has the highest minimum value of 9.419953 while earnings per share have the lowest minimum value of -1.340000. The highest standard deviation value is the market price per share of 235.3727, and the minimum standard deviation is a log of total debt with a value of 2.139660. Based on the descriptive statistics, most of the variables have positive descriptive statistical values.

Table 2: Augmented Dickey-Fuller Unit Root Test

Variables	ADF Unit Statistics	Mackinnon Critical Value			Test for Unit Root
	6.471205	-3.474567	-2.880853	-2.577147	Stationary at a level
	10.00777	-3.474567	-2.880853	-2.577147	Stationary at a level
	7.881670	-3.474567	-2.880853	-2.577147	Stationary at a level
	4.068033	-3.474567	-2.880853	-2.577147	Stationary at a level
	4.986496	-3.475500	-2.881260	-2.577365	Stationary at a level

The above Table 2 gives the unit root test results of the set of data used in the regression analysis. All variables used in the regression analysis are jointly significant at a level. Individually, the log of total debt (LTD) has an absolute ADF statistics of 6.471205 which is greater than the MacKinnon critical values of -3.474567, -2.880853 and -2.577147.

The log of equity (LEQ), return on asset (ROA), earnings per share (EPS), and market price per share(MPS) also have ADF of 10.00777, 7.881670, 6.750735, 4.068033 and 4.986496 respectively (in absolute terms) which are greater than their respective levels of significance.

Arising from the result of the unit root test, we conduct ordinary least square of fixed and random effect as analytical techniques.

Table 3. Correlated Random Effects - Hausman Test Test cross-section random effects

Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	11.271706	2	0.0036

Cross-section random effects test comparisons:

Variable		Random	Var(Diff.)	Prob.
LTD	-0.000000	-0.000000	0.000000	0.0008
LEQ	0.000000	0.000000	0.000000	0.0746

Sources: Researchers' Result, (2018)

Table 4. Correlated Random Effects - Hausman Test Test cross-section random effects

Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	8.537619	2	0.0140

Cross-section random effects test comparisons:

Variable		Random	Var(Diff.)	Prob.
LTD	-0.000000	-0.000000	0.000000	0.0044
LEQ	-0.000000	-0.000000	0.000000	0.0943

The probability of the Hausman test with a probability of 0.0140 which is significant at 5% reveals that fixed effect is appropriate for analysis.

Table 5. Determination of the effect of Equity on Profitability (fixed effect estimation)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.117211	3.636139	2.507388	0.0146
LEQ	-0.140874	0.165005	-0.853758	0.3963
LTD	-0.382852	0.169796	-2.254783	0.0274

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.162655	Mean dependent var	0.620362
Adjusted R-squared	0.037678	S.D. dependent var	2.158969
S.E. of regression	2.117905	Akaike info criterion	4.468767
Sum squared resid	300.5300	Schwarz criterion	4.801123
Log-likelihood	-163.2819	Hannan-Quinn criteria	4.601815
F-statistic	1.301482	Durbin-Watson stat	2.014509
Prob(F-statistic)	0.247908		

From Table 4.2 fixed effect estimation, the log of equity has no significant effect on return on asset. The probability of log of equity being 0.3963. Which is greater than 5% v, we, therefore, accept the hypothesis that equity has no significant effect on profitability when it is measured by return on asset. While the log of debt has a significant effect on return on asset. the probability of the log of debt being 0.0274 which is lesser than 5% level of significance, we, therefore, fail to accept the null hypothesis that debt has no significant effect on profitability when it is measured by return on asset

Table 6. Correlated Random Effects - Hausman Test on of the influence of Equity on Shareholders' Wealth Maximization

Test cross-section random effects

Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	11.271706	2	0.0036

Cross-section random effects test comparisons:

Variable		Random	Var(Diff.)	Prob.
LTD	-0.000000	-0.000000	0.000000	0.0008
LEQ	0.000000	0.000000	0.000000	0.0746

The probability of the Hausman test with a probability of 0.0036 which is significant at 5% reveals that fixed effect is appropriate for analysis

Table 7 Determination of the influence of Equity on Shareholders' Wealth Maximization (fixed effect estimation)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-32.04564	21.47696	-1.492094	0.1404
LEQ	3.004546	0.974607	3.082827	0.0030
LTD	-0.503115	1.002902	-0.501659	0.6176

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.502649	Mean dependent var	9.217115
Adjusted R-square	0.428417	S.D. dependent var	16.54624
S.E. of regression	12.50947	Akaike info criterion	8.020884
Sum squared resid	10484.62	Schwarz criterion	8.353240
Log-likelihood	-301.8145	Hannan-Quinn criter.	8.153932
F-statistic	6.771359	Durbin-Watson stat	1.087785
Prob(F-statistic)	0.000000		

From table 7, fixed effect estimation, the log of equity has a significant effect on earnings per share. The probability of log of equity being 0.0030, which is less than 5% level of significance. We, therefore, fail to accept the null hypothesis that equity has no significant effect on profitability when it is measured by earnings per share. While the log of debt has no significant effect on earnings per share. The probability of log of debt being 0.6176. Which is higher than 5% level of significance. We, therefore, accept the null hypothesis that debt has no significant effect on profitability when it is measured by return on asset.

Table 8 Correlated Random Effects - Hausman Test the effect of Total Debt on Profitability

Test cross-section random effects

Summary	Chi-Sq. Statistic	Chi-Sq. d.f.
Cross-section random	10.231556	2

Cross-section random effects test comparisons:

Variable		Random	Var(Diff.)
LTD	-0.000000	-0.000000	0.000000
LEQ	0.000000	0.000000	0.000000

The probability of the Hausman test with a probability of 0.0060 which is significant at 5% reveals that fixed effect is appropriate for analysis.

Table 9 Determination of the effect of Total Debt on Profitability (fixed effect estimation)

Variable	Coefficient	Std. Error	t-Statistic	
C	-34.08798	21.31748	-1.599063	0.1145
LEQ	3.057839	0.967370	3.160982	0.0024
LTD	-0.461767	0.995455	-0.463875	0.6442

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.515929	Mean dependent var	8.718333
Adjusted R-squared	0.443680	S.D. dependent var	16.64714
S.E. of regression	12.41658	Akaike info criterion	8.005977
Sum squared resid	10329.48	Schwarz criterion	8.338333
Log-likelihood	-301.2331	Hannan-Quinn criteria	8.139025
F-statistic	7.140959	Durbin-Watson stat	1.108928
Prob(F-statistic)	0.000000		

From the table 9, fixed effect estimation, the log of equity has a significant effect on dividend per share. The probability of log of equity being 0.0024 which is less than 5% level of significance. We, therefore, fail to accept the null hypothesis that equity has no significant effect on shareholders wealth when it is measured by dividend per share. While the log of debt has no significant effect on dividend per share. The probability of log of debt being 0.6442. Which is higher than 5% level of significance. We, therefore, accept the null hypothesis that debt has no significant effect on profitability when it is measured by return on asset.

Table 10.Correlated Random Effects - Hausman Test of effect of Total Debt on shareholders' Wealth Maximization

Test cross-section random effects

Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	14.231556	2	0.0340

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
LTD	-0.000000	-0.000000	0.000000	0.0024
LEQ	0.000000	0.000000	0.000000	0.0457

Table 10 depicts that fixed effect is appropriate for the analysis of market price per share and capital structure.

Table 11 Determination of the effect of Total Debt on shareholders' Wealth Maximization (fixed effect estimation)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	42.04653	191.9164	0.219088	0.8272
LEQ	-8.091720	8.709012	-0.929120	0.3562
LTD	14.17080	8.961854	1.581235	0.1185

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.803742	Mean dependent var	137.8359
Adjusted R-squared	0.774449	S.D. dependent var	235.3727
S.E. of regression	111.7836	Akaike info criterion	12.40104
Sum squared resid	837203.4	Schwarz criterion	12.73340
Log-likelihood	-472.6406	Hannan-Quinn criteria	12.53409
F-statistic	27.43869	Durbin-Watson stat	0.604650
Prob(F-statistic)	0.000000		

Sources: Researchers' Result, (2018).

From table 11 the log of equity has a significant effect on the market per share. The probability of log of equity being 0.3562. Which is higher than 5% level of significance. We, therefore, accept the null hypothesis that equity has no significant effect on shareholders wealth when it is measured by market price per share. Also, the log of debt has no significant effect on market price per share. The probability of log of debt being 0.1185. Which is higher than 5% level of significance. We, therefore, accept the null hypothesis that debt has no significant effect on shareholders wealth when it is measured by market price per share.

4.0 Discussion of findings

From the regression analysis, we found that the R2=0.162655, 0.502649, 0.515929 and 0.803742 for ROA, EPS, DPS and MPS respectively which implies that about 16% of the changes in ROA, 50% changes EPS, 52% in DPS changes 80% of the changes in MPS are caused by capital structure while the remaining percentages are caused by other factors not considered (included) in the models.

The existence of companies without adequate finance (capital structure) is in doubt, so also companies' positive financial performance. Our findings indicate a negative effect of capital structure variables on return on asset. The effect was insignificant for log of equity while it was significant for log of debt. This is in line with the findings of Salamba (2015) who found that capital structure has a negative impact on the profitability of Small and Medium Scale Enterprises in Tanzania. However, this finding contradicts findings by Gambo et al. (2016) who found that capital structure has a significant effect on the profitability of firms in Nigeria. Also, capital structure proxy by the log of equity has a significant positive effect on earnings per share while the relationship between the log of total debt on earnings per share is negative. This finding partially aligns with earlier findings by Tanver et al. (2012) who discovered that debt to asset ratio has a negative relationship with profitability. Moreover, capital structure measured by the log of equity has a significant positive effect on dividend per share while the relationship between the log of total debt and earnings per share is negative and non-significant.

This finding is also consistent with the findings of Hasson, Tran, and Quach which discovered that leverage has a negative effect on dividend policy of firms in Palestine. Lastly, capital structure, proxied by the log of equity has a negative and non-significant effect on market price per share while the positive but non-significant effect of and a log of total debt was found on market price per share. This finding is in contrast with the findings of Lambe (2012) which conclude that market value is influenced by choice of capital structure (financial leverage).

The study, however, contradicts the pecking order theory which says that more profitable firms would prefer to use less of external finance in financing their operations. Nevertheless, our study corroborates other studies and is likely to influence the way practitioners' in the manufacturing industry in Nigeria perceive the contribution of capital structure to the profitability and shareholders wealth maximisation of the firm.

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From this study, it has been established that capital structure is vital to the performance of businesses in Nigeria. Entities are more interested in the cost associated their various sources of finance used by a company in financing its operations and has been considered as one of the most important factors in firm financing policy due to its crucial role in corporate performance. It is with that that the study examined the effect of capital structure on the financial performance of firms in Nigerian manufacturing sector. Is now clear that there are statistically significant and non- significant effects of capital structure on performance variables of interest.

5.2 Recommendation

Despite our findings, we suggest caution should be exercised in concluding differences in industry structure and other factors not captured by this study may affect the position of each firm. Furthermore, there may be other external factors which affect the profitability of the firm which is ignored by most studies such as the quality of Human Resources, environmental factors, organisational structure and operational procedures as opined by Asian (2015).

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Domestic Investment and Economy Growth in Nigeria: An Empirical Investigation

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Abstract

Nigeria domestic investment has not been growing over time and it is with this that this study aimed at investigating the impact of domestic investment and economic growth in Nigeria. The model was subjected to a Co-integration test in order to determine the long run relationship between domestic investment, and economic growth in Nigeria for the period of 1980-2016. The Granger causality test was also used to determine the causality between domestic investment, and economic growth in Nigeria for the period of 1980-2016.The results also showed long run significant relationship exists between the variable examined and domestic investment. Granger cause economic growth in Nigeria within the period under study. The study also found that domestic investment positively influences real gross domestic product. The study recommends that government should create enabling an environment for domestic investment to rise through the adoption of macroeconomic policies that will boost investment opportunities in Nigeria.

***Keywords**:* Capital Formation, Foreign Direct Investment, Domestic Investment, Economic Growth.

1.0 Introduction

1.1Background to the Study

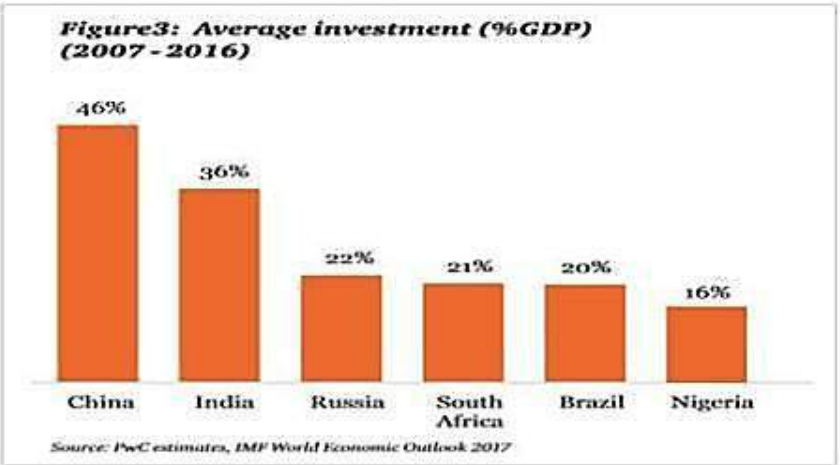
The nature and stability of domestic investment have attracted enormous debate in the economics literature, particularly in the advanced market economies. The preponderance of studies on this subject includes Uremadu (2006), Adegbite and Owulabi (2007) where they argued that although foreign direct investment (FDI) is beneficial to host countries by speeding up the process of economic growth and development, its multiplier effect is greater. In other words, developing countries should depend greatly on domestic investment rather than foreign direct investment (FDI). This is because, borrowing from outside is not a proper strategy for growth and development since it does not only have adverse effect on the balance of payment as these loans will be serviced in the future with the use of their domestic resources, but it equally carries a foreign exchange risk such as devaluation of their currency which is one of the specific conditionality's for borrowing from International Monetary Fund (IMF). Hence, domestic investment through the capital formation is not just paramount but serves as a prerequisite for the geometric acceleration of growth and development of every economy as it provides domestic resources that can be used to fund the investment effort of the economy. The essence of this economic growth is for the creation of economic and social overhead capitals (or costs), which leads to increase in national output and income through the creation of employment opportunities and reduction of thevicious circle of poverty both from the demand side and supply side. Nigerian economy has undergone at least three distinct phases since independence from colonial rule in 1960 (Adeleke, 2014; Akanbi, 2010). The first is the vibrant era that was inherited from the colonial masters which lasted till around 1980.

This phase was characterized by a buoyant agricultural sector in terms of production diversification (staple foods and cash crops), contribution to the gross domestic product (GDP) which averaged about 70 percent employment and export. The first phase witnessed the first large inflow of petro-dollar funds due to the Arab– Israeli conflict of the early 1970s. Growth performance could be described as impressive over this period. The recession in advanced western economies which started in the late 1970s due to rising interest rates and high production costs led to sharp decline in Nigerian export. The international price of crude also collapsed. The agricultural sector witnessed neglect due to the ease of flow of foreign exchange (forex) in the early 1970s. Growth performance in Nigeria declined significantly and by mid-1986 the country had to agree to adopt and implement some far-reaching economic reform measures in other to qualify for international assistance from multilateral lending institutions (Kalu and Mgbemena, 2015).

1.2 Statement of the Problem

Domestic investment has generated hit debates among scholars as to its importance in nation building (Kanu, Ozurumba & Anyanwu, 2014; Kanu, 2008; Lean & Song, 2008; Qin, Cagas, Quising, &. He, 2006; Odedokun, 1997). After the Nigerian civil war, the government sought an approach to build the national economy and place the economy on the part of development. As such, the government in an effort to build the economy embark on massive reconstruction and public-sector investments to achieve sustainable economic growth and development. However, records of the past four decades have generated some concern over the slow pace of industrial and infrastructural development Questions have been raised as to what should constitute the optimal size of government's capital outlays that can turn around the economy. Overtime, the Nigerian nation has witnessed a tremendous increase in her revenue profile through oil exports. She has equally enjoyed cycles of an oil boom with successive governments harnessing the resources of the nation to execute its budget. Ironically, there has been an increase too in her expenditure pattern overtime. Paradoxically, it does not appear as if the increase in capital expenditures has translated into the increased capital formation and consequently economic growth and development.

The problem becomes that Nigeria domestic investment as well as capital accumulation has not been growing and has declined by 24% between 1998-2013 (World Bank, 2014). This is a real problem. Although, foreign direct investment has been growing steadily except with the recent economic recession in the country that sawa substantial reduction in FDI by about 28% within 2014-2016 (CBN, 2016). Nigeria macroeconomic indicators show the pitiable performance of a Domestic investment in Nigeria for the period 1986 till date (CBN, 2016). For example, domestic investment declined from 12.3% of GDP in 1991 to 8.3% of GDP in 1992, this may be partly due to the reduced public investment, which fell during the same period. Domestic investment then increased to 12.5% in 1993 and to 16% in 1994. Later, it fell continuously to 8.9% in 1996. Between 2001 and 2010, the ratio averaged 13%; it peaked at 16.2% in 2002 but fell again to 152% in 2010 (CBN, 2015). A mere look at the figure below will reveal domestic investment percentage of GDP in Nigeria is the lowest among the countries examined. From the graph, we could see why China remains the second largest economy in the world with 46% domestic investment percentage of GDP.



In view of the inconsistency in the findings of the various research reviewed, the q1declining nature of domestic investment in the country despite its tremendous contribution to national growth and development. As well as the fact that literature on investment in Nigeria is dominated by foreign direct investment which contributes more to the home companies' country more than the host company country. It is, therefore, necessary to investigate holistically domestic investment, and economic growth in Nigeria between the periods of 1980-2016.

1.3 Objectives of the Study

To examine the impact of domestic investment on economic growth in Nigeria.

1.4 Research Hypothesis

H_{o1}: There is no significant impact of domestic investment on economic growth in Nigeria

2.0 Literature Review and Theoretical Framework

2.1 Concept of Domestic Investment

Real domestic investment is an expenditure made to increase the total capital stock in the economy. This is done by acquiring further capital-producing assets and assets that can generate income within the domestic economy. Physical assets particularly add to the total capital stock. Boosting economic development requires higher rates of economic growth than savings can provide. Part of the finance for investment is provided by the corporate sector, bank loans and households' savings make up the other part. With this, savings is no longer a constraint to investment demand. With lower rates of interest, asset values tend to be on the upward swing which invariably represents the discounted value of such assets thereby increasing the rate of acquisition and investment in such assets increases aggregate demand. Investment, therefore, is not constrained by aggregate savings but more by domestic interest rates. Therefore, the new equation of investment is Investment = (Savings) + (newly created money available to Deposit Money Banks). Attempts at reducing expenditure have affected investment and had led to poor and sluggish growth and eventually affecting savings performance (Tang, Selvanathan, & Selvanathan, 2008).

The components of the Nigerian capital formation as analyzed by the National Bureau of Statistics (NBS, 2011)) comprises of both tangible and intangible stocks. The intangibles are the soft assets and increases or improvements on them. They are also known as the non-productive capability of the country. The statistics further states that the increase in capital formation in the country over the past year – 2010, was merely 1 billion (about $6.3 million) has been propelled by capital equipment's imports by firms involved in crude oil exploration and exploitation. This is worrisome, though nobody seems to care about the general welfare of the population.

2.2 Theoretical Framework

2.2.1 Neo-classical Theory of investment

Neoclassical financial theorists have made acrobatic theoretical efforts to defang the principal-agent problem so that the Pareto efficiency properties of markets could escape unscarred from its grasp. Unfortunately, the assumptions required to accomplish this task have no significant foundation in empirical or institutional reality. Stiglitz has accurately characterized the neoclassical principal-agent literature as "the triumph of ideology over theory and fact". Neoclassical investment theory, on the other hand, fails even to acknowledge the existence of the problem. Virtually all neoclassical models of the enterprise investment decision begin with the unsupported assertion that the firm's objective is the pursuit of the owners' objectives: the firm maximizes market value. Three points about the value maximization assumption are worthy of note. First, there is a great deal of empirical and institutional evidence that this assumption is false and virtually no direct empirical evidence that it is true.3 Second, if this highly questionable assumption is rejected, it is not at all clear that a distinct neoclassical approach to the theory of the firm can be identified. In its absence, neoclassical theorists have no generally agreed upon method for choosing an enterprise objective function, for specifying the constraint set, or even for identifying the cost of financial capital.

2.2.2 Keynesian Theory of investment

Gordon presents a formal model of what he calls the Keynesian theory of investment. We are less ambitious here, attempting only to sketch out the general characteristics of an investment theory based on the substitute core assumptions discussed in the previous sections. A realistic theory of investment should incorporate the assumption that the firm is a semi-autonomous agent with a preference function of its own. We would expect the firm to pursue growth in size or market share and in profits -its growth objective - and avoid threats to its decision-making autonomy or its financial security - its safety objective. The existence of this safety objective makes the firm itself risk-averse. Growth is attainable only through capital accumulation, but capital accumulation must be financed. Debt finance creates explicit, legally binding cash flow commitments to creditors. But even internal funding and stock flotation create implicit cash flow commitments to shareholders. If commitments to stockholders cannot be met out of the future operating profits generated by invested capital, management may experience a threat to its decision-making autonomy; if commitments to creditors are not met, the firm might go bankrupt.

2.3 Empirical Framework on Domestic Investment and Economic Growth

Empirical work on domestic investment and economic growth has been enormous and somewhat consistent with its findings. For instance, Villa (2008) applies a multivariate time series analysis on output growth rate, investment and government consumption in Italy from 1950 to 2005 and finds that the causality is running from domestic investment to economic growth. But empirical findings

from Qin, Cagas, Quising and He (2006) show a causal relationship between domestic investment and economic growth show that the causality is running from economic growth to domestic investment. Furthermore, Tang, Seventh and Selvanathan(2008) investigated the causal link between foreign direct investment, domestic investment and economic growth for the period 1988-2003 in China, by applying a multivariate VAR system with error correction model (ECM). Their findings show that domestic investment and economic growth are positively correlated, as such great economic growth spurs large domestic investment and vice versa. By implication, it means China's domestic investment has a greater impact on growth than FDI. They, therefore, recommend that the country's precedence should be based on encouraging and promoting domestic savings for domestic investment than attracting FDI. On the other hand, in the same study, Tang, Selvanathan and Selvanathan (2008) equally found that China's domestic investment and GDP do not have much impact on FDI inflows in the long run.

Export has been considered as one of the important variables in determining economic growth. Therefore, domestic investment and export may be fundamental in generating sustainable economic growth. Ghirmay, Grabowski and Sharma (2001) used co-integration test and Granger causality test to investigate the relationship between export-led and investment-led growth for 19 less developed countries. Findings from their study reveal that exports and investment are co-integrated with economic growth, particularly in Malaysia economy. However, these findings do not consistent with that of Sinha (1999) who uses the Johansen Co-integration test in some Asian countries and finds that domestic investment and exports are not co-integrated with economic growth in the case of Malaysia. Some studies, however, documented a close relationship between FDI and domestic investment in developing economies. In analysing the impact of FDI and domestic investment on economic growth in Sub-Saharan Africa for the period 1990-2003, Adams (2009) reveals that domestic investment is positively and significantly correlated with economic growth in both the Ordinary Least Squares (OLS) and fixed effects estimation.

3.0 Methodology

The research plan that is adopted for the study is descriptive research method and Ex Post Facto Research Design.The variables used for the analysis areall gross domestic product (RGDP) known as the dependent variable in the model and the independent variables: domestic investment (DIN), and government expenditure (GEX).

The variable used in the analysis was subject to unit root test to determine whether the variables are stationary or not. The model was subjected to aco-integration test to determine the long run relationship between Domestic investment and economic growth in Nigeria for the period of 1980-2016. The Granger causality test was also used to determine the causality between Domestic investment, and economic growth in Nigeria for the period of 1980-2016.The research utilized secondary data annual time series for the variables identified above. The data was from the sources such as; Central Bank of Nigeria (CBN) statistical Bulletins, Nigeria Stock Exchange (NSE), and World Bank Data Base.

3.1 Model Specification

$RGDP_t = b_0 + b_1DIN_t + b_2GEX_t + u_t$

Where; b_0 = Constant term,

b_1 = Regression coefficient of DIN,

b_2 = Regression coefficient of GEX

GEX = Government Expenditure

DIN = Domestic Investment

u_t = Error Term

4.0 Results and Discussion

4.1 Domestic Investment and Economic Growth

The impact of domestic investment and economic growth is examined in this section. The hypothesis used to test the impact is given below.

Hypothesis

H_{o1}: There is no significant impact of domestic investment on economic growth in Nigeria

4.2 Unit Root Test

The Augmented Dickey-Fuller (ADF) was employed to test for the existence of unit roots in the data using trend and intercept. The results are presented in table one below.

Table 4.1: Augmented Dickey-Fuller Unit Root Test

Trend and Intercept @ Levels

Series	ADF Test Statistic	5% critical values	10% critical values	Order	Remarks
LRGDP	-1.433594	-3.552973	-3.209642	0	Not Stationary
LDI	-3.456777	-3.552973	-3.209642	0	Not Stationary
LGEX	-0.330000	-3.552973	-3.209642	0	Not Stationary

Sources: Researchers' compilation from E-view (version 9.0) (2018)

Table 4.2: Augmented Dickey-Fuller Unit RootTest

Trend and Intercept @ 1st Difference

Series	ADFTest Statistic	5% critical values	10% critical values	Order	Remarks
LRGDP	-6.228408	-3.548490	-3.207094	1	Stationary
LDI	-4.532332	-3.548490	-3.207094	1	Stationary
LGEX	-3.681068	-3.548490	-3.207094	1	Stationary

Sources: Researchers' compilation from E-view (version 9.0) (2018)

The above empirical test shows that RGDP, DIN,and GEX, are not stationary at levels. Considering the time series using Augmented-Dickey Fuller at Trend & Intercept and Intercept, all their calculated statistics are less than the critical values both at 10% and 5% level of significance integrated of order one. However, at 5% level of significance, all the variables became stationary at first difference since their t-test is greater than the Critical value at 5% level of significance. Since the result is significant, we, therefore, proceed to conduct a co-integration test to ascertain if there exists along-run relationship between the variables under consideration. It should be further noted that proper examination of the co-integration test, Error Correction Model (ECM) and Granger causality test cannot be conducted without first carrying a unit root test. According to Pesaran and Yongcheol (1999) and Pesaran, Yongcheol and Richard (2001), if variables are stationary at level normal OLS can be used to estimate the parameters, but if series are not stationary at level but are stationary at same order, I(1) and is co integrated we can go ahead and estimate their parameter estimate with an ECM result.

Table 4.3. Johansen co-integration test

Series: LOG(RGDP) LOG(DIN) LOG(GFCF) LOG(FDI) LOG(SAV) LOG(GEX)				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.596346	108.7602	95.75366	0.0047
At most 1 *	0.580214	77.00833	69.81889	0.0119
At most 2	0.447395	46.62800	47.85613	0.0649
At most 3	0.361792	25.86911	29.79707	0.1327
At most 4	0.247786	10.15094	15.49471	0.2693
At most 5	0.005278	0.185223	3.841466	0.6669
Trace test indicates 2 co-integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Sources: Researchers' compilation from E-view (version 9.0) (2018)

Under the Johansen Co-integration Test, there is one co-integrating equation. In Johansen's Method, the trace statistic determines whether co-integrated variables exist. As can be seen from the trace statistics, here only the absolute values of RGDP are greater than 5% critical values (i.e. GDP [108.7602 >95.75366], also its Eigen-value is greater than 5% level of significance, signifying the presence of long-run relationship among the variables employed in the analysis. In other words, the null hypothesis of no co-integration among the variables is rejected since at least two variables in the five equations at 5% were statistically significant. The test result shows the existence of a long-run equilibrium relationship among the variables.

4.3 Vector Error Correction Mechanism (VECM)

The presence of long-run equilibrium relationship among the variables as found from the Johansen co-integration led to the application of VECM. With this approach, both the long-run equilibrium and short-run dynamic relationships associated with variables under study is established.

Table 4.4: VECM Table 4.4: VECM

Included observations: 34 after adjustments			
Standard errors in ( )& t-statistics in [ ]			
Co-integrating Eq:	CointEq1		
LOG(GDP(-1))	1.000000		
LOG(DIN(-1))	1.762600		
	(0.35956)		
	[4.90214]		
LOG(GEX(-1))	1.191110		
	(0.45915)		
	[2.59414]		
C	-11.70186		
Error Correction:	D(LOG(GDP))	D(LOG(DIN))	D(LOG(GEX))
CointEq1	-0.44331	0.408863	-0.011533
	(0.01839)	(0.09093)	(0.03782)
	[-24.1060]	[4.49663]	[-0.30491]
D(LOG(GDP(-1)))	0.404644	-1.405117	0.898070
	(0.10946)	(1.03551)	(0.43075)
	[3.69673]	[-1.35694]	[2.08489]
D(LOG(GDP(-2)))	0.093574	1.508287	-0.492901
	(0.21094)	(1.04281)	(0.43379)
	[0.44361]	[1.44637]	[-1.13627]
D(LOG(DIN(-1)))	0.217483	0.589033	0.077088
	(0.02924)	(0.14457)	(0.06014)
	[7.43785]	[4.07448]	[1.28187]
D(LOG(DIN(-2)))	0.040378	0.100930	0.028299
	(0.03517) [1.14808]	(0.17387) [0.58049]	(0.07233) [0.39126]
D(LOG(GEX(-1)))	0.144712	-0.040827	-0.331537
	(0.06444)	(0.46688)	(0.19421)
	[2.24569]	[-0.08745]	[-1.70708]
D(LOG(GEX(-2)))	0.125437	1.329219	0.117031
	(0.09100)	(0.44986)	(0.18713)
	[1.37849]	[2.95476]	[0.62539]
C	0.057248	-0.168707	0.122880
	(0.03882)	(0.19192)	(0.07984)
	[1.47465]	[-0.87904]	[1.53916]
R-squared	0.599053	0.604542	0.379029

Sources: Researchers' compilation from E-view (version 9.0) (2018)

F-statistics = 22.466

DW = 2.0

The choice of lag length of one (2) was informed by the better results of the VECM which met the two conditions necessary for use of error correction model and was determined by AIC and Schwarz SC.

4.4 Granger Causality Test

With this test, the pair-wise relationships between the estimated variables are ascertained. Thus, the table is presented below:

Table 4.5: Granger Causality

Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
LOG(DIN) does not Granger Cause LOG(RGDP)	36	6.75200	0. 0001
LOG(RGDP) does not Granger Cause LOG(DIN)		1.06625	0.3570

Sources: Researchers' compilation from E-view (version 9.0) (2018)

4.5 Test of Research Hypotheses

4.5.1 Hypothesis

H_0: There is no significant impact of domestic investment on economic growth in Nigeria

H_1: There isa significant impact of domestic investment on Nigeria economic growth in Nigeria.

F- Test: is employed in testing the hypothesis. This test will help to capture the joint influence of the explanatory variables on the dependent variable.

4.5.2 Decision Rule;

If F-cal. > F-tab reject the null hypothesis or if the P-value is less than 5% level of significance, otherwise accept the null hypothesis. Using 5% level of significance at 3 and 33 degrees of freedom, the tabulated F-value is 2.82. Since the calculated F-value (22.4) is greater than the tabulated F-value at 5% level of significance; we reject the null hypothesis and conclude that domestic investment has a significant impact on Economic Growth of Nigeria within the sample period.

4.6 Detail Discussions of the Findings

This section dealt with the discussion of the findings. Thus, discussions were made in the light of the data analysis, thereby linking the results of the analysis to the existing theory. The test on unit root test shows that LRGDP, LDIN, and LGEX, and are not stationary at levels. However, all the variables are stationary at first difference in ADF tests. Considering the time series using Augmented-Dickey Fuller at Trend & Intercept, all their calculated statistics are greater than the critical values at 5% level of significance. The results show that the time series are integrated of the same order; I (1), with the application of ADF test respectively. According to Pesaran and Yongcheol (1999) and Pesaran, Yongcheol and Richard (2001), if the data used in the econometric analysis is not stationary at level but is stationary after differencing the data, it means that information regarding the long run relationship between the variables has been lost during the process of differencing the data. As such they advocate for the test of long-run relationship to ascertain the long run status of the model.

The summary of the Johansen Co-integration Test is shown in above. The model with lag 1 was chosen with the linear deterministic test assumption. In order to find out if there is long-run equilibrium relationship that exists between the LRGDP and the explanatory variables; LDIN, and LGEX, using the Johansen Co-integration Test. 136

The test revealed that there is one co-integrating equation among the co-integrating equation. As can be seen from the trace statistics above and Eigen-value. The trace statistics is greater than the critical value at 5% level of significance and was collaborated by the Eigen-value which is significantly different from zero.

In other words, the null hypothesis of no co-integration among the variables is rejected since at least one equation at 5% critical value is statistically significant. The test result shows the existence of a long-run equilibrium relationship among the variables. With the identification of co-integrating equations among the variables employed for estimation, vector error correction model VECM estimation presents the only option for predicting the dynamic behaviour of LRGDP in response to, LDIN and LGEX in the first model

The Error correction term in both models met the required conditions. Negative sign and statistical significance of the error correction coefficients are necessary conditions for any disequilibrium to be corrected. In light of this, the coefficient of ECM (-1) in the model is -0.44331. The coefficient indicated that the speed of adjustment between the short-run dynamics and the long run equilibrium in the first model is 44.3%. Thus, ECM will adequately act to correct any deviations of the short run dynamics to its long -run equilibrium annually in both the first model.

The t-test revealed that all the variables in the first model which sought to seek the impact of domestic investment on economic growth in Nigeria are all significant at 5% level of significance. This is revealed by the fact that both the P-value of Lagged RGDP, Lagged DIN by one year and Lagged government expenditure were all less than the 5% level of significance. As such, it is convenient to conclude that domestic investment particularly has appositive significant impact on Nigeria economic growth within the period under review.

4.7 Implication of the Results

From the discussion above, it was revealed that domestic investment has a significant positive impact on economic growth in Nigeria within the period under review. This finding means that the higher the domestic investment the higher the economic growth of Nigeria. The findings conform to the findings of Adekunle and Aderemi (2012) who examined the relationship between Domestic Investment, Capital Formation and Population Growth in Nigeria. They noted that there exists appositive relationship between economic growth and domestic investment in Nigeria. For instance, Ghura and Hadji 1996) conducted research on domestic investment and capital formation in selected Africa countries and argued that domestic investment has a significant impact on the economic growth among the countries investigated.

5.0 Conclusion and Recommendation

5.1 Conclusion

The general objective of this study is to evaluate the link existing among domestic investment, and economic growth while the specific objectives are to; ascertain if there is long run significant relationship that exists among domestic investment, and economic growth in Nigeria within 1980 and 2016 and to find out if there is significant causal relationship between domestic investment and economic growth within the period under study.

The study employed ex-post facto research design using Nigeria's data obtained from Central Bank of Nigeria (CBN) (1980-2016). The empirical results were on Augmented Dickey-Fuller test. In the second step, Johansen Co-integration Test was conducted. The presence of long-run equilibrium found led to the use of Vector Error Correction Mechanism (VECM). It was found that domestic investment cause growth of the economic growth in Nigeria within the period under study. It is therefore imperative to conclude from the findings that domestic investment, have significant impact on Nigeria economic growth The researcher noted that, if Nigeria economy will make a meaningful progress, there is need to increase investment in the domestic economy, encourage industrialization, promote agricultural output drastically and above all draft developmental document that addresses how the country will achieve sustainable high level of economic growth.

5.2. Policy Recommendations

Given the above findings, the research, therefore, made the following pertinent recommendations:

1. There is a need for government to create enabling an environment for domestic investment to rise through the adoption of macroeconomic policies which will boost investment opportunities in the economy thereby contributing to the growth of the economy.

2. It was found that domestic investment cause economic growth; there should be diversification of the economy. Policy formulators in Nigeria need to enact some investor-friendly policies that will encourage, promote domestic investment.

3. The government should pursue the policy of export promotion thereby encouraging domestic companies to go into more production. To achieve this, the government needs to reduce both the tax rate and interest rate by at least 10% to encourage domestic investment in the country.

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