Mode 3 Theories in Higher Education: Potential Modalities of Emerging University-Society Engagements, Teklu Abate Bekele, The American University in Cairo, Egypt

Abstract

Knowledge has been an organizing logic and one of the major functions of universities since their establishment. Contemporary developments in society and economy seem to bestow even more 'currency' to knowledge than ever before. Knowledge production chiefly dictates international university rankings, national science policy making, funding and quality assuring regimes worldwide. The quantity and quality of knowledge production and dissemination seems to justify the social significance and relevance of higher education to national development. The mode of knowledge production is but as varied as it is prolific. Conceptually driven studies could broadly be classified into four non-exclusive and non-exhaustive major strands: Disciplinary cultures, professional cultures, Mode 2, and epistemic cultures. While higher education researchers continue 'experimenting' with Mode 2 perspectives and epistemic cultures, the emergence of Mode 3 knowledge production is proclaimed. Analytical frameworks (mentioned in the literature as theories) which claim to align within Mode 3 thinking are developed. Our understanding of how and to what extent Mode 3 theories are distinct from each other, and from Mode 2 and epistemic cultures with regard to particular knowledge production parameters is however unclear. Work that features the possible commonalities and differences among Mode 3 theories, and Mode 2 and epistemic cultures is needed, as it can leave implications regarding the social relevance and significance of higher education to socio-economic development. To partly address this knowledge gap and then to better inform future research, this configurative review aims to map out the conceptual contours of Mode 3 theories in comparison with Mode 2 and epistemic cultures using particular parameters. It examines whether there is cultural convergence, divergence, or emergence within Mode 3 theories, and among Mode 3, Mode 2 and epistemic cultures. In this study, culture as in cultural convergence, divergence, and emergence draws on definitions from epistemic cultures and disciplinary cultures to refer to the socio-cultural, technological, material, methodological, and epistemological features or dimensions of knowledge production. It includes academic norms, traditions, expectations, and other conditions that affect knowledge production.

Keywords: mode 3 theories, university-society engagements, higher education

Introduction

Knowledge production has been an organizing logic (Clark, 1983) and one of the major functions of universities (Castells, 2001) since their establishment. Contemporary developments in society and economy seem to bestow even more 'currency' to knowledge than ever before (Breton, 2003; Carnoy, 1999; Castells, 2000; Gibbons, 2003; Gibbsons et al., 1994; Knorr Cetina, 2007; Petrella, 2003; Salmi, 2003; Scott, 2003). Knowledge production chiefly dictates international university rankings, national science policy making, and funding and quality assuring regimes worldwide. The mode of knowledge production is but as varied as it is prolific. Conceptually driven studies could broadly be classified into four nonexclusive and non-exhaustive major strands. One, the hitherto common approach takes *disciplinary*

cultures as 'looking glasses' (e.g. Becher, 1987/1994; Biglan, 1973; Böschen et al., 2006; Clark, 1987/1984/1980, Holland, 1997; Kastenhofer, 2007; Kekale, 2002; Knorr Cetina, 1999; Lattuca & Stark, 1994; Paulsen & Wells, 1998; Stark et al., 1986; Smeby, 1996/2000). Gibbons et al. (1994) dubbed the disciplinary line of knowledge production as Mode 1. Within the general context of Mode 1, the theory of academic capitalism and the new economy explains emerging market-like behaviors in higher education (Slaughter & Rhoades, 2004). Two, other studies consider primarily *professional cultures* (e.g. Eraut, 1985; Hoholm et al., 2004; Jensen, 2007; Karseth & Nerland, 2007; Lindblad et al., 2007; Lindblom-Ylänne et al., 2006; Lueddeke, 2003; Mørk et al., 2008; Nerland, 2008; Stark, 1998).

Three, Mode 2 is presumably the *emerging* mode and claims to sufficiently consider global and national 'forces' that affect knowledge production in an age of globalization (Gibbons et al., 1994; Nowotny et al., 2001/2003; Marton, 2005). Mode 2 purports to reflect "changes in the relationship between science and society and a change in the societal role of science" (Kastenhofer, 2007, 364) and it is considered *complementary* to Mode 1 (Gibbons et al., 1994).

Four, Knorr Cetina's (2007) works on epistemic cultures, knowledge cultures, and macro epistemics seem to 'appropriate' disciplinary cultures. Knorr Cetina maintained that an epistemic culture replaces disciplinary culture to "amplify the knowledge machineries of contemporary sciences until they display the smear of technical, social, symbolic dimensions of intricate expert systems" (1999, 3). Epistemic cultures 'embody' disciplinary and professional cultures and reflect recent developments in science and society (Knorr Cetina, 2007). This research strand is also emerging alongside Modes 1 and 2.

While higher education researchers continue 'experimenting' with Mode 2 perspectives and epistemic cultures, the emergence of Mode 3 knowledge production is proclaimed. Analytical frameworks (mentioned in the literature as *theories*) which claim to align within Mode 3 thinking are developed.

Sandstrom (2014) analyzed the historical development of Mode 3 theories. Sandstrom examined "the emergence of Mode 3 thinking, how it is used and applied by different authors and what it does or might mean for the present and future of higher education and science for development on local, regional and global scales" (2014, 16). The main purpose of Sandstrom's analysis was "to find out where the notion of 'Mode 3' came from, who started using it, when and what it means to them" (204, 17). The study significantly improved our understanding of the development of Mode 3 thinking.

Our understanding of how and to what extent Mode 3 theories are distinct from each other, and from Mode 2 and epistemic cultures with regard to particular knowledge production parameters is however unclear. Sandstrom's work "open a path for others to go further in their research than the narrow boundaries of this article" (2014, 18). Work that features the possible commonalities and differences among Mode 3 theories in comparison with Mode 2 and epistemic cultures is needed.

To partly address this knowledge gap and then to better inform future research, this configurative review aims to map out the conceptual contours of Mode 3 theories in comparison with Mode 2 and epistemic cultures using particular knowledge production parameters outlined below. Using appropriate analytical frameworks, this study examines whether there is cultural convergence, divergence, or emergence within Mode 3 theories, and among Mode 3, Mode 2 and epistemic cultures.

In this study, *culture* as in cultural convergence, divergence, and emergence draws on definitions from epistemic cultures (Knorr Cetina, 2007) and disciplinary cultures (Becher, 1987) to refer to the socio-cultural, technological, material, methodological, and epistemological features or dimensions of knowledge production. It includes academic norms, traditions, expectations, and other conditions that affect knowledge production.

Study purpose, significance, and questions

The primary purpose of this study is not to bring about consensus on current knowledge production cultures as such but to identify their core attributes and to clearly delineate tensions and issues that merit further scholarship. A working conclusion is drawn as to whether Mode 3 is paradigmatically different from Mode 2 and epistemic cultures.

To that end, Mode 3 is examined from substantive, theoretical, and methodological angles. One, studying the conditions which triggered the emergence of Mode 3 theories can reveal the points of departure of Mode 3. Two, understanding Mode 3 conceptions of *knowledge* and the conditions that affect its production could reveal their epistemological core. Three, revealing Mode 3 empirical, theoretical, and/or practical evidence bases is vital to 'judge' their rigor. Four, exploring Mode 3 methodological preferences linked to data collection and analysis also reveals their 'scientific method'. Five, examining quality assurance mechanisms could enable understanding of the roles various actors play in knowledge production. The analytical frameworks highlighted below provide conceptual scaffolding. This approach enables a holistic understanding of the theories which will better inform further discussions on emerging science/research-society linkages and engagements.

However, two points need to be outlined. One, the study approaches the topic from a higher education perspective, and not from the perspectives of the history or philosophy of science. Two, as the study aims at conceptual mapping, the focus is on identifying the core assumptions, principles, propositions, or theses of Mode 3 without evaluating their integrity, rigor, or fecundity.

The overarching study question posed to meet the purpose is, *How and to what extent are Mode 3 theories distinct from or compatible to each other and Mode 2 and epistemic cultures?* The following specific questions, which are informed by the analytical frameworks outlined below, guide the study.

- What triggered the emergence of Mode 3 theories?
- How is *knowledge* conceived by the theories?
- What conditions and factors do affect knowledge production?

- What research methodology is relevant within Mode 3 thinking?
- How is quality assured in Mode 3 knowledge production?
- What are the evidence bases of Mode 3 theories?

Analytical frameworks

For this study explores Mode 3 in comparison with its predecessors, several analytical frameworks are considered. Core assumptions guide the selection of the frameworks. Successful examination of Mode 3 theories requires a consideration of 1) theories that 'contextualize' disciplinary cultures within recent developments in higher education and society, 2) theories from which Mode 3 thinking directly emerged, and 3) conceptions that delineate scientific change over time. Epistemic cultures (Knorr Cetina, 2007), Mode 2 (Gibbons et al., 1994), and scientific/theory change over time (Kastenhofer, 2007) are found relevant. The frameworks (a) inform the articulation of the study questions, (b) guide the development of themes for synthesis, and (c) support a holistic discussion of the findings. As a prelude, a brief account of higher education operation is provided first, followed by a discussion of each analytical framework.

Higher education operation

A plethora of conditions and factors affect higher education operation including knowledge production. The major ones relate to the cultures of the discipline, the institution, the national, and the (academic) profession (Clark, 1983). These are the hitherto predominant categories of conditions that affect higher education functions. The Triple Helix model of university-industry-government relations (Etzkowitz & Leydesdorff, 1995/2000); the Quadruple Helix model adding "media-based and culture-based public" and "civil society" to the Triple Helix, and the Quintuple Helix model adding 'natural environment, natural environments of society' to the Quadruple Helix (Carayyanis & Campbell, 2012, 20) presumably better explain emerging higher education-society linkages. This study explores how and to what extent Mode 3 converges to or diverges or emerges from these conceptions of linkages and epistemic cultures.

Epistemic cultures

Knorr Cetina's (2007) works on epistemic cultures, knowledge cultures, and macro epistemics seem to 'appropriate' disciplinary cultures. Knorr Cetina maintained that epistemic cultures replace disciplinary cultures to "amplify the knowledge machineries of contemporary sciences until they display the smear of technical, social, symbolic dimensions of intricate expert systems" (1999, 3). Epistemic cultures are the "interiorized processes of knowledge creation. … those sets of practices, arrangements and mechanisms … which… make up *how we know what we know"* (Knorr Cetina 2007, 363).

Topics of discussion include (Knorr Cetina, 2007) epistemic subjects (knowledge agents-machines, group of scientists), epistemic objects (the subjects of study), epistemic settings (knowledge places/habitats), and object-relations regimes (prescribed ways of relating to epistemic objects in research). Core characteristics of epistemic cultures (Knorr Cetina, 1991) include the transepistemic nature of science/research (involving scientists, non-scientists,

materials, technologies); the contextuality and disunity of science (the scientific method is multi-textured and not a standardized tool for reason or rationality); and the significance of collective epistemic subject (erasure of an individual scientist from being epistemic subject). Knorr Cetina (2007) positioned the conception of epistemic cultures within the context of larger national and global cultures of knowledge such as knowledge cultures and macro-epistemic cultures.

Knowledge cultures

The structures and policies of knowledge societies, which promote or restrict certain epistemic outcomes, reflect knowledge cultures which range from "… national and international regulations, to the media …" (Knorr Cetina, 2007, 370). They also include the cultural, social, political and economic life of society (Ibid, 369 - 370). Simply, knowledge cultures may mean national science research policies and regulations, funding regimes; socio-cultural fabrics of society; level of economic development; and governance style. These along with conditions and factors at the international level supposedly influence the volume and quality of knowledge production.

Macro-epistemic cultures

Macro-epistemics are "intermediate arrangements between knowledge cultures and epistemic cultures" (Knorr Cetina, 2007, 362). They are *knowledge verifying units and organizations* that "… take on specific knowledge related tasks in larger knowledge contexts" such as multinational networks (Ibid, 367). In the academe, macro-epistemics may mean professional associations, publishers (including editors and reviewers), professional networks, and quality assurance agencies at various levels as macro-epistemics "…can also be linked to national and international regulations…" (p. 370). Mode 2 seems also to acknowledge these wider networks of knowledge verifying units.

Mode 2 knowledge production

Gibbons et al. (1994) investigated changes in knowledge production in the natural sciences, technology, the social sciences, and the humanities. A new form of knowledge production, Mode 2, is emerging alongside disciplinary cultures, Mode 1. Mode 2 is considered a *complementary* analytical perspective to Mode 1. The defining characteristics of Mode 2 include the following:
- Knowledge is generated within a context of application versus basic science.
- Transdisciplinary versus multi/disciplinary orientation is taken.
- Diverse knowledge production sites are emerging.
- Knowledge is highly reflexive versus objective.
- Novel forms of quality control versus the peer review system are emerging.

Follow-up publications (Nowotony et al., 2001/2003) examined the dynamic relationship between science and society by collecting data from secondary sources and implicit observation of science and research policy. The 2001 publication reaffirmed the emergence of Mode 2 knowledge production within the context of Mode 2 society and emphasized the

contextualization of science and knowledge. This study explores how and to what extent Mode 3 thinking diverges or emerges from or converges to Mode 2 propositions.

Scientific change over time

This study explores the extent of Mode 3 cultural divergence, convergence, or emergence from and to the aforementioned conceptions. In this regard, Kastenhofer (2007) conception of scientific or theory change over time is found relevant.

Kastenhofer characterized the qualitative nature of change processes in theory or in science generally using three concepts: Cultural convergence, divergence, and emergence. These conceptions explain qualitative changes across fields of study and epistemic cultures- in Knorr Cetina's usage of the term. *Convergence* and *divergence* simply reflect limited positional changes in some elements whereas *emergence* reflects profound changes to the way a system is organized.

> *Convergence, divergence and emergence are all processes describing changes within and across scientific fields and, especially, how different scientific components change their positions relative to each other in a given system over time. Convergence and divergence primarily point to a positional change of a constant set of elements; emergence, on the other hand, emphasizes a change of the very set of a systems' elements. All three processes can also be relevant for understanding how epistemic cultures develop over time* (Kastenhofer, 2007, 363).

Convergence, divergence, and emergence "may also be interpreted as being embedded in general societal changes, encompassing changes in the relationship between science and society and a change in the societal role of science" (Kastenhofer, 2007, 364). Convergence and divergence explain qualitative changes of a limited scale whereas emergence explains a substantial reconfiguration equivalent to a paradigm change. The development of epistemic cultures over time appears "highly fluid and irregular" and should be considered in relative terms only (Kastenhofer, 2007). This configurative study aspires to settle whether Mode 3 theories are results of cultural convergence, divergence, or emergence.

Methods

This configurative review explores how and to what extent Mode 3 theories are consistent with each other and with Mode 2 and epistemic cultures. Mode 3 theories (Barnnet, 2004; Carayannis & Campbell, 2006; Jimenez, 2008; Ray & Little, 2001; and Rhoades & Slaughter 2006) are the primary target for analysis in this study, using the six parameters described above. To get more information about some concepts, additional publications by the same authors (e.g. Barnnet, Carayannis & Campbell) are consulted. Other than acknowledging it as a Mode 3 theory, the Sandstrom study did not characterize the Rhoades & Slaughter theory, which this study does. On the other hand, the Kunneman (2005) theory considered in the Sandstrom study is not covered in this study due to its inaccessibility.

To identify possibly more Mode 3 theories, Google and Scopus searches are conducted using such keywords as Mode 3, Mode 3 knowledge, Mode 3 knowledge production, Mode 3

knowledge production in higher education and society, and emerging knowledge production cultures. Other than works that use, replicate or appropriate the already identified theories, no additional work is found. Still, some studies published in inaccessible outlets and in a different language than English might exist out there. As the goal of this study is not to consider all the possible studies on the topic but to examine the major conceptual attributes or characteristics of the already identified ones, it does not affect the overall integrity of the study. That the topic under study is a recent phenomenon implies a possible lack of theoretical 'saturation'.

The study questions and the analytical frameworks guide the analysis and synthesis of the theories. Themes, which reflect substantive, methodological and theoretical significance, are identified for categorization. Each Mode 3 theory is examined along these lines: the rationales given for the development of Mode 3 theories, conception of *knowledge* and the conditions and factors that affect its production, the evidence bases of the theories, their quality assurance practices, and methodological preferences.

The analysis and synthesis are conducted in two stages. First, a table maintaining the aforementioned themes as headings is constructed. Under each heading, concise and clear information is inserted based on information gained from each theory. Once all the studies are summarized this way, patterns and/or trends as well as unique cases are identified for further interpretation. The constant comparison method (Maykut & Morehouse, 1994)) is employed to form themes/concepts and then to compare and contrast each theory. Once themes are created, the table is excluded for efficiency reasons.

It is expected that each Mode 3 theory may not contain explicit information about all the analysis parameters/themes. To overcome this particular challenge, studies are closely read start-to-end and effort is made to extract meaning from implicit assumptions. If information about one or more themes is missing, that is clearly indicated in the table. Although there certainly is a degree of subjectivity on this, it does not affect the overall conclusions of the study. The overall analysis and synthesis are taken from the perspective of higher education, and not from the philosophy of science, systems approach, or innovation.

Using the analytical frameworks, a general discussion of the major findings related to each study question is conducted. First, each Mode 3 theory is compared and contrasted with each other using the parameters. Second, Mode 3 theories are compared and contrasted to epistemic cultures and Mode 2 theories, again using the same parameters. The goal is to identify whether there is cultural divergence, convergence, or emergence among the theories. Conclusions are then drawn as to how and to what extent Mode 3 theories are in/compatible with each other and with Mode 2 and epistemic cultures. Areas for further scholarship are identified and the limitations of the study are acknowledged.

Major findings

This section outlines the major attributes of Mode 3 along the themes outlined above. Commonalities and differences among them are highlighted. To substantiate emergent themes and divergent cases, some direct quotations are included. For a contextualized understanding,

the section first briefly introduces the theories, focusing on their purposes and their major concentration areas.

Contextualization

Ray and Little (2001) compares Western and Japanese modes of knowledge and its production in higher education. This Mode 3 theory however examines how group tacit knowledge drives Japan's workplace performativity. Modes 1 and 2 are compared "with the privileged role that Japan's workplace ba accord to insider collective-tacit knowledge, which we tentatively call 'Mode 3' knowledge" (Ray & Little, 2001, 154). Although the theory acknowledges the significance of considering pluralist epistemology (Modes 1 and 2) to better understand epistemic works, it concludes that "situated group-tacit or Mode 3 knowledge would appear to be particularly important as a tool for enabling practice within Japan's workplace ba" (163). The focus on workplace performativity and tacit knowledge accumulated over time mainly through experience distinct this theory from other theories.

Barnnet (2004) problematizes *learning* in the 'unknown future', in the future of "supercomplexity". Supercomplexity, "arises under conditions of a conceptual overload: in short, supercomplexity is the outcome of a multiplicity of frameworks. ... No longer are the boundaries, or the forms of right knowing clear" (Barnnet 2000, 415). The specification of learning in terms of knowledge or skills is presumed to be abandoned in favor of cultivating human qualities and dispositions. Accordingly, "A Mode 3 knowledge surely beckons, in which it is recognized that knowing the world is a matter of producing epistemological gaps. The very act of knowing- knowledge having become a process of active knowing- now produces epistemological gaps" (Barnnet 2004, 251). The focus of this theory is on learning in higher education within the context of societal super complexity.

By creating a conceptual link between systems and systems theory, Carayannis and Campbell (2006) develop their version of Mode 3. Accordingly, "Mode 3 focuses on linking systems theory and knowledge, and the analysis of knowledge" (19) and is presumed to more directly integrate conceptual considerations from systems theory, knowledge, and innovation. Its principles include that systems theory and systems approach represent a more holistic paradigm than a purely economy-based rationale; knowledge-based systems concepts need to be constantly tested; knowledge is more aggregative than research, science, technology and innovation; multilevel systems of knowledge are relevant for holistic understanding; and networking connects "different modes of knowledge production and knowledge use and also connects (sub nationally, nationally, and transnationally) different systems or sectors of society" (20). The theory is widely applied in various contexts including within the contexts of the quadruple and quintuple helices, and innovation.

Building on Mode 2, and academic capitalism and the new economy, Rhoades and Slaughter explore "the restructuring of employment and productivity in the academe, into a new form that we call Mode 3. Such changes involve reorienting academe to more "relevant", "practical" purposes related to work outside higher education" (2006, 9). They challenge many of Mode 2 propositions and discussed their conception of Mode 3, "embedding it in a

discussion of academic capitalism and the new economy in the U.S." (Ibid, 11). Mode 3 "foregrounds the significance of new professional groupings that are emerging in the interstices of academic organizations" (15).

Drawing on the globalization of the economy and of science, Jimenez (2008) conceptualizes how research is closely linked to "the learning function" and to real community needs in Mexico. Graduate research, which is driven by current societal problems, is used as a stepping stone to conceive Mode 3: "a mode of knowledge production whose distinctive characteristic is a commitment to be at the service of mankind" (49). Mode 3 is conceived to "solve felt needs of specific communities, hence actually being more socially accountable than Mode 2" (55).

In sum, the five Mode 3 theories introduced above seem to take varied perspectives and frames of references. Ray and Little conceptualize tacit knowledge in the workplace whereas Barnnet problematizes learning in higher education within the context of supercomplexity. Rhoades and Slaughter theorize on how and to what extent higher education aspires to make research and instruction more commerciable whereas Jimmenezi explores how graduate research is born out of and is conducted for solving real community problems. On the other hand, Carayannis and Campbell argued for a systems approach to the production of knowledge and acknowledged various multilevel knowledge systems.

The next section consecutively examines the theories with regard to their rationales, knowledge conceptions, conditions/factors affecting knowledge production, evidence bases, methodological approaches, and quality assurance systems.

Mode 3 rationales

To justify their significance, all Mode 3 theories identify Mode 2 deficiencies or inadequacies. Generally, three inclusive lines of thought or rationales are identified.

Expansive-holistic rationale. Barnett, and Carayannis & Campbell theories claim that Mode 2 does not adequately reflect societal complexity and the dynamics of knowledge and its production. These theories aspire to configure a more holistic understanding of societal and knowledge complexity. They acknowledge alternative and multiple approaches (which may include Modes 1 and 2) to knowledge, emphasizing respectively on supercomplexity and systems approaches. These theories claim to expand on Mode 2 thinking to enable a more holistic analysis of conditions at subnational, national, regional, and global levels.

Pragmatic-local rationale. Other Mode 3 theories seem to capitalize on how and to what extent 1) professionals deal with practical tacit knowledge (Ray & Little), and 2) local community needs give 'birth' to the conduct of research (Jimenez). The purpose of research is to directly contribute to organizational productivity (Ray & Little) and to community development (Jimenez). As in expansive-holistic theories, pragmatic-local theories seem to acknowledge the role of alternative knowledge modes. They consider "Mode 1 knowledge as a tool, Mode 2 knowing as practice, Mode 3 knowledge as a collective tacit tool of knowing"

(Ray & Little, 154). Employees and communities are primed as producers and users of knowledge. Overall, pragmatic-local theories are more locally and pragmatically driven than expansive-holistic theories are.

Critical-refutationist rationale. Although holistic and pragmatic theories try to challenge Mode 2 thesis, they generally appear to expand and build on it. Rhoades and Slaughter Mode 3, however, critically challenges the conceptual and empirical foundations of Mode 2. Nearly all the major propositions of Mode 2 are presumably refuted, putting to test the very scientific rigor of Mode 2. Points of departure include that Mode 2 does not make adequate distinctions between Modes 1 and 2; higher education-society linkage is not a manifestation of social accountability but more of revenue generation scheme by the former; new structures within higher education are not transient; Mode 2 focuses on research only; research is not conducted in the prime interest of corporations but in university economy interest; and transdisciplinary research engagements are mere additions to traditional department organization.

Overall, Mode 3 theories justify their contributions vis-a-vis the strengths and weakness of Mode 2 thinking. All seem to proclaim that science and the scientific method traditionally associated with Mode 1 need reconceptualization and pluralistic interpretations of society and science need to be considered. Part of the reconceptualization is linked to their conceptions of *knowledge* itself.

Knowledge conceptions and conditions

Mode 3 theories share substantial commonalities with regard to their conceptions of knowledge and the conditions that affect its production. One, most (Barnnet, Caraynnis & Campbell, Jimenez, Ray & Little) view knowledge as a social construction and hence acknowledges the roles various actors play in its production. Barnett claims that "our descriptions of the world are always contestable and in which we know that to be the case. Our hold on the world is now always fragile" (2004, 250). Knowledge is viewed as a complex of personal, tacit, experiential and propositional knowledge (Ibid, 251). A "pluralist approach suggests a useful way of recognizing that different types of knowledge can contribute to practice without losing their intrinsic identity because of 'conversion'; insisting that knowledge is all of one type can have severe consequences" (Ray & Little, 162).

Two, Carayannis & Campbell, Jimenez, and Ray & Little consider knowledge as situated within socio-cultural, economic, and political realities. This conception challenges the universality of knowledge claims.

Three, all the theories consider knowledge within application versus theoretical contexts. Meaning, research produces applicable knowledge. Rhoades & Slaughter contend that "our discussion of academic capitalism and the new economy, and relatedly of managerial professionals and Mode 3 should make clear that problem definition is grounded in the economic interests of the university, which are pursued in concert with particular corporate interests outside the academy" (2006, 17).

Four, all acknowledge the role eventual knowledge users play in its production. Five, knowledge is open and accessible (Barnnet, Caraynnis & Campbell, Jimenez). It is no longer confined to expert communities and hence is presumably becoming more of a public good. Six, intersubjectivity along the process is implicated by all but Rhoades & Slaughter. Knowledge as an objective and stable reflection or representation of reality is challenged. Seven, subnational (institutional), national and international-level conditions (Barnnet, Carayannis & Chambers, Rhoades & Slaughter), community of practice (Jimenez, Ray & Little), and multiplicity of epistemological frameworks (Carayannis & Campbell, Barnnet) affect knowledge production.

Two more points are worth mentioning. One, a more bottom-up, local-societal/national initiative is emphasized in knowledge production (Carayannis & Campbell, Jimenez), Carayannis & Campbell theory also acknowledges top-down initiatives. Two, although research and instruction tend to be viewed in commercial values, disciplinary cultures are still the core of higher education organization and knowledge production (Rhoades & Slaughter). Meaning, within the general culture of the academe, university units aspire to add more economic value to their research and instruction. Mode 3 theories "involve reorienting academe to more "relevant", "practical" purposes related to work outside higher education and entail a growing infrastructure within colleges and universities that connects the production of research and instruction to the external world" (Rhoades & Slaughter, 9). This thesis seems beguiling and compelling given the amount of evidence put forward in support of it.

Methodology and quality assurance

Mode 3 theories seem to hold similar methodological views. One, they generally acknowledge multiple perspectives, world views, and methodologies- plurality of knowledge production modes is acknowledged. Except for Barnett (where incompatibility is implicated), Modes 1, 2, and 3 are considered as compatible, complementary or alternative modes. Carayannis and Campbell Mode 3 emphasizes "the additionality and surplus effect of a co-evolution of a pluralism of knowledge and innovation modes. Two, intersubjectivity, transdisciplinarity, or multidisciplinarity are also acknowledged. Three, all theories but Rhoades & Slaughter's clearly promote social/participatory epistemology. In Carayannis & Campbell Mode 3, "Constructivist notions are emphasized, implying that social systems cannot be understood independently of an observer, since they are not naturally predetermined but to a large extent socially constructed" (2006, 2).

Four, knowledge is permanently open for further qualification/validation (Barnnet, Carayannis & Campbell). Barnnet claims that "knowing the world is a matter of producing epistemological gaps. The very act of knowing becomes a process of active knowing" (2004, 251). Also, "There is a need for permanently testing the applicability of knowledge-based systems concepts. Through this application orientation, the theoretical development of knowledge systems concepts will be further enhanced" (Carayannis & Campbell 2006, 19). Except for Rhoades & Slaughter's, all the theories seem to undertone the significance of the scientific method closely associated with Mode 1.

These theses have implications to quality control or quality assurance in knowledge production. One, there is no clear boundary or form of right knowing and knowledge (Barnnet, Carayannis & Campbell). Meaning, "Supercomplexity produces a multiplication of incompatible differences of interpretation" (Barnett 2004, 259). Two, all theories consider knowledge producers and users as quality validators/regulators. Theories indicate a shift from peer to public review of science, implying the presence of competing voices or conflict of interest. Rhoades & Slaughter Mode 3 maintains that "accountability is narrowed by the academy's increasing market embeddedness. Accountability is more and more a matter of the potential to generate revenue…..Accountability comes from the private sector marketplace, which is not a demanding taskmaster in terms of a range of public good considerations" (2008, 18).

Evidence base

The evidence bases of Mode 3 theories are varied. All of them conducted conceptual/literature reviews of Modes 1 and 2 knowledge and observed change dynamics in higher education and society. Rhoades & Slaughter, Carayannis & Campbell, and Jimenez Mode 3 theories draw on empirical data and complement their analyses with reconceptualizations of existing frameworks. The theories also considered third-party data. Barnnet, and Ray & Little theories are primarily conceptually driven, building mainly on extant literature and very limited empirical data. Overall, more empirical grounding and replicability of theories across contexts seem wanting.

Discussion and conclusion

Using the analytical frameworks as organizing logics, this section discusses the major findings of the study. A case is first made whether there is cultural convergence, divergence, or emergence within Mode 3 theories. The epistemic cultural differences or similarities between Mode 3 and Mode 2 are then highlighted. For a holistic mapping out of the conceptual contours, cultural differences or similarities existing among Mode 2, Mode 3, and epistemic cultures are finally compared. To better inform further scholarship, the concluding paragraphs identify tensions and issues in characterizing the various modes of knowledge production along cultural conceptions.

The findings reveal substantial commonalities within Mode 3 theories with regard to their rationales, conceptions of knowledge, the conditions and factors that affect knowledge production, methodology, and quality assurance systems. Mode 3 theories seem to hold that 1) they offer a better depiction of contemporary science-society linkages than Mode 2 does; 2) knowledge is mainly a social construction prone to intersubjectivity; 3) knowledge is socio-culturally, economically, politically, and temporally situated- the universality of science is questioned; 4) knowledge production is framed primarily within application contexts; 5) knowledge users are engaged in the planning and conduct of research and in quality control- the public review of science is emerging; 6) science/knowledge is open/accessible for use and for further validation- knowledge as a purely objective and static conception available only to researchers and their professional networks is in question; 7) research is transepistemic, involving and responding to conditions at individual, institutional, national, regional,

professional, and global levels- consistent with the Quintuple Helix model of university-industry-government-media/civil society-natural environments of society relations (Carayyanis & Campbell 2012); and 8) multiple/plural perspectives, frameworks, methodologies, and modes of knowledge production are acknowledged- the unitary conception of the scientific method is deconstructed. These are the major attributes or propositions of Mode 3 thinking in higher education.

Consequently, Mode 3 theories seem to demonstrate more of cultural convergence than divergence or emergence. They converge around a shared reconceptualization of science/research, taking in to account emerging developments in society and in higher education. The holistic-expansionist and the pragmatic-local Mode 3 theories outlined above clearly reveal more cultural commonalities than differences. Although each theory aspires to offer a better explanation of emerging higher education-society linkages, they appear to hold similar propositions with regard to the analysis parameters considered in this study.

This cultural convergence could be considered significant when the historical development of Mode 3 theories is considered. Sandstrom claims that "Multiple voices are currently speaking about Mode 3 knowledge in contrast to Modes 1 and 2. But up until now they are not always addressing the same thing (or even speaking the same language) and are not in several cases even aware of each other" (2014, 36). That 1) each theory is not aware of the other, 2) each has a particular thematic focus area, and 3) each tends to converge along several epistemic 'lines' outlined above partly indicates the 'validity' of Mode 3 thinking generally. The theories appear complementary to each other and could be acknowledged for their self-replicatory function.

Sandstrom indicates, "there is a new paradigm, new model, new theory or new approach to higher education and knowledge, etc. now called 'Mode 3'" (2014, 36). The current study points toward the thesis that Mode 3 is more of a mode or an approach than it is a paradigm or a theory as such. To qualify as a paradigm, Mode 3 must hold substantially distinct theoretical/methodological assumptions and principles compared to its predecessors, Modes 1 and 2.

Mode 2 maintains that 1) knowledge is generated within a context of application versus basic science; 2) transdisciplinary versus multi/disciplinary orientation is getting hold, 3) diverse knowledge production sites are emerging; 4) knowledge is highly reflexive versus objective; 5) novel forms of quality control versus the peer review system are emerging; and 6) science and knowledge are contextual. These propositions are in perfect parlance with the propositions of Mode 3. Considering the parameters of this study, Mode 3 appears 'appropriations' or 'substantiations' of Mode 2 across settings. Mode 3 propositions do not seem to make a qualitatively substantial 'drift' from Mode 2 propositions. Hence, there is also more of cultural convergence than divergence or emergence between Mode 2 and Mode 3. Considering the parameters this study employed, it could be argued that Mode 3 thinking 'validates' Mode 2 thesis across a set of contexts.

The critical-refutationist Mode 3 theory (Rhoades & Slaughter, 2006) is but a clear exception to the cultural convergence. This Mode 3 theory tends to refute Mode 2 core propositions. Its points of departure include that Mode 2 does not make adequate 'rift' from Mode 1; higher education-society linkage is not a manifestation of social accountability but more of revenue generation scheme by the former; new structures within higher education are not transient; Mode 2 focuses on research only; research problem definition is not conducted in the prime interest of corporations but in university economy interest; and transdisciplinary research engagements are mere additions to traditional department organization. Along these lines, propositions are put forward to supposedly better depict emerging knowledge production modes along commercial lines. It could thus be claimed that there is cultural divergence between Mode 2 and Rhoades and Slaughter Mode 3 theory. As the latter seems generally operating within and extending Mode 1, the cultural divergence between Mode 1 and Mode 2 could be considered as another indication of the divergence between it (Rhoades and Slaughter Mode 3) and Mode 2.

It is also interesting to outline cultural similarities or differences between Modes 2 and 3 thinking, and Knorr Cetina's epistemic cultures (including knowledge cultures, and macro-epistemics). As outlined in the analytical frameworks section, Knorr Cetina theories hold that 1) disciplinary cultures are inadequate to explain contemporary policy and strategy of knowing; 2) research is becoming transepistemic, involving scientists, professional associations, non-scientists, funders, policies, and other stakeholders including media-consistent with the Quintuple Helix model (Carayyanis & Campbell, 2012); 3) the scientific method is viewed as multi-textured, refuting the standardized objective view; 4) research is sensitive to socio-cultural contexts; 5) knowledge production and progress is not limited to clear-cut processes of verification and falsification, but with "untidy" businesses of experimentation (Knorr Cetina. 1999, 101); and 6) all the above reveal the disunity of the sciences. These theses are generally consistent with Mode 2 and Mode 3 theses. This could be considered indicative of more of cultural convergence than divergence among epistemic cultures, and Modes 2 and 3 thinking. These three knowledge production cultures are complementary and jointly better explain emerging science-society change dynamics than Mode 1 does.

In sum, Modes 2 and 3, and epistemic cultures appear to make substantial 'shifts' from Mode 1, indicative of cultural divergence. They jointly reflect how and to what extent higher education is repositioning itself to better address emerging changes at various levels. The grand thesis is that research is becoming transepistemic (Knorr Cetina, 1999), involving scientists, machineries, funders, national policies, quality assurance regimes, and users during planning and its conduct. Research is becoming more and more collaborative and transcends disciplinary and national boundaries and networks, affecting both epistemic subjects/objects and methodological perspectives. The contextuality of knowledge production is manifested in *levels* (local, institutional, national, regional, and global), *dimensions* (socio-cultural, economic, and political), and *elements* (norms, power relations, regulative principles, technologies, resources, and strategies) (Bekele, 2018). This deconstructs the universal

conception of science/knowledge and makes replication/validation of theories a particular challenge.

However, this study concurs with Scott's claim that it is "misleading to see these changes (Modes 1 and 2 and the Triple Helix) as evidence of a kind of linear paradigm shift from an "old economy" of pure science and disinterested scholarship to a "new economy" of applied science and activist research" (2003, 215). As the foregoing discussions reveal, the cultures co-exist and even complement each other. Modes 2 and 3 and epistemic cultures seem to make shifts only in limited areas and not in overall Mode 1 set up- the cultural change is limited to divergence. Considering this and the cultural convergence between Mode 3 and Mode 2, and within the various Mode 3 theories, it is concluded that paradigmatic change does not yet occur in higher education knowledge production.

Yet, Modes 2 and 3, and epistemic cultures seem to have multifaceted ramifications, potentially affecting the organization of not only research but also teaching, learning, science policy, quality and regulatory regimes, and even governance. That the conceptions consider developments in the natural and social sciences as well as technology and innovation fields simply amplify their significance. They seem to call for a substantial reconceptualization of quality, relevance, and significance of higher education amidst societal changes.

However, some points need to be considered with regard to cultural convergences and divergences found in this study. One, this study focuses only on the pattern and trend in cultural change with regard only to six parameters, as the purpose is to map out the conceptual contours of the various modes. Differences of substantial nature might exist among the modes along other 'lines' not included in this study. Two, Mode 3 and even Mode 2 appear to primarily rely on limited empirical data collected at some point in time and place, and reviews of literature and science policies. This might leave some reservations about their rigor and overall fecundity. Three, the modes are relatively new, awaiting further qualifications and replications across contexts. Four, cultural change over time appears "highly fluid and irregular" (Kastenhofer, 2007, 368). Moreover, "since the investigation of epistemic cultures can only be done comparatively, such an approach allows only for a discussion of relative convergences and is unable to address convergence in absolute terms" (Ibid). It is therefore better to consider the cultural convergences (within Mode 3 theories, and between Mode 2 and Mode 3) and cultural divergences (between Mode 2 and epistemic cultures, and Mode 1) only as processes of relative convergence and divergence of general qualitative nature. There is a possibility of spotting some elements of divergence within converging cultures and convergence within diverging cultures. Only closer examinations of the cultures could reveal nuanced distinctions among them.

Further studies are recommended on many fronts. One, studying the knowledge production cultures in comparison with poststructural, postmodern, postcolonial, and/or critical perspectives could yield more interesting insights. Approaches from the history and philosophy of science could be relevant in this regard. Two, within the conceptual confines of Modes 2 and 3, and epistemic cultures, further studies that problematize scientific rigor and contextuality, academic freedom and institutional autonomy, governance and power relations,

and quality and relevance of education could substantially improve our understanding of emerging higher education-society change dynamics.

This configurative study aspires to contribute to our understanding of Mode 3 theories in comparison with Mode 2 and epistemic cultures with regard to particular parameters. It maps out the conceptual contours of these modes of knowledge. General divergences and convergences existing between and among the knowledge production cultures along certain parameters are featured. This could be considered a modest contribution to further sustain the discussion on this significant and timely topic of higher education-society linkages and engagements.

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