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Scholarly Conceptions of the Nature of Academic Research in Universities: A Literature Review

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Abstract

Conceptions of the nature of academic research in universities are blurred. Although higher education scholars concede that academic research within universities has been conceptualised in terms of basic and applied research, the conceptual debate with regard to what constitutes each type of research still lingers on. The purpose of this literature review is to highlight these conceptions by shedding light on how the nature of basic and applied research is understood in the extant literature.

Keywords: academic research, basic research, applied research

According to scholars, academic research can take different forms and target different audiences. For instance, it can be seen in terms of social relevance, as a catalyst for the innovation process, as a means to enhance industry-university collaboration, and, in terms of professional development of academic staff and the satisfaction of the scientific community (Cherney, Head, Povey, Boreham, & Ferguson 2015; Reddy, 2011; Pamfie, Guisca, & Bumba, 2014; Pearson & Brew, 2002; Laursen, Reichstein & Salter, 2008; Ijeoma, Ibegbulam, & Eze, 2016). Premised on the above, it appears that academic research has in the main been dichotomized into two broad types i.e., basic and applied research, each serving its audience and satisfying certain roles. Efforts to describe the two broad types of research have resulted into the coining of phrases like "mode 1" and "mode 2" knowledge production (Gibbons et al., 1994) and the "first" and "second" academic revolutions (Etzkowitz, 2003). In this paper, I review scholarly work pertinent to the different scholarly conceptions regarding basic and applied research.

Conceptions of Basic Research

This type of research satisfies the academic market i.e., the community of scholars as research targets fellow researchers in line with internationally acceptable standards (Ylijoki, Lyytinen, & Marttila, 2011). The aim is to make a contribution to one's own field and promote academic science (Hakala & Ylijoki, 2001). Within this orientation, the most regarded products are the traditional research outputs in form of publications in peer-reviewed journals, scientific monographs and edited books (Ylijoki et al, 2011). Although higher education scholars (Etzkowitz, 2003; Hakala & Ylijoki, 2001; Kekale & Lehikoinen, 2000; Gibbons et al, 1994; Slaughter & Leslie, 1997) concede that scientific knowledge within universities has been conceptualised in terms of basic research, the conceptual debate with regard to what constitutes basic research and its significance still lingers on. Yet while this conceptual debate continues, the term basic research is still broadly used to distinguish between mode two knowledge (applied research) and mode one science (basic research) (Schauz, 2014).

According to Shauz (2014) and Calvert and Martin (2001), there is a proliferation of interchangeable terms that are used to describe the term basic research and that such terms may or may not mean the same thing. For instance, Gibbons et al (1994) referred to it as mode 1 science; Nowotny, Scott, & Gibbons, (2003) called it pure or blue skies research; Karagianis (2014) and Ylijoki et al (2011) described it as curiosity-driven research; Bentley, Gulbrandsen, and Kyvik (2015) portrayed it as fundamental research; whereas Hakala and Ylijoki (2001) branded it theoretical knowledge. In a related study that sought the views of 50 scientists and policymakers regarding the meaning of the term basic research, Calvert and Martin (2001) found out that majority of the interviewees used multiple criteria to define basic research. They concluded that "most scientists do not have one clear idea about what basic research is, but that they draw on many different features when describing the term" and that "the diversity of ways in which basic research is defined shows that it is ambiguous and has different meanings for different individuals and that it can potentially incorporate a range of different characteristics" (p. 3).

Despite the myriad of terms used around the term basic research, a number of scholars construe it in terms of research initiatives relating to research projects that are aimed at the general advancement of knowledge without specific commercial objectives and immediate application (Bentley et al, 2015; Mouton, 2010; Henard & McFadyen, 2005; Nowotny et al., 2003; Ziman, 1996; Gibbons et al. 1994). To Schauz (2014), the above definition of basic research is not only averse to technology and application; it is also akin to the concept of pure science.

The idea of pure science is associated with the Ancient Greeks, for whom basic research was associated with social status and the quest for knowledge was valued "for its own sake" (Calvert & Martin, 2001). When universities in Europe and the US finally emerged, they incorporated the notion of pure research (Stokes, 1997) cited in Calvert and Martin (2001) and it remains an important element of the contemporary understanding of the term basic research (Schauz, 2014; Etzkowitz, 2003; Ylijoki, 2003). Because pure science or knowledge produced "for its own sake" is not meant for application, it is theoretical and largely seen as a means of enabling the researcher to be recognised by the international scholarly community. In addition, pure science is driven by the values of academic freedom, disinterestedness, a curiosity-driven choice of research topics, individual scholars' priorities and interests and the desire to advance their career (Mouton, 2010; Hakala & Ylijoki, 2001). In addition, publication in refereed journals is highly valued because publications are the basis of the researchers' statuses and academic promotion (Slaughter & Leslie, 1997). One of the more obvious consequences of pure science is that it does not have much influence on society (Zeleza, 2002). This resonates with Mouton's (2010) submission that pure research results into, among others, fragmentation of effort as opposed to interdisciplinary research and lacks rigour in methodology.

In accordance with the above, it can be discerned that the tendency to project basic research as pure science implies engagement in knowledge production without thought to practical ends. However, Schauz (2014) asserts that the tendency to do so contradicts the original understanding of the term. He maintains that basic research was originally understood in the context of application. This particular position is backed up by Henard and McFadyen (2005) who in their complementary view of basic research held that when investment in basic research interacts with investment in applied research, there is improvement in an organisation's performance. The above views cohere with Rosenberg's (1990, cited in Henard & McFadyen, 2005) contention that investment in basic research can be justified if organisations view the nexus between both types of research as complementary.

The above conceptualisations of basic research agree with that of Irvine and Martin (1984 cited in Bentley et al., 2015) who described basic research as strategic research, arguing that pure knowledge is produced with the hope that it will yield a broad base of knowledge likely provide a basis for applied research. Woolf's (2008) also shared many of the above characteristics when he argued that harnessing basic research supports practical uses, particularly within the health sciences. Compliant with the above and in agreement with Schauz (2014), it is clear that to some scholars, engaging in basic research implies laying a cornerstone for future technologies or new products. The idea that basic research is a trigger that generates original knowledge that solves big problems, and underpins applications was also supported by Karagianis (2014). The contemporary understanding of the term basic research, therefore, shows that because of developments in the knowledge economy, there is a redefinition of the term basic research to reintegrate application goals into it.

It is therefore obvious that the term basic research orientation is understood differently in literature. To one group of scholars, basic research has no application and the growing market orientation implies a radical discontinuity and break between basic and applied research (Nowotny et al., 2003; Gibbons et al. 1994; Ziman, 1996). To them, as summarised by Nowotny et al (2003), "the research that is variously described as "pure", "blue-skies", "fundamental", or "disinterested", is now a minority preoccupation—even in universities'' (p. 184). They also share Gibbons et al.'s (1994) contention that Mode 2 science, produced for practical purposes, has become the dominant form compared to academic-oriented, disinterested, disciplinary and autonomous research (Mode1) that is produced within universities (Mode 1).

Other scholars, however, opine that basic research should be understood in the context of application; continuity rather than rupture expresses the relationship between the basic and applied research orientations; and that applied science did not replace basic research but rather supported and grew alongside it (Schauz, 2014; Henard & McFadyen, 2005; Slaughter and Leslie, 1997; Clark, 1998; Rosenberg, 1990 cited in Henard & McFadyen, 2005). Seen in this light and in line with Stokes (1997 cited in Calvert & Martin, 2001) who introduced the category of "use-inspired basic research", basic research may be pursued for some very practical concerns. Moreover, as observed by Calvert and Martin (2001), the history of funding of basic research from the 1950s reveals a drift from the idea that scientists should be supported as autonomous truth-seekers towards the idea that they should orient basic research rather more toward social and economic objectives to enhance its relevance.

It is therefore clear that although the term basic research is commonly used, there is no agreement on its meaning. As such, calls for clarity of what actually constitutes basic research have been persistent in literature (Schauz, 2014; Calvert 2000; Calvert & Martin, 2001). Questions that related to whether basic research should be defined as research that underlies other types of research; or as research that is guided purely by the curiosity of the researcher; or as research that is generated for publication and dissemination to the community of scholars are an enduring phenomenon.

Conceptions of Applied Research

Governments, research funders, development partners and other stakeholders are putting universities under enormous pressure to justify the relevance of the knowledge they produce (Cherney et al., 2015; Ylijoki et al., 2011). Because of this demand, applied research is increasingly becoming significant. Customarily, within many flagship universities, the focus has been on the production of knowledge that satisfies the academic market (i.e., scientific community) via traditional research outputs such as journal articles, edited books, book chapters, monographs, and conference papers. However, the focus seems to have expanded to now include the production of knowledge to satisfy other research markets such as the corporate, the policy, and public markets. As such, the culture of engaging in applied research (mode 2 Science) has gained traction within universities.

There is scholarly consensus that applied research is associated with commercially oriented research (Etzkowitz & Leydesdorff, 2000; Lam, 2010); policy-relevant research (Jacob, 2006; Nisbet & Huge, 2006; Jacob & Hellstrom, 2000); and Community-oriented/social-problem research (Hakala & Ylijoki, 2001; Ylijoki, 2011).

Commercially-oriented/entrepreneurial research

Entrepreneurial research is done for application, mainly the generation of new products that have market value and through which it is possible, through spin-off firms to make profit (Clark, 2004; Hakala & Ylijoki, 2001).

This type of knowledge is commercial and the research aims at satisfying the needs of potential customers. As such, the quality of this type of research is determined by the market forces (Ylijoki et al., 2011). This type of research that satisfies the corporate market is variously referred to as entrepreneurial research (Ylijoki et al, 2011; Hakala & Ylijoki, 2001)

Relating to the conceptualisation of entrepreneurial research among higher education scholars, varied conceptions have been reported in literature. These conceptions relate to whether the growing entrepreneurial orientation has entirely replaced the Mertonian imperatives of science or not and whether it has not followed a path which has seen the decrease of Mertonian science. To Crespo and Dridi (2007), the growing entrepreneurial orientation implies breaking free from the traditional ivory tower image of academic science to a state where the relevance of academic research can be enhanced. This kind of thinking owes its roots to the mode 1 and mode 2 science thesis introduced by Gibbons et al (1994) and the notion of the triple helix by Etzkowitz & Leydesdorff (2000) in which they held that basic research is giving way to entrepreneurial research which is problem-oriented, transdisciplinary, externally financed, done in the context of application and assessed by social and economic utility.

However, scholars like Ziman (1996) and Slaughter and Leslie (1997) perceived the increasing entrepreneurial orientation with skepticism. Ziman (1996) for instance argued that replacing the Mertonian imperatives of science such as academic freedom, communism, universalism, and disinterestedness with market-driven norms of proprietary, commodification, secrecy, and authoritarianism suggests that academic research progressively looks like industrial research that private goods instead of producing the common good and publicly available knowledge. Equally, Slaughter and Leslie (1997) were somewhat skeptical about the benefits of the entrepreneurial research orientation. They contended that this orientation to academic research meets the interests of those academic disciplines that are close to the market, such as technology and engineering.

There are also varied conceptions among higher education scholars regarding the trajectory followed by the entrepreneurial orientation. Whereas scholars like Albert (2003), Ylijoki (2003), and Lam (2010) argued that this orientation has not followed a path which has seen the decrease of mode 1 science, others like Feldman and Desrochers (2004) and O'Shea, Allen, Chevalier, & Roche (2005) insisted on an entire shift from mode 1 to mode 2 science. For instance, in a study of two Canadian universities in which two cohorts of professors were studied, Albert (2003) found out that entrepreneurial research fields conformed more to the knowledge demands of the scientific community than to those of non-academic actors. However, Feldman and Desrochers (2004) found out a dissimilar situation in US universities. Their study of academic culture and technology transfer indicated that entrepreneurial research in American research universities is dominated by hard applied disciplines (technology & medicine) and presents an entire shift to mode 2 science since this is seen as a source of technical advance for industry. They concluded that even with those universities that were founded on an academic vision, the interests of technology transfer increasingly shaped that culture. These findings cohere with those of O'Shea et al (2005) who in a study of the entrepreneurial orientation, technology transfer and spinoff performance of U.S universities found out that entrepreneurial research in most US universities follows a path which has seen an entire shift from the basic to the entrepreneurial orientation.

Surprisingly, Ylijoki (2003) found out that although Finnish universities are immersed in entrepreneurial research as a response to the decrease in research funding, the increasing entrepreneurial orientation hardly displaces traditional academic practices, values, and ideals as researchers try to accommodate them to entrepreneurial activities. Similarly, Lam (2010) found out that academic scientists in the UK research universities actively seek to shape the relationship between science and business by ensuring that as they engage in mode 2 knowledge production, they at the same time seek to protect and negotiate their positions, and also make sense of their professional role identities.

All in all, the above empirical studies and scholarly views yield conflicting results regarding the conceptualisation of the entrepreneurial research orientation. At one extreme, study findings and scholarly views show that the entrepreneurial research orientation is so strong that it has replaced the Mertonian imperatives of science with market-driven norms of proprietary, and commodification (Crespo & Dridi, 2007; Etzkowitz & Leydesdorff, 2000; Feldman & Desrochers, 2004; O'shea et al, 2005). At the other end of the continuum, the entrepreneurial orientation is not only perceived with skepticism, its power is regarded as much more restricted, thus leaving space for both the survival and applicability of traditional academic values (Ziman, 1996; Slaughter & Leslie, 1997; Albert, 2003; Ylijoki, 2003; Lam, 2010).

The above studies are lauded for highlighting the implications of the entrepreneurial turn to research-led universities. However, their focus is on European and American universities. The need for a study meant to deepen and refine our understanding of the same in the Sub-Sahara African context is long overdue.

Policy-relevant research

This type of research is used to generate knowledge for policymaking. The audience for the research is usually governmental for which researchers collect and analyse data concerning some acute societal problems (Hakala & Ylijoki, 2001). This research is applied or problem-oriented and its aim is to produce information for the needs of governance and administration.

The growing importance of policy-relevant research derives from the recognition that scientific knowledge and policy are interwoven in the most inextricable terms (Ezrahi, 1990; Jasanoff, 1998; Gornitzka & Sverdrup, 2010;

Jacob, 2006; Nisbet & Huge, 2006). As argued by Gornitzka and Sverdrup (2010) academic research is indispensable for informed policymaking in a number of ways. For instance, it can serve as an instrument for problem-solving where scientific knowledge has a direct and decisive impact on the choice of a solution to a specific policy problem (Gornitzka & Sverdrup, 2010), it can contribute to the epistemic quality of decisions, and it can legitimise policy positions (Ezrahi, 1990; Jasanoff, 1998). The above observations fit well within the submissions made by Nisbet and Huge (2006) that academic research serves both a policy substantiating and a policy legitimising role; can provide competence and information on the feasibility and different effects of various policy initiatives; and can be an agenda-setter when scientific discovery unveils conditions that inform salient policy issues.

Conceptualisations of how academic science and policy relate have been explained in literature with help of social science models. Thus, despite the criticism by scholars such as Jacob and Hellstrom (2000), Hajer (2003) and Jacob (2006) that the social science school neglected the influence of other forms of scientific knowledge (such as natural and technical science) on policy, the contribution of this school in shaping our understanding of the connection between scientific knowledge and policy has been acknowledged in extant literature. Proponents of the social science school (Weiss, 1979, Casswill & Shove, 2000; Jacob, 2006; Lemos & Morehouse, 2005; Voss, Greene, Post & Penner, 2008; Weiss, Kinney, & Hurst, 2015) have attempted to articulate the research-policy nexus using the knowledge-driven/utilisation model, the problem solving model; and the interactive model.

According to the knowledge-driven/utilization model, social science research can and should be the founding principle of social policy (Weiss, 1979). Knowledge utilisation is conceptualised as linear, i.e. knowledge is produced in universities after which it is disseminated and then taken up by policy-makers. The model considers policymakers as passive consumers of scientific research and as such operates on the principle that knowledge is produced first and then the researcher figures out how and why policy-makers or others use this knowledge (Casswill & Shove, 2000). In this model that is akin to disciplinary mode one form of knowledge production, the research antedates the policy problem and is drawn in on need (Weiss, 1979, Weiss et al., 2015). This model assumes efficiency in the communication links for scientific knowledge to reach the policy maker or the person with the problem (Weiss, 1979). However, with the rise of the triple helix system by Leydesdorff and Etzkowitz (2000) and its focus on the tripartite coalition between three actors as equal partners in the production of knowledge i.e., university, industry, and government, the knowledge-driven model seems to have lost its lustre (Jacob, 2006).

Another social science model that shaped the understanding of policy-oriented research is the problem-solving model. Popularised by Weiss (1979) and later amplified by Voss et al (2008), this linear model holds that a policy problem exists and a decision has to be made through research to provide the missing knowledge that is needed to solve that problem. When the knowledge gap is filled, a decision is reached. In this formulation of research utilisation in policy, the problem ante-dates research and then social science researchers are called upon to provide the missing knowledge (Weiss, 1979). Policymakers faced with a decision may go out and search for information from already existing published research to identify a promising policy response (Voss et al., 2008). Pre-existing researched information may be found in newsletters, newspapers, magazines or at conferences. However, although Weiss (1979) warned that "the problem to research to policy decision route" taken by this model could have an element of chance, I contend that the model is a notch better than the knowledge-driven approach because it generates scientific knowledge that is focused to prior identified policy problems.

Like the knowledge-driven model, the problem-solving model has been faltered on two accounts. First, for failing to close the gap between scientific knowledge and policy due to its inability to bring academic scientists and policymakers and practitioners into dialogue to ask questions and search for solutions collectively (Latour, 1998). Second, for failing to provide an understanding of how scientific knowledge from basic disciplines like natural sciences influence policy (Jacob, 2006). Yet according to Hajer (2003) and Jacob and Hellstrom, (2000) concern with understanding how all types of scientific knowledge influence policy have obscured academic interest in policy utilization of social science knowledge. Indeed as Ranius, Rudolphi, Steins, and Marald (2017) observe, natural scientists have been conditioned to oscillate between two directions: the scientifically oriented direction and the policy-oriented direction. As they immerse themselves in the pursuit of pure scientific knowledge, they endeavour to embrace external values and pay attention to the potential use of basic science (Ranius et al., 2017). This perspective of science-policy interaction that is emphatic on the importance of maintaining a focus on societal relevance of both basic and applied research represents the contemporary view (Ranius et al., 2017).

It was in view of the above weaknesses that the contemporary social science model i.e., the interactive model emerged. This model is associated with scholars like Haas (1992); Lemos and Morehouse (2005); and Jacob (2006). Inspired by the triple helix narrative and the mode 2 thesis that was proposed by Gibons et al (1994), this model operates in a more interactive transdisciplinary way and holds that instead of policymakers being passive users of scientific knowledge, they should collaborate with scientists to produce knowledge for policy and that the resulting networks of academics and policy practitioners may be seen as epistemic communities (Jacob, 2006). Epistemic communities are defined as ''networks of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area" (Haas, 1992, p. 3).

The interactive model, therefore, promoted the idea that for scientific knowledge to effectively inform policy, interaction between academic science and policy must be seen as a co-production of knowledge and policy rather than dissemination of knowledge from science to policy (Jacob, 2006). Co-production of knowledge engages researchers, funding agencies, and user groups into interaction throughout the entire research process, including during the definition of the research agenda, project selection, project execution and the application of research insights (Lemos & Morehouse, 2005).

The above shift in perspective implies that instead of producing knowledge and then figure out how and why policy-makers or others use this knowledge, there is a need for the research community to be more concerned with recruiting user groups into the process of knowledge production (Casswill & Shove, 2000). This supports Bogelund's contention (2015) that the context within which scientific knowledge is created has entered the realm of social constructivism, in which knowledge is no longer true per se; it is a product created through a reassuring process where several actors cooperate to create growth and profit. Bogelund's contention coheres with Hajer's argument (2003) that more than before, solutions for pressing policy problems cannot entirely be found within universities because they often lack the powers to deliver policy-relevant research alone. Jasanoff (1998), guided by the social construction model contend that in order to close the gap between scientific research and policy, there is a need to involve knowledge users in the production of scientific knowledge.

The above scholarly views conform to Gornitzka and Sverdrup's (2010) conclusions in their study of the role of scientists in EU governance, that the pattern of participation by academic scientists in the different stages of the policy cycle did not support the contention that EU decision making is hijacked by academic science in the sense that they are the exclusive providers of information. Gornitzka and Sverdrup's study however recognised academic scientists as a significant group of actors in the policy-making discourse.

As authors amplify the effectiveness of the interactive model in bridging the knowledge-policy divide, they at the same time call attention to the many constraints faced by practitioners of interactive research such as: dissimilar cultures between scientists and policymakers, loss of academic freedom, organization of research environments, and the dangers of interdisciplinary versus disciplinary approaches (Weiss, 1979; Gibbons et al., 1994; Lemos & Morehouse, 2005; Weiss et al., 2015). Wolgar (2000) advises that the above dangers can be minimised by appreciating the values of methodological efficiency, egalitarianism, and accountability. ''Methodological efficiency'' stresses that when the recipients of research are engaged, more data, information, and, feedback are provided, which, in turn, results into better research. According to the ''egalitarian ideal'', there is an added political-moral imperative in engaging recipients of scientific knowledge, in that the benefits of research need to be shared with those who have assisted in their formation. Finally, the ‘‘imperative of accountability’’ ‘‘demands that publicly funded research demonstrate an account of its value in terms of a return on the original investment’’ (Wolgar, 2000, p. 166).

Other methods of tailoring scientific knowledge to policy that have been suggested in literature include: use of more direct and organic channels of communication involving relationship building and regular contact between researchers and policymakers (Best & Holmes, 2010); dissemination through research events where researchers actively engage policymakers (Phipps, Cummings, Pepler, Wendy, & Cardina, 2016); use of multi-skilled knowledge brokers as go-betweens to facilitate collaboration between researchers and policymakers (Gagnon, 2016); use of social media platforms such as Instagram and Twitter because they are fast, cost-effective, reach a wider audience, and create the potential for future research collaboration (Katy, Nigel, Fiona & Ruth, 2016; Phipps et al., 2016); and on-going dialogue with policymakers in choosing research topics and distributing research papers and newsletters to key policymakers (Gagnon, 2016; Cherney et al., 2015).

From the above, it is evident that the use of multiple interactive engagement strategies to enhance research use in policy could bridge the research-policy gap. However, institutional and disciplinary rewards for interactive engagement are found to be either lacking or inadequate due to the preoccupation with traditional models of measuring scientific impact such as citations, conferences, publications in high impact journals, and awards for special accomplishments (Bornmann, 2012).

All in all, it is clear from the above foregoing that engagement and co-production of knowledge is the ultimate panacea when it comes to bridging the research-policy divide. It improves the quality of decision-making and increases the likelihood that policy formulation and implementation will be more legitimate, effective and efficient. I, therefore, argue, in line with Phipps et al and Gibbons et al that scientific knowledge becomes more relevant to policy if it is co-produced in the context of everyday interface between scientists and policymakers. Indeed, as Latour (1998) suggests, there is a need for university scientists to come together to ask questions and search for solutions collectively. However, as Lemos and Morehouse (2005) observe, many of the influential studies on the use of academic research in policymaking have focused on the dichotomy between science produced for policy (applied research) and science grounded in research alone (basic research). Besides, such studies relate to systems in the developed world and as such, the extent of their applicability in the context of the developing world and Sub-Saharan Africa, in particular, deserves more attention.

Community-oriented /social-problem research

In addition to carrying out research for academic, commercial, and policy-making purposes, there is need to demonstrate societal relevance of scientific knowledge by producing practical knowledge to improve society and the prevailing practices (Hakala & Ylijoki, 2001; Ylijoki, et al., 2011). As such, research satisfies civil society and the lay people (i.e., the public market) and provides instruments for them to understand society and to better command their lives. The core motivation force to do research is to produce knowledge that could increase people's well-being and level of awareness, thereby promoting empowerment (Ylijoki, et al., 2011). This type of research is anchored in the “mode 2” thesis and the “quadruple helix” model in which civil society constitutes a “fourth partner” for cooperation (in addition to the university, industry, and government) and in which the role of the local population in innovation and economic development is recognized. This review intends to present existing research on the key conceptions of the construct of societal relevance of scientific knowledge as it pertains to the civil society research orientation.

Academic scientists are increasingly being tasked to demonstrate the societal impact of their scientific work (ERiC, 2010). However, due to variability and the complexity of evaluating the societal impact of research, scholarly perceptions of the subject vary considerably (Bornmann, 2012). No wonder, a chain of dissimilar terms are in use: “societal benefits” or “societal quality” (van der Meulen & Rip, 2000), “public values” (Bozeman & Sarewitz, 2011), “third-stream activities” (Molas-Gallart, Salter, Patel, Scott, Duran, 2002), “usefulness” (Department of Education Science & Training, 2005), “societal relevance” (Holbrook & Frodeman, 2011), “nonacademic impact” (Sandberg, 2012), “broader impact” (ARC, 2012) and “knowledge transfer” (van Vught & Ziegele, 2011). Yet, each of these terms ultimately focuses on evaluating the social, cultural, environmental and economic benefits from publicly funded research (Bornmann, 2012). Thus, in this review, I use the terms societal relevance, societal impact, nonacademic impact, and broader impact interchangeably.

Different scholars, research communities, academic disciplines, and research institutions have evolved different conceptions and definitions of societal relevance of research and how it is measured. According to ERiC (2010) (a Dutch research evaluation project), relevance is defined in retrospective and prospective terms. Retrospectively, societal relevance is defined by the degree to which research contributes to and creates an understanding of the development of societal sectors and practice (such as industry, education, policymaking, health care) and the goals they aim to achieve, and to resolving problems and issues (such as climate change and social cohesion)” (ERiC, 2010 p. 10). Prospectively, societal relevance is defined by “a well-founded expectation that the research will provide such a contribution in the short or long term” (ERiC, 210 p. 10). As such, the retrospective definition alludes to what the research has yielded in terms of specific societal contributions and effects whereas the prospective delineation makes reference to the expectation that the research will eventually be able to yield such contributions. Underlying the prospective meaning of societal relevance is the notion that the relevance of some research to society (such as basic research) may not immediately become visible. However, evidence of relevance should be apparent in the interaction between research groups and stakeholders (ERiC, 2010). The challenge for universities is to ensure that basic research meets the prospective criterion.

Sandberg (2012) defined societal relevance of research as the value research provides to the community in form of economic, social, environmental and cultural impacts as a result of engagement in applied or basic research. HEFCE (2011) looked at societal relevance as all the diverse ways in which knowledge and skills generated through research benefit individuals, organizations and nations by fostering global economic performance, increasing the effectiveness of public services and public policy, and enhancing the quality of life, health, and creative outputs. What is demonstrably clear in HEFCE's definitions is that it downplays the societal relevance of basic research because its actual effects on society are not immediately visible. On that premise, I take ERiC's definition in which societal relevance of research is described in retrospective and prospective terms. I recognise, in accordance to previous studies (Calvert & Martin, 2001; Bornmann, 2012; Sandberg & Faugert, 2012; Molas-Gallart et al., 2002) that assessment of societal relevance of research will always need to pursue a holistic approach which examines a number of channels that bind research to the rest of society. Furthermore, I acknowledge, in line with Sandberg (2012) that like applied research, basic research has societal impact although this is more complex to evaluate. I also agree with Bornmann's contention (2012) that societal impact can be anticipated and unanticipated.

Research into broader impact is still nascent in the field of higher education (Boshoff & Esterhuyse, 2016). For long, the only aspect of interest when measuring relevance was the impact of research on academia and scientific knowledge. The belief was that society could derive the most benefit from science conducted at the highest level (Bornmann, 2012). As such, the focus has been on scientific impact assessment that heavily relies on web-based databases such as Scopus by Elsevier and the Web of Science by Thomson Reuters which serve as readily-available sources for calculating the necessary indicators of scientific impact and does not require collection of primary data (Boshoff & Esterhuyse, 2016). Thus, methods to assess scientific impact are already in place. Among others, they include counting publications in high impact journals and tracking the number of citations in scientific literature using the journal impact factor and citation rates (Bornmann, 2012; Tijssen, 2007).

However, from the early 1990s onward, because of dwindling public funding of higher education research, academic science was compelled to account for its accomplishments in the form of societal relevance (ERiC, 2010; Bornmann, 2012; Van der Meulen, Rip, 2000). The scope of research impact assessment became broader as the societal products (outputs), societal use (societal references), and societal benefits (changes in society) of research came into scope (van der Meulen, Rip, 2000). Today, changes in the societal role and position of science have ensured a more direct demand for relevant knowledge, which has been theorized in concepts such as "mode2 knowledge production", or the "triple helix" or "quadruple helix" (Gibbons et al., 1994; Etzkowitz & Leydesdorff, 2000; Hessels & Van Lente, 2009).

At present, what stakeholders expect are measures of the relevance of science on, for example, human lives and health, on industry, on education, on social cohesion, on organizational capacities of firms, institutional and group behaviour, and on the environment. However, Bornmann warned that it is not easy to separate the above areas of societal impact from one another (Bornmann, 2012). Along this line, Salter and Martin (2001) shared that there is an unclear boundary between economic and noneconomic benefits of research. They wondered whether a new medical treatment that improves health and reduces the days of work lost to illness is an economic or social benefit (p. 510).

Stakeholders have been described in the SIAMPI approach as "anyone who takes part in the iterative process that induces the results of research into social impact" (SIAMPI, 2011, p.6). Three broad groups of stakeholders for societal impact have been identified by Spaapen, Dijstelbloem, and Wamelink (2007). These groups that are seen as critical in enhancing productive interactions between academic science and society and in hastening the production of knowledge that is socially robust (Barre, 2005) are: professional users (profit and nonprofit) such as industry and societal organizations that want knowledge to develop products and services; policymakers at the intermediary or government level, who want to use research for policy formulation or to facilitate the transfer of knowledge from science to society; and, end users i.e., the public at large or individual target groups.

Thus, as opposed to "mode 1" where the scientific community is the only stakeholder for research impact, "mode 2" has ushered in the perspective of sociology of science that is insistent on utilitarian values of academic science (Bornmann, 2012). Accordingly, collaboration (among academic scientists and between the scientists and other stakeholders), transdisciplinarity (several disciplines simultaneously studying a real-world problem), and (basic) research conducted in the context of application for the users of the research have become the preoccupation of universities.

Consistent with the above and as held by Boshoff and Esterhuyse (2016); Bornmann (2012), and Sandberg (2012) it is apparent that within the civil society research orientation discourse, the concept of productive interaction between stakeholders is vital in optimising societal impact of research. The existence of productive interactions between research groups and stakeholders has been found to positively correlate with societal impact (Boshoff & Esterhuyse, 2016; Spaapen & Van Drooge, 2011; ERiC, 2010).

That is why Bornmann was categorical in his submission that: "whenever the interaction between stakeholders and scientists is highly productive and professionalised, this generally also results in societal impact. So, scientists do not transfer the knowledge that they generate themselves; rather, societal impact happens on the basis of iterative processes among researchers and research stakeholders" (p. 226). Such interactions can take place during the definition of the research agenda, during the conduct of research, or during the dissemination of research findings (ERiC, 2010).

According to the ERiC project, productive interaction takes place through one-on-one contact, for instance in joint projects, consortiums, consultancy relationships, networks, part-time practitioner work; stakeholder input into the group's research agenda; publications such as papers in journals, reports, protocols and educational material; artefacts, such as exhibitions, software, websites, models, musical scores; and stakeholder contributions to the research such as financial, direct involvement, or facility sharing. The above forms of productive interaction are in tandem with those suggested by Spaapen and Van Drooge (2011) that involve direct personal connections i.e., face-to-face contact or interactions over the phone, email or video-conferencing in meetings, conferences, and chance encounters; indirect encounters in which contact is facilitated by materials such as articles, reports, guidelines, codes of practices or individuals who act as go-betweens; and financial interactions in form of economic exchanges between researchers and stakeholders that usually take the form of research contracts or financial contributions. Similar forms of interactions were suggested by Bornmann (2012). However, broader impact can only occur with at least one of the three kinds of interactions between researchers and stakeholders being present. It, therefore, appears that awareness of productive interactions is needed in order to conduct an assessment of societal impact.

Measuring societal impact within the civil society research orientation basically tracks the productive interactions between the researchers and stakeholders in order to determine which of these interactions can be deemed productive (Boshoff & Esterhuyse, 2016). Productive interactions, in this case, are those interactions that bring about behavioural change, uptake and use in the stakeholder domain. However as already observed, societal impact is much harder to evaluate than scientific impact because methods of assessing societal impact are yet to be developed. Besides, societal impact of research often takes longer making it difficult to identify the connection between a certain piece of research and a certain impact (Bornmann, 2012). As such within this research orientation, societal impact assessment has been differently conceptualised.

One of the major methodological conceptualisations of assessing societal impact of research today are case studies that generally feature as cases of success stories (Bornmann, 2012; Martin, 2011; Denovan, 2008). Case studies have been recognised by the Higher Education Funding Council for England (HEFCE) as a means to review narrative evidence supported by appropriate quantifiable indicators (Bornmann, 2012). Examples of studies that have carried out societal impact measurement include the SIAMPI project (Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions between science and society developed by Jack Spaapen and his colleagues as part of the Seventh Framework Programme of the EU) and the Dutch research evaluation project-ERiC (Evaluating Research in Context).

Case studies have been used in many studies to capture health impacts, economic impacts, and climate impacts. No wonder, universities are increasingly adopting case studies to assess societal impact of their research by communicating their research successes to stakeholders such as civil society, funders, industrialists, policy makers, and the wider public (Chikoore, 2016). Chikoore argues that for universities, case studies provide better results when it comes to assessing broader economic and societal impact of research as they are capable of capturing information on both reach and significance that are required for evaluation.

The case study method has however been criticised for being labor-intensive and a craft rather than a quantitative activity (Bornmann, 2012). What is more, case studies are often undertaken long after the research has been concluded, resulting in attribution problems (Chikoore, 2016). Nevertheless, they appear to be a more popular approach of measuring societal impact within the civil society research orientation (Bornmann, 2012). Case studies are considered "the 'state of the art" for providing the necessary evidence-base for increased financial support of university research across all fields (Donovan, 2011). Holbrook and Frodeman (2011) also support the use of case studies; they contend that although labour intensive, case studies appear to be a better alternative of measuring broader research impact.

Other methodological conceptualisations of measuring societal impact in the civil society research orientation manifest in form of econometrics and survey techniques (Bornmann, 2012). The use of econometrics was premised on the notion that scientific knowledge is meant to enable a country to generate wealth. Thus, the measurement of impact was based on economic measures using techniques such as Payback period and Internal rate of return (IRR) to determine the return on investment in research (Donovan, 2008). Although econometrics are simple to use while monitoring and benchmarking and appear to be more objective because they are not affected by people's opinions and bias (Alun & Liam, 2014), they are too data dependent implying that their effectiveness depends on the quality of the data collection techniques used (Jones, 2011). On the other hand, survey techniques make less use of economic and financial variables as compared to econometrics. Although they have been used as an alternative (Bornmann, 2012; Donovan, 2011), their "broad-brush" approach of attempting to cover all situations has been criticised by Buxton, Hanney, Packwood, Roberts and Youll (2000, p.32) who instead opt for case studies because they believe case studies provide the best opportunity of capturing broader impacts of research projects.

However, despite the importance attached to societal impact assessment, the exercise is beset with challenges that relate to time lag, attribution, and context (Morton, 2015). Unlike academic impact which can be tracked through citation, attribution of broader impact is difficult due to a complex set of interactions between multiple institutions and stakeholders (Donovan, 2011, Oanacea, 2013). Because impact occurs over a long time period, follow up is either too soon before the impact has happened or too late when researchers and end-users have vague recollections (Donovan, 2011). Impact assessment also becomes difficult because of the limited understanding of the context or changes in the context of research use (Morton, 2015).

Likewise, according to Bornmann (2012), the following problems are associated with societal impact measurements. These are: 1) the causality problem which relates to "lack of clarity regarding which impact should be attributed to which cause"; 2) the attribution problem which arises "because impact can be diffuse or complex and contingent, and it is not clear what should be attributed to research or to other inputs"; 3) the internationality problem that arises "as a result of the international nature of R&D and innovation, which makes attribution virtually impossible"; and 4) the timescale problem that occurs "because the premature measurement of impact might result in policies that emphasize research that yields only short-term benefits, ignoring potential long-term impact" (p. 674).

The above notwithstanding, the production of knowledge that has research impact is at the centre of universities' strategic directions (Alun & Liam, 2014). For instance, Makerere University makes reference to (research) impact in its current strategic plan (Makerere University, 2008 p. 26). Internationally, many universities are metamorphosing from being discipline centred to being transdisciplinary by opening up academic disciplines to actors outside the academic world so as to increase research impact (Wernil & Darbellay, 2016). In conjunction with system critical knowledge users (such as vendors, funders and policymakers), universities are developing research information management systems (RIMS) to enable them to gather, store and submit research impact records to the national evaluation bodies (Ferdorciow & Bayley, 2014).

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