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Assessment of the Research Orientation of Academics in Ghana through the Lens of Entrepreneurialism

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ABSTRACT This paper examines from, an entrepreneurial perspective, the research orientation of academic researchers, across academic discipline. It also investigates knowledge requirements, in the form of research requests, by the carriers of innovation in relation to the research orientation of academics. It follows an explanatory sequential mixed methods approach to analyse survey data from a stratified sample of 266 academic researchers and interview responses from 11 key informants from two universities, in Ghana, with the entrepreneurial mandate to contribute to regional and national development. Data were analysed with mean values, skewness, kurtosis and Kruskal-Wallis tests. The research findings indicate versatility in the research orientation of the academics surveyed although no statistically significant differences were established among academics from the Sciences, Technology, Engineering and Mathematics, the Social Sciences and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers. Further exploration shows that knowledge requirements by the carriers of innovation were in line with the academics' research orientation. Versatility in the research orientation of the academics, is an indication of the capacity of the two universities to fulfil their entrepreneurial mandate of knowledge production, in the Ghanaian economy.

Keywords: Development, entrepreneurial university, Ghana, innovation, knowledge, research

Introduction

Knowledge is a critical input to the entrepreneurial activities of the carriers of innovation in an economy. For instance, discussion of the subject matter by Hughes and Kitson (2012) and Zhao and Wang (2015) show that technical knowledge can be a source of technological breakthrough and enable entrepreneurs to offer superior products on the market while market knowledge can influence the ability of entrepreneurs and entrepreneurial organisations to have access to resources, expand their customer base and or enact proactive and productive economic policies. Over centuries, universities have been a major source of scientific and technological knowledge for industrial and human capital development (Martin and Etzkowitz, 2000; Seol, 2012; Sharma, 2015). The knowledge production function of universities is very much heightened in research on the knowledge-based economy.

In the knowledge-based economy universities, and for that matter academic researchers, have the entrepreneurial mandate to undertake research, disseminate the research findings and assist in the use of the findings in solving societal problems and

in the pursuit of innovation to enhance individual lives, societies and regional and national economies (Leydesdorff, 2012; Trencher *et al.,* 2014). The entrepreneurial roles of universities have become highly crucial, inter alia, due to the ardent quest of nations to improve lives, reduce poverty and pursue sustainable development in the face of globalisation, rapid technological advancements and economic and financial crises with the attendant imperative for the judicious use of state funds (Hannon, 2013; Vice Chancellors Ghana, 2013). According to the OECD (2012), the entrepreneurial roles of universities are reflected by leadership and governance, organisational capacity, curriculum, pathways that are created, and the relationships that universities build with businesses and other external partners for knowledge exchange.

It is essential to note that the entrepreneurial mandate of universities has been found to exist and is evolving in several university models including the western or universal university model based on Newman's and Humboldt's principles, the research university, the entrepreneurial university, and national-oriented models such as the Brain Korea 21 Program (Etzkowitz, 2003; Fuller, 2005; Seol, 2012). All the models require research and the exchange of the information that is generated for the purposes of advancing the knowledge base of an economy through the advancement of knowledge and or innovation.

In this light, the quadrant model of scientific research by Stokes (1997), popularly known as the Stokes' quadrant (Chang *et al.,* 2011), provides a comprehensive framework of research types, namely basic, applied and use-inspired basic research in relation to the objectives of seeking understanding, application or both understanding and application, respectively. But, literature increasingly indicates the need for research and innovation in developing countries to focus on learning-by-doing instead of re-inventing the wheel due to the limited capacity of developing countries to match up to the capacity of lead countries (Lucas, 1988; Mathews and Hu, 2007; UNCTAD, 2011). In this sense, contrary to the norm whereby the Sciences, Technology, Engineering and Mathematics (STEM) are prioritized over the Social Sciences and the Arts in policy interventions and studies, adequate research activities from all academic disciplines become crucial, especially, in informing policy on interventions that call for multidisciplinary and holistic approach to development-driven research and innovation (Bakhshi et al., 2008; Hughes et al., 2011).

In Ghana, public universities are charged to provide higher education, carry out research, exchange and disseminate knowledge through purpose-driven relationships with stakeholders to drive the development agenda of the country (Crabbe, 2005; Government of Ghana, 1992; University of Ghana, 2012). However, empirical studies, such as those by Baba *et al.* (2009) and Hughes and Kitson (2012), point to the fact that the ability of the university to adequately fulfill its knowledge production function, through research, depends to a larger extent on the research orientation of academics who work for the university and compatibility between academic research and societal, industrial, regional and or national knowledge requirements. Thus, from the perspective of knowledge production and usage (Gibbons *et al.*, 1994; Stokes, 1997), research results from the university may yield limited uptake if there is a mismatch between the research orientation of academics and the knowledge demands of the user community.

The objective of this paper is, therefore, to explore, from an entrepreneurial perspective, the research orientation of academics from the University of Cape Coast (UCC) and the Kwame Nkrumah University of Science and Technology (KNUST) in Ghana. The corporate strategic plans of the two universities indicate their commitment to providing higher education, research and extension, as well as to promoting

entrepreneurship and regional development (KNUST, 2005; UCC, 2012). Both universities comprise a blend of academic researchers from the STEM, the Social Sciences and the Arts but do not have explicit policies that prioritise research in any particular discipline. This creates a starting point for the assessment of the research orientation of academics, across academic discipline, as specified in the following composite non-directional hypothesis:

H_0: There are no significant differences among academic researchers in the STEM, the Social Sciences, and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers.

H_1: There are significant differences among academic researchers in the STEM, the Social Sciences, and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers.

In subsequent section of the paper, theoretical and conceptual discussions on entrepreneurial roles of universities, research orientation and academic discipline are presented under the generic title of literature review. This is followed by discussions of the methodology and results. The paper ends with the conclusions and the associated policy implications as well as limitations of the study.

Literature Review

In the light of entrepreneurship as constituting the pursuit of opportunities, through productive creativity and innovation, without regard to resources under one's control (Shane *et al.,* 2012), universities have entrepreneurial roles to play in society. The roles include the development of entrepreneurial workforce through education and contribution to regional development through research, entrepreneurship and innovation (Audretsch, 2014; Guerrero *et al.,* 2016). Universities, irrespective of type or mission, perform one or a combination of these roles due to the evolutionary nature of societies, economies and organisations and the onus on the latter to naturally co-evolve with the former (Martin and Etzkowitz, 2000; see also Hannon, 2013). For example, today's socio-economic landscape, characterised by high youth and graduate unemployment, teeming health and climatic challenges and rapid technological advancements (Sharma*,* 2015), defines entrepreneurial roles for all types of universities including teaching, research and entrepreneurial universities.

Literature increasingly affirms the role of the teaching university as comprising the entrepreneurial mandate to educate and develop entrepreneurial individuals some of whom may aim at entrepreneurship and self-employment as a profession while others support their employers to pursue intrapreneurship and contribute to innovation and regional competitiveness. Whereas much attention of the research university is drawn to scientific investigations into various research problems, the entrepreneurial university distinguishes itself with much emphasis on addressing societal and economic challenges through research, entrepreneurship and innovation, using for instance purpose-driven multi-organisational arrangements and linkages with key actors in the knowledge-based economy, extensive research, business incubation and technology development and transfer (Etzkowitz, 2003; Gibbons and Johnston, 1974; Hannon, 2013).

The evolution and prominence of the three basic university types and their corresponding missions and roles are in tandem with the discovery, over the years, of the drivers of economic growth and development. The university's first mission of teaching, encapsulated in the role of human capital development through education,

was well justified by the works of classical theorists, such as Adam Smith and Karl Max, which illustrated labour as one of the drivers of economic growth and development (Hagemann, 2009; Lin, 2011; Osha, 2014). Subsequently, Solow's (1956) neoclassical theorising in reference to the Harrod-Domar model of savings and fiscal discipline, brought to light the importance of input growth in the form of education and acquisition of technological knowledge.

Other neoclassical works, for instance by von Hayek, (1945), Arrow (1962), Leibenstein (1968), Lucas, (1988) and Romer (1986; 1990), inspired a new economics of knowledge culminating into endogenous growth theories which established knowledge as a critical source of technical change and a major driver of economic growth, particularly, as ushered by forces within an economy as opposed to forces outside it (Schumpeter, 1934 [1983]). Thereafter, several theories and models, such as the knowledge spillover theory of entrepreneurship and the national capability approach to development, augmented earlier insights on the critical role of the university in knowledge production through research and the transformation of research findings into innovations through entrepreneurship (Acs *et al.,* 2009; Dang and Umemoto, 2009).

Although research findings are expected to naturally spillover in the form of entrepreneurial opportunities to, particularly, entrepreneurial start-ups, strategic research for the development of competitive innovations often takes place through collaborative research whose tenets are defined by the key actors in the knowledge-based. The actors include the university which is primarily in charge of knowledge production, industry responsible for innovation and government with oversight responsibility through governance and regulation (Audretsch, 2014).

In the multi-organisational arrangements, collaborative research between academia and the carriers of innovation augments the capacity of the entrepreneurial society to bridge the knowledge filter through the conversion of research output into useful and competitive innovations (Robin and Schubert, 2013; Smith and Bagchi-Sen, 2012). Nevertheless, the pursuit of collaborative research is highly contingent upon a number of factors including the research orientation of academics and the adequacy of the orientation vis à vis the knowledge requirements of the carriers of innovation (O'Gorman *et al.,* 2008).

Scientific research has been severally categorised. A leading classification comprises basic and applied research while an emerging taxonomy includes use-inspired basic research (Chang *et al*., 2011; Hughes *et al.,* 2011). Basic research is defined by the American National Science Foundation as an original investigation for the advancement of scientific knowledge which does not have immediate commercial objectives (Mansfield, 1980). Thus, the outcome of basic research is essential to the teaching responsibility of the academic in staying up-to-date on matters of interest and scholarship as well as in forming the basis for the conduct of applied research. According to Stokes (1997), applied research is mainly driven by consideration for its use with relatively little quest for advancing science while use-inspired basic research aims at both knowledge production for understanding and application.

In the face of the growing expectations of the university to produce knowledge for application in addition to knowledge for the advancement of science (Calvert, 2002; Stephan, 2013), scholars have dedicated much attention to the goal-oriented distinction between basic research and applied research, especially, whether basic research can, eventually, be applied or used for innovation. For instance while Nelson (1959) held the view that basic research was less oriented towards innovation, Rosenberg and Nelson (1994) thought otherwise on the basis of growing evidence that

successful pure basic research often yields relatively more, advanced and diversified benefits to society (see also Hughes and Kitson, 2012; Moore *et al.,* 2010).

Furthermore, the usefulness of basic research to innovation (Mansfield, 1980; Salter and Martin, 2001) has been well established in literature. For example, Grilliches (1985), in a study of research and development (R&D), focusing on basic research and productivity growth at the firm level, found that basic research contributed to productivity growth in US manufacturing in the 1970s, much fueled by private R&D expenditure as against public expenditure. In the face of the rising evidence in support of the contribution of basic research to innovation, scholars, including Nelson (2006), who hitherto believed otherwise, conceded to the argument that basic research could eventually lead to innovation. Nelson (2006) further argued that in many scientific disciplines, such as engineering and molecular biology, a number of basic research commences with questions about how technology works or an inquiry into more general practical problems that are still begging for solutions.

Stokes (1997) was among the early scholars who believed in the usefulness of basic science to innovation. Based on the outcome of a technical and historical analysis of scientific inquiry beginning with the ancient Greeks, who are believed to have invented scientific research, Stokes identified three goals and three types of research and researchers, respectively. The goals include the quest for understanding, consideration of use and the pursuit of the combined goals of understanding and consideration of use. The three goals, according to Stokes, give rise to three types of research, namely, pure basic, pure applied and use-inspired basic research and their corresponding group of scientists, namely, Bohr scientists, Edison scientists and Pasteur scientists (Baba *et al.,* 2009; Grimpe and Fier, 2010). Thus, whereas the primary research preoccupation of Bohr or Star scientists is basic research, that of Edison scientists is applied research. Pasteur scientists have a use-inspired basic research orientation and mainly carry out research that advances scientific understanding and have potential real-world utility (Hughes and Kitson, 2012).

Empirical studies on the primary research orientation of academics appear to be quite a relatively recent phenomenon and largely limited to western country experiences. Studies by Baba *et al.* (2009), Perkmann and Walsh (2009), Grimpe and Fier (2010) and Chang *et al.* (2011) indicate the prevalence of use-inspired basic research orientation among academics. The findings are consistent with Stokes' (1997) argument that the Pasteurian research orientation is relatively ideal for advancing the knowledge base of an economy due to its capacity to meet the dual goals of advancing science and consideration of use by industry.

However, contrary to arguments such as those by Chang *et al.* (2011), that elevate the STEM above other academic disciplines in their capacity to contribute to innovation, the results of a related study by Hughes *et al.* (2011) showed that the Arts and Social Sciences or Humanities could consist of disciplines that are applied in nature and could make valuable contributions to collaborative innovation if given the needed policy support. Similar arguments were raised by Bakhshi et al. (2008) in a study of the contributions of the Arts and Humanities, in the United Kingdom (UK), to innovation.

Another debate in development literature is the growing emphasis on the need for least developed and developing countries to engage less in new-to-the-world innovations and more in new-to-the-country and reverse innovations as well as focus more on outward-oriented industrialisation (Lucas, 1988; Mathews and Hu, 2007; UNCTAD, 2011). Mathews and Hu (2007) argue that new-to-the-world innovations consist of commercialisation of inventions, usually by lead countries, which develop-

ing countries can hardly match up to. Alternatively, an empirical study by Ang and Madsen (2011) supports the recommendation for developing countries to aim at reverse innovation. The implication is that academic researchers should focus more on new-to-the-country research since such research offers opportunities for new-to-the-country or reverse innovation, and export of products to already established markets (Lazonick, 2004; Zedtwitz *et al.,* 2015).

In sum, the relevance of research to economic activity, and eventually to economic development, has made the definition of research a subject of discussion over time. The various classifications notwithstanding, consensus is being built upon the classification of research into basic, applied and use-inspired basic research as advanced by Stokes (1997) and employed in various studies (Baba *et al.*, 2009; Hughes *et al.,* 2011; Moore *et al.,* 2010). Furthermore, within the framework of endogenous growth and global competition, underdeveloped and developing countries are likely to reap substantial growth advantages by concentrating more on new-to-the country research and reverse innovation as against new-to-the-world research.

Methodology

Explanatory sequential mixed methods approach (Fetters *et al.,* 2013) was employed in the study of the research orientation of academic researchers from UCC and KNUST. Substantial part of the study followed the quantitative research approach and comprised a survey of academics while the minor and subsequent part consisted of interviews of key duty bearers from the two universities. The purpose of the qualitative aspect was to obtain in-depth knowledge of key issues that emerged during the quantitative survey. The study was conducted at UCC and KNUST because they provided a comprehensive population of the STEM, the Arts and the Social Sciences, which was needed to test hypothesised differences in research orientation of academics, by academic discipline. Thus, whereas UCC enhanced the Social Sciences and Arts profile of the population, KNUST augmented that of the STEM. The population was 1531 and consisted of all academic senior members employed by the two universities to teach, research and engage in outreach.

The elements of the population for each institution were divided into three strata, namely, STEM, Social Sciences, and Arts (see Table 1). The groupings were informed by categorisations in previous studies, such as those by Hughes and Kitson (2012) and Moore *et al.* (2010), which analysed research orientation of academics across disciplines. Therefore, all academics in the Sciences, Technology, Engineering and Mathematics and related departments formed the STEM group. Academics in departments that teach and research into various forms of expressions of human experience rooted in culture, constituted the Arts. The Social Sciences comprised academics in departments that research into society, its structure, systems, functions and relationships (Hughes and Kitson, 2012; Bakhshi *et al*., 2008). After determining the proportion of each stratum in relation to the total sample size, respondents were selected from each stratum through the computer method of generating random samples.

Table 1. Stratified Sample Sizes for the Study Institutions

Academic discipline	UCC	KNUST	Total Population (and sample size)
	Population (and sample size)	Population (and sample size)	
STEM	251 (82)	645 (215)	896 (297)
Social Sciences	278 (92)	130 (46)	408 (138)
Arts	102 (35)	125 (41)	227 (76)
Total	631 (209)	900 (302)	1531 (511)

Source: Field survey (2014)

In order to ensure that the sample size for the quantitative aspect was sufficiently large to cater for non-responses, permit reasonable estimation and avoid Type 1 and Type 2 errors, 511 academics (see Table 1) were selected through proportional stratified sampling while 11 key informants for the qualitative aspect were identified through judgment sampling (Henson and Roberts, 2006; Sola, 2014). The key informants were made up of eight academics, from the three disciplines in the two universities, who had several years of experience in outreach, particularly extensive engagement in research collaboration with the carriers of innovation in the Ghanaian economy. The remaining three informants comprised the director of the Directorate of Research, Innovation and Consultancy (DRIC) at UCC and heads of the Office of Grants and Research (OGR) and the Technology Consultancy Centre (TCC) at KNUST.

Research orientation was studied within the framework of the quadrant model of scientific research (Stokes, 1997) and was preceded by an assessment of the research interest of respondents (Mathews and Hu, 2007). Research orientation was operationalised into three types and measured on a semantic differential rating scale varying from 1 (lowest orientation) to 7 (highest orientation). Definition of the types of orientation followed that by Stokes (1997) in his quadrant model of scientific research and definitions in empirical studies such as that by Chang *et al.* (2011) and Moore *et al.* (2010). Therefore, basic research was defined as research in pursuit of understanding while applied research was defined as the conduct of research with consideration of applying the research findings in innovation or problem solving. Use-inspired basic research constituted research for both understanding and application.

Data were collected through administration of questionnaire, and in-depth interviews using two interview guides. One of the interview guides was designed to solicit information from the eight experienced academic researchers while the other guide was administered to the director and heads of the research and technology transfer units of the study institutions. The face and content validity of the instruments

were established by five independent and experienced researchers after which ethical clearance was sought from the UCC Institutional Review Board in August 2014. Questionnaire administration lasted from November 2014 to March 2015 and yielded 266 total valid responses while interviews were conducted in May and June, 2015, with participation from all 11 key informants.

The quantitative data were analysed with tools from IBM Statistical Product and Service Solutions (SPSS) Version 19. Initial assessment of the data showed that the data met assumptions of parametric analysis. However, in spite of fulfilling the assumption of normality and large sample size of 25 participants per condition (Pallant, 2011; Schmider *et al.,* 2010), Kruskal-Wallis tests were performed instead of ANOVA due to violation of the assumption of homogeneity of variance. Apart from basic research which had an insignificant Levene's statistic ($p = .40$), applied research and use-inspired basic research recorded significant Levene's statistics of $p = .04$ and $p = .05$, respectively. Transcribed and auditory data, from the qualitative study, were coded and interpreted along similar and contrasting themes from the questionnaire survey.

Results and Discussion

The results and discussions are in two parts. The first part consists of the background characteristics of respondents. This is followed by the second part which comprises an assessment of the research focus and research orientation of academics in relation to academics' knowledge production function in the knowledge-based economy as well as results of the tests of hypotheses of the research orientation of academics, across academic discipline.

Demographic Characteristics of Respondents

Total number of respondents stood at 266 academics. Out of this, 24% were females while 76% were males. The majority of respondents were senior lecturers (48%) while the minority were professors (2%). Eleven percent of respondents were assistant lecturers, 33% were lecturers while 6% were associate professors. In addition, 256 out of the total number of 266 respondents indicated their academic discipline. More respondents were from the STEM (62%) as compared to the Social Sciences (25%) and the Arts (13%). The mean number of years of service was 10 years with one and 39 years as the minimum and maximum number of years of service, respectively.

Research Focus and Research Orientation of Academic Researchers

Frequency distribution (Table 2) of multiple responses on the research focus of respondents revealed that a significant number (43.5%) of the researchers had been engaging in country-specific research. However, 39.2% of the researchers specified new -to-the-country research as the primary research focus, while a lower percentage (17.3%) of responses related to new-to-the-world research. Interview results from the 11 key informants to the study, also showed that country-specific research, such as inquiry into economic, technological and health-related issues peculiar to Ghana, and new-to-the-country research, which involved exploration of the feasibility of upgrading, adopting and or adapting innovations from elsewhere to suit local conditions,

were dominant. New-to-the-world research, hardly came up as research focus of interviewees.

Table 2. Research Focus of Respondents

Research interest	Frequency (multiple responses)	%
New-to-the-country research	165	39.2
New-to-the-world research	73	17.3
Country-specific research	183	43.5
Total	421	100.0

Source: Field survey (2015)

Although the survey and interview results indicated relatively higher focus on country-specific research, the findings appear consistent, to an extent, with recommendations by Mathews and Hu (2007), who advised developing countries to focus less on new-to-the-world innovation and, rather on new-to-the-country innovation and, hence, new-to-the-country research. Nonetheless, the relatively fewer engagement in new-to-the-country research coupled with lower engagement with the private sector, could limit the capability of academics in the two study organisations to support Ghana's development agenda through the pursuit of effective outward-oriented industrialisation (Lucas, 1988; Rodrik, 2001) which thrives on reverse innovation (Lazonick, 2004; Zedtwitz *et al.,* 2015).

In addition to assessment of research focus, the primary research orientation of respondents, and research requests by collaborating partners, were analysed. The analysis was informed by the quadrant model of scientific research (Hughes and Kitson, 2012; Stokes, 1997) which categorises research into basic, applied and use-inspired basic research. Each type of research was scored on a scale of 1 (very weak agreement) to 7 (very strong agreement), that most of the research that respondents conducted throughout their career was basic, applied or use-inspired basic research.

The results of the analysis, as shown in Table 3, indicated skewness and kurtosis values below ±2 and ±7, respectively. The values do not signify substantial departure from normality (Curran *et al.,* 1996; Kim, 2013), hence, the mean was reported as the measure of central tendency. Assessment of the descriptive statistics, presented in Table 3, showed mean scores of 5.63 for basic research and applied research, and 5.62 for use-inspired basic research. Thus respondents highly agreed that, throughout their career, most of the research they conducted were either basic, applied or use-

inspired basic research. Similarly, respondents who had engaged in research collaboration, within the past ten years, indicated that requirements for basic research (M = 5.45, SD = 1.315), applied research (M = 5.49, SD = 1.384) and use-inspired basic research (M = 5.41, SD = 1.405) were quite high (Table 3).

Table 3. Research Orientation of Respondents and Research Request by Collaborating Partner(s)

	N	Mean	SD	Skewness	Kurtosis
Research orientation:					
Basic research	265	5.63	1.299	-1.436	-1.436
Applied research	262	5.63	1.183	-1.237	-1.237
Use-inspired basic research	261	5.62	954	-1.777	-.777
Partner's research request:					
Basic research	120	5.45	1.315	-1.153	-1.153
Applied research	114	5.49	1.384	-1.102	-1.102
Use-inspired basic research	119	5.41	1.405	1.365	-1.365

Source: Field survey (2015)

The results point to an almost equal distribution of Edison, Pasteur and Bohrian researchers (Stokes 1997) among the academics surveyed. Interview results revealed that, at least, one interviewee from each academic discipline cited use-inspired basic research as the primary research orientation while a respondent indicated that "you can't do the applied without the basic…" The results imply that use-inspired basic research is critical to the attainment of a knowledge-based economy. The findings are quite similar to those of Baba *et al.* (2009) and Chang *et al.* (2011) who established that use-inspired basic research was the leading research orientation of scientists studied in Japan and the UK, respectively.

Research orientation was also assessed from the perspective of respondents who had engaged in research collaboration within the past ten years. Specifically, respondents were asked to rate on a scale of 1, representing least requirement, to 7 representing major requirement, the purpose for which collaborating partners requested for the research. Descriptive statistics (Table 3) showed mean scores from 5.41 to 5.49 for use-inspired basic research, basic research and applied research, meaning that

research requests by collaborating partners were either use-inspired, basic or applied in nature. The results show a close match between research orientation and the knowledge requirements of users (see Table 3). The implication is that use of collaborative research output in innovation is an outcome of the interplay between research demand and supply.

Furthermore, the findings indicate versatility in the research demands of knowledge users contrary to Baba *et al.*'s (2009) and Grimpe and Fier's (2010) findings that use-inspired basic research and applied research are the most demanded research types. The difference could be attributed to differences in study focus. That is, whereas this study focused on respondents' indication of knowledge requirements from users, irrespective of their sector of operation, the studies by Baba *et al.* (2009) and Grimpe and Fier (2010) focused on firms, which according to literature, often require applied knowledge.

In line with the hypotheses of the study, Kruskal-Wallis tests were conducted to assess whether respondents from the STEM, Social Sciences and Arts differ in their research orientation. In spite of fulfilling the assumption of normality and large sample size of 25 participants per condition (Pallant, 2011; Schmider *et al.,* 2010), Kruskal -Wallis tests were performed instead of ANOVA due to violation of the assumption of homogeneity of variance. With the exception of basic research which had an insignificant Levene's statistic (p = .40), applied research and use-inspired basic research recorded significant Levene's statistics of p = .04 and p = .05, respectively. Basic research, that is research aimed at creating understanding, was analysed with a total of 254 responses (Table 4). The analysis showed that the Social Sciences recorded the highest mean rank (133.62) while the Arts had the lowest mean rank (119.94).

Table 4. Basic Research across Academic Discipline

Academic Discipline	N	Mean Rank	Median
STEM	157	126.6	6.00
Social Sciences	64	133.62	6.00
Arts	33	119.94	6.00
Total	254		6.00

Source: Field survey (2015)

However, as presented in Table 4, the three academic disciplines recorded the same median score (6.00), which is an indication that the respondents highly agreed that most of the research they conducted, throughout their career, was basic research. According to the Kruskal-Wallis results, there were no statistically significant differences in basic research orientation across the three academic disciplines [(Group 1, n = 157: STEM, Group 2, n = 64: Social Sciences, Group 3, n = 33: Arts), χ^2 (2, n = 254) = .889, p = .641].

Applied research was assessed based on 251 responses (Table 5). Applied research was operationalised as research aimed at applying the findings to problem solving or in innovation. Mean ranks, as presented in Table 5, indicate that the STEM had the highest score (132.10) followed by the Arts with a score of 121.76. The Social Sciences recorded the lowest mean rank (113.19).

Table 5. Applied Research by Academic Discipline

Academic Discipline	N	Mean Rank	Median
STEM	156	132.10	6.00
Social Sciences	64	113.19	6.00
Arts	31	121.76	6.00
Total	251		6.00

Source: Field survey (2015)

The three disciplines recorded the same median score (6.00), as shown in Table 5, meaning that respondents highly agreed that most of the research they conducted, throughout their career, was applied research in nature. Results of the Kruskal -Wallis test confirmed the absence of statistically significant difference in applied research orientation across the three academic disciplines [(Group 1, n = 156: STEM, Group 2, n = 64: Social Sciences, Group 3, n = 31: Arts), χ^2 (2, n = 251) = 3.510, p = .173].

The third research orientation was use-inspired basic research which aims at creating knowledge for both understanding and application. Analysis of use-inspired basic research was based on 250 responses (Table 6). Assessment of the mean ranks revealed that the STEM and the Arts recorded the highest (129.19) and lowest (113.58) mean ranks, respectively.

Table 6. Use-inspired Basic Research by Academic Discipline

Academic Discipline	N	Mean Rank	Median
STEM	155	129.19	5.50
Social Sciences	64	122.34	5.50
Arts	31	113.58	5.50
Total	250		5.50

Source: Field survey (2015)

However, the three disciplines recorded the same median scores (5.50), as shown in Table 6. The Kruskal-Wallis test on use-inspired research orientation showed no statistically significant difference across the three academic disciplines [(Group 1, n = 155: STEM, Group 2, n = 64: Social Sciences, Group 3, n = 31: Arts), χ^2 (2, n = 250) = 1.416, p = .493].

The preceding findings led to acceptance of the composite null hypothesis (H_0) that there are no statistically significant differences among academic researchers from the STEM, Social Sciences and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers. Thus, there were as many Bohr scientists as there were Edison and Pasteurian scientists. The findings contradict those of Chang *et al.* (2011) and Hughes *et al.* (2011).

Chang *et al.* (2011), in a study of how university departments respond to the rise of academic entrepreneurship, found that academics from the STEM were more of use-inspired basic researchers. Hughes *et al.* (2011) in an exploration of hidden connections established that, except academics from the Creative Arts and Media, academics in the Arts and Humanities were much more likely to describe their research as basic research. Even though the quadrant model of scientific research (Stokes, 1997) and empirical studies including those of Baba *et al.* (2010) and Chang *et al.* (2011) point to the supremacy of use-inspired basic research as the ideal alternative that meets knowledge requirements of both knowledge producers and knowledge users, the findings of this study show versatility in orientation, of the academics surveyed, for meeting various knowledge needs of the Ghanaian economy.

Conclusion

The objective of this paper was to assess, from the perspective of the entrepreneurial roles of universities, the research orientation of academic researchers in Ghana by using the case of two of Ghana's public universities (that is UCC and KNUST) with clear entrepreneurial mandates. On the basis of the findings of the study, it was concluded that academic researchers were similar in their research orientation. That is, there were similarities with respect to the focus on basic research, applied research and use-inspired basic research across the STEM, Social Sciences and Arts.

In essence, the desire of academics to pursue basic research, applied research or use-inspired basic research was independent of their academic discipline, and this was an indicator of their versatility. This versatility points to the capacity of the two universities, when given the needed policy support, to fulfill their entrepreneurial roles, particularly, in contributing towards the diverse knowledge requirements of the Ghanaian economy, for instance, in the exploration and development of innovation in lead industries.

Policy Implications

The similarities, in terms of focus on the three types of research and across disciplines, can have implications for a developing country that is interested in innovation and entrepreneurship. Basic research, in and of itself does not, ordinarily, generate innovation and entrepreneurship, especially in the short to medium term. It is rather applied research and use-inspired basic research that have the specific objectives of contributing directly towards innovation and entrepreneurship. This has implications for the mobilisation of funding for research and how such funds can be appropriated across the types of research in order to create innovation, entrepreneurship, employment and overall improvement in living conditions, in Ghana.

Moreover, since multidisciplinary research is fundamental to economic development, the similarities in research orientation across academic discipline make it necessary for enough space to be created for all academic disciplines within government and university research and development agenda, in line with Ghana's development priorities. Thus, research support schemes should guard against selective interventions in favour of a particular academic discipline since such selectivity will be detrimental to the promotion of multidisciplinary research and effective knowledge exchange between academia and the carriers of innovation.

Limitations of the Study

Although this research holds much promise in being among pioneering inquiries into the capacity of Ghanaian universities to fulfill their knowledge production function for regional and national development, it does not analyse user knowledge requirements from the perspective of the carriers of innovation, hence, this is recommended for future research.

The study is also limited in scope as it involved only two universities in Ghana. In order to have a broader perspective, future research may focus on a national survey of the research orientation of academics and the contribution of academic research to innovation.

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Declaration

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References

Acs, Z. J., Braunerhjelm, P., Audretsch, B. D. and Carlsson, B. (2009) The Knowledge Spillover Theory of Entrepreneurship, *Small Business Economics,* 32, pp. 15-30.

Ang, J. B. and Madsen, J. B. (2011) Can Second-Generation Endogenous Growth Models Explain the Productivity Trends and Knowledge Production in the Asian Miracle Economies? *Review of Economics and Statistics*, 93, 4, pp. 1360-1373.

Arrow, K. J. (1962) Economic Implications of Learning by Doing, *The Review of Economic Studies,* 29, 3, pp. 155-173.

Audretsch, D. B. (2014) From the Entrepreneurial University to the University for the Entrepreneurial Society, *The Journal of Technology Transfer*, 39, 3, pp. 313-321.

Baba, Y., Shichijo, N. and Sedita, S. R. (2009) How do Collaborations with Universities Affect Firm's Innovative Performance? The Role of "Pasteur Scientists" in the Advanced Materials Fields, *Research Policy*, 38, pp. 756-764.

Bakhshi, H., Schneider, P. and Walker, C. (2008) *Arts and Humanities Research and Innovation*, London, Arts and Humanities Research Council (AHRC) & NESTA.

Calvert, J. (2002) Making Academic Research Useful. Scientists' Responses to Changing Policy Demands, paper presented at the NPRNet Conference on Rethinkin Science Policy: Analytical Frameworks for Evidence-Based Policy, 21st – 23rd March, Brighton, United Kingdom.

Chang, Y. C., Yang, P. Y., Tsai-Lin, T. F. and Chi, H. R. (2011) How University De partments Respond To The Rise Of Academic Entrepreneurship. The Pasteur's Quad rant Explanation, DRUID working paper No. 11-07, Danish Research Unit for Indus trial Dynamics, Aalborg, 8 April.

Crabbe, C. R. A. C. V. (2005) *Laws of Ghana,* Vol. 7, London, LexisNexis Butterworths Ltd.

Curran, P. J., West, S. G. and Finch, J. F. (1996) The Robustness of Test Statistics to Nonnormality and Specification Error in Confirmatory Factor Analysis, *Psychological Methods,* 1, 1, pp. 16-29.

Dang, D. and Umemoto, K. (2009) Modeling the Development toward the Knowledge Economy: A National Capability Approach, *Journal of Knowledge Management*, 13, 5, pp. 359-372.

Etzkowitz, H. (2003) Research Groups as 'Quasi-Firms': The Invention of the Entrepreneurial University, *Research Policy*, 32, pp. 109-121.

Fetters, M. D., Curry, L. A. and Creswell, J. W. (2013) Achieving Integration in Mixed Methods Designs – Principles and Practices, *Health Services Research*, 48, 6, pp. 2134-2156.

Fuller, S. (2005) What Makes Universities Unique? Updating the Ideal for an Entre preneurial Age, *Higher Education Management and Policy,* 17, 3, pp. 27-49.

Gibbons, M. and Johnston, R. (1974) The Roles of Science in Technological Innova tion, *Research Policy*, 3, 3, pp. 220-242.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. *(1994) The New Production of Knowledge: The Dynamics of Science and Research in* (1995) *Contemporary Societies*, New York, Sage Publications.

Government of Ghana. (1992) *University of Cape Coast Law, 1992 (PNDC Law 278),* Accra, Government of Ghana.

Griliches, Z. (1985) Productivity, R&D, and Basic Research at the Firm Level in the 1970s", NBER working paper No. 1547, National Bureau of Economic Research, Cambridge, available online at: http://www.nber.org/papers/w1547 (accessed 14 Octo ber 2014).

Grimpe, C. and Fier, H. (2010) Informal University Technology Transfer: A Comparison between the United States and Germany", ZEW working paper No. 09-03, Centre for European Economic Research, Mannheim, available at: http:// www.econstor.eu/bitstream/10419/27714/1/605024669.PDF (accessed 12 July 2014).

Guerrero, M., Urbano, D. and Fayolle, A. (2016) Entrepreneurial Activity and Regional Competitiveness: Evidence from European Entrepreneurial Universities, *The Journal of Technology Transfer*, 41, 1, pp.105-131.

Hagemann, H. (2009) Solow's 1956 Contribution in the Context of the Harrod-Domar Model, *History of Political Economy,* 41, pp. 67-87.

Hannon, P.D. (2013) Why is the Entrepreneurial University Important? *Journal of Innovation Management*, 1, 2, pp. 10-17.

Henson, R. K. and Roberts, J. K. (2006) Use of Exploratory Factor Analysis in Published Research: Common Errors and some Comments on Improved Practice, *Educational and Psychological Measurement*, 66, 3, pp. 393-416.

Hughes, A. and Kitson, M. (2012) Pathways to Impact and the Strategic Role of Universities: New Evidence on the Breadth And Depth of University Knowledge Exchange in the UK and the Factors Constraining its Development, *Cambridge Journal of Economics,* 36, 3, pp. 723-750.

Hughes, A., Kitson, M., Probert, J., Bullock, A. and Milner, I. (2011) Hidden Connections: Knowledge Exchange between the Arts and Humanities and the Private, Public and Third Sectors", Unpublished Manuscript, Centre for Business Research, Universi ty of Cambridge, Cambridge.

Kim, H. Y. (2013) Statistical Notes for Clinical Researchers: Assessing Normal Distribution (2) Using Skewness and Kurtosis, *Restorative Dentistry & Endodontics*, 38, 1, pp. 52-54.

Kwame Nkrumah University of Science and Technology [KNUST]. (2005) *Corporate Strategic Plan (2005 – 2014)*, Kumasi, KNUST.

Lazonick, W. (2004) Indigenous Innovation and Economic Development: Lessons from China's Leap into the Information Age, *Industry and Innovation*, 11, 4, pp. 273-297.

Leibenstein, H. (1968) Entrepreneurship and Development, *The American Economic Review,* 58, 2, pp. 42-83.

Leydesdorff, L. (2012) The Triple Helix, Quadruple Helix,…, and an N-Tuple of Heli ces: Explanatory Models for Analyzing the Knowledge-Based Economy?, *Journal of the Knowledge Economy*, 3, 1, pp. 25-35.

Lin, J. Y. (2011) New Structural Economics: A Framework for Rethinking Develop ment, *The World Bank Research Observer,* 26, 2, pp. 193-221.

Lucas, R. E. (1988) On the Mechanics of Economic Development, *Journal of Mone tary Economics*, 22, 1, pp. 3-42.

Mansfield, E. (1980) Basic Research and Productivity Increase in Manufacturing, *The American Economic Review*, 70, 5, pp. 863-873.

Martin, H. and Etzkowitz, H. (2000) The Origin and Evolution of the University Spe cies", SPRU working paper No. 59, Science and Technology Policy Research Unit, Brighton, available at: http://citeseerx.ist.psu.edu/viewdoc/download? doi=10.1.1.599.5719&rep=rep1&type=pdf (accessed 9 April 2013).

Mathews, J. A. and Hu, M. (2007) Enhancing the Role of Universities in Building National Innovative Capacity in Asia: The Case of Taiwan, *World Development*, 35, 6, pp. 1005-1020.

Moore, B., Hughes, A. and Ulrichsen, T. (2010) *Synergies and Tradeoffs between Re search, Teaching and Knowledge Exchange* (Research Report to HEFCE), Public and Economic Corporate Consultants (PACEC) and the Centre for Business Research (CBR), Cambridge.

Nelson, R. R. (1959) The Simple Economics of Basic Scientific Research, *The Journal of Political Economy,* 67, 3, pp. 297-306.

Nelson, R. R. (2006) Reflections on "The Simple Economics of Basic Scientific Re search": Looking Back and Looking Forwards", LEM working paper No. 2006/20, Laboratory of Economics and Management, PISA, Italy, available at: http:// www.sssup.it/UploadDocs/5690_2006_20.pdf (accessed 19 March 2013).

O'Gorman, C., Byrne, O. and Pandya, D. (2008) How Scientists Commercialise New Knowledge via Entrepreneurship, *Journal of Technology Transfer,* 33, pp. 23-43.

Organisation for Economic Co-operation and Development [OECD]. (2012), *A Guid- ing*

Framework for Entrepreneurial Universities, Paris, OECD.

Osha, S. (2014) The Concept of Innovation and the South African Nation", *Africa Development,* Vol. 1, pp. 159-172.

Pallant, P. (2011) *SPSS Survival Manual: A Step By Step Guide to Data Analysis Using SPSS* (4th ed.), Crowns Nest, Allen & Unwin.

Perkmann, M. and Walsh, K. (2009) The Two Faces of Collaboration: Impacts of University-Industry Relations on Public Research, *Industrial and Corporate Change,* 18, 6, pp. 1033-1065.

Robin, S. and Schubert, T. (2013) Cooperation with Public Research Institutions and Success in Innovation: Evidence from France and Germany, *Research Policy* 42, 1, pp. 149-166.

Rodrik, D. (2001) The Global Governance of Trade: As if Development Really Mat tered", manuscript prepared for the UNDP, available at: https://www.sss.ias.edu/files/ pdfs/Rodrik/Research/global-governance-of-trade.pdf (accessed 3 November 2012).

Romer, P. M. (1986) Increasing Returns and Long-Run Growth, *Journal of Political Economy*, 94, 5, pp. 1002-1037.

Romer, P. (1990) Endogenous Technological Change, *Journal of Political Economy,* 98, 5, pp. 71-102.

Rosenberg, N. and Nelson, R. R. (1994) American Universities and Technical Ad vance in Industry, *Research Policy*, 23, 3, pp. 323-348.

Salter, A. J. and Martin, B. R. (2001) The Economic Benefits of Publicly Funded Basic Research: A Critical Review, *Research Policy*, 30*,* pp. 509-532.

Schmider, E., Ziegler, M., Danay, E., Beyer, L. and Bühner, M. (2010) Is it Really Robust? Reinvestigating the Robustness of ANOVA against Violations of the Normal Distribution Assumption, *Methodology,* 6, 4, pp. 147-151.

Schumpeter, J. A. (1983) *The Theory of Economic Development.* (R. Opie, Trans. with new introd. by J. E. Elliott), New Jersey, Transaction Publishers Brunswick, (Reprint of *Theorie der Wirtschaftlichen Entwicklung* by J .A. Schumpeter, 1934, Cambridge, Mass., Harvard University).

Seol, S. (2012) A Model of University Reform in a Developing Country: The Brain Korea 21 Program, *Asian Journal of Innovation and Policy*, 1, pp. 31-49.

Shane, S., Locke, E. A. and Collins, C. J. (2012) Entrepreneurial Motivation, *Human Resource Management Review,* 13, pp. 257-279.

Sharma, L. (2015), A Review of the Role of HEI's in Developing Academic Entrepre neurship: An Evaluative Study of Uttarakhand State, India, *Journal of Entrepreneur ship in Emerging Economies,* 7, 2, pp. 168-188.

Smith, H. L. and Bagchi-Sen, S. (2012) The Research University, Entrepreneurship and Regional Development: Research Propositions and Current Evidence, *Entrepre neurship & Regional Development,* 24, 5-6, pp. 383-404.

Sola, A. F. (2014) Using Principal Components in Multivariate Stratification Scheme, *International Journal of Applied Science and Technology,* 4, 2, pp. 224-235.

Solow, R. M. (1956) A Contribution to the Theory of Economic Growth, *The Quarter ly Journal of Economics,* 70, 1, pp. 65-94.

Stephan, P. (2013) *The Endless Frontier: Reaping What Bush Sowed?* NBER Working Paper No. w19687, Philadelphia: National Bureau of Economic Research.

Stokes, D .E. (1997) *Pasteur's Quadrant: Basic Science and Technological Innova tion*, Washington, D. C., Brookings Institution Press.

Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N. and Kraines, S. B. (2014) Beyond the Third Mission: Exploring the Emerging University Function of Co-Creation for Sustainability, *Science and Public Policy*, 41, 2, pp. 151-179.

UNCTAD. (2011) *Science, Technology and Innovation Policy Review – Ghana,* Swit zerland, United Nations.

University of Cape Coast [UCC]. (2012) *University of Cape Coast Strategic Plan (2012-2017),* Cape Coast, UCC.

University of Ghana. (2012) *Basic Laws of the University of Ghana*, Accra, University of Ghana.

Vice Chancellors Ghana. (2013, July 17) Letter to UTAG, University of Cape Coast Branch of UTAG Archive, Cape Coast.

von Hayek, F. A. (1931) Reflections on the Pure Theory of Money of Mr. J. M. Keynes (I), *Economica,* 11, 33, pp. 270-295.

Zedtwitz, M., Corsi, S., Søberg, P. V. and Frega, R. (2015) A Typology of Reverse Innovation, *Journal of Product Innovation Management*, 32, 1, pp. 12-28.

Zhao, W. and Wang, L. (2015) How Knowledge Affects Resource Acquisition: Entrepreneurs' Knowledge, Intra-Industry Ties and Extra-Industry Ties, *Journal of Entrepreneurship in Emerging Economies,* 7, 2, pp. 115-128.