



ISSUES IN BRIEF

Mapping the Complexity of Higher Education in the Developing World



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Higher education in developing countries represents a highly dynamic and complex problem, incorporating social, political and financial components. Effective and sustainable systems of learning and scholarship are not only important for the economic and social success of individual countries

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but are also fundamental to peace, security and sustainability of the world at large. By higher education “system” we mean the network of public and private institutions, their interconnectivity and the flow of information, scholarship and academic activity within them, and between them and the national economy and society.

While a number excellent institutions of higher learning exist across the developing world, the experiment to create effective systems of higher education in the developing world has, barring a few notable exceptions, failed. While the problems involved in developing and sustaining educational institutions in the developing world have been studied for decades, a quantitative understanding of how these institutions operate within the systems of higher education in developing countries remains elusive. Indeed, very few attempts have been made to map such an understanding.

Even where robust information about specific institutions is available, system-wide information remains scant. Systems level information would incorporate the network of public and private institutions, their interconnectivity and the flow of information and academic activity within them. Information at the systems level is critical for improved social development, policy implementation and long-range sustainability of a higher education system. In the absence of system level information, resources are often allocated to a handful

of institutions even as other elements that may be equally necessary for the integrity of the system as a whole are neglected, making the system unstable and, ultimately, unsustainable.

In a globalized world defined by its “knowledge economy”, there is a heightened urgency to understand how economically sound, socially robust, and academically effective institutions may be developed and sustained. The long-term goal of any system of higher education is to have depth and flexibility to withstand political, social and economic turbulence. Achieving such robustness is often a long and iterative process, and has not been particularly successful

in the developing nations where, by definition, the political, economic and social contexts often tend to be unstable and volatile.

Additionally, a system-level understanding is also highly desirable for integrating the national vision, goals and needs with the curriculum of higher education. Like any sustainable system, the higher education system needs to have both specialized and broad-based institutions, catering to

different needs of the society and its citizens. For example, an appropriate balance of fiscal and human resource allocations between small specialized vocational colleges and large universities can only be understood by assessing the system as a whole.

The need for developing a system-wide understanding of the factors that influence the existence and success of institutions is further amplified as a global economic downturn threatens projects that were traditionally supported by non-governmental organizations (NGOs), international organizations and philanthropy. The NGO sector has also played an important role in providing alternate routes, supporting small vocational training centers that complement the educational institutions. These small institutions that are now threatened due to economic turmoil have often been successful in educating women, who traditionally or culturally have been denied access to higher education.

With these issues in mind, a two-day workshop of leading global experts of higher education in developing countries was organized at Boston University in October, 2009 (See box on p. 3). The goal of the meeting was to understand the complexity of higher education, the key players and parameters, and to discuss some of the gaps in our understanding of these issues and how best to fill these voids. This policy brief benefited from the discussions at the workshop.

Dimensions of Higher Education Complexity

Higher education systems, including in the developing world, are complex both in qualitative and quantitative terms. Quantitatively, these systems involve a large number of interacting components that are sensitive to local and global trends. These components have a time-dependent behavior and the links between them are also sensitive to time and the micro- and macro-environment. The interacting components include access to secondary education, institutions of various sizes, the local, state and federal governments, financial stakeholders, human resources, employment opportunities, student data including economic backgrounds, academic quality, prior training, etc. In this regard, it resembles a complex network with nodes, hubs and links, with the hubs having small to medium sized networks within them.

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But it is the qualitative aspect that needs even more attention. Unless we grasp the qualitative aspects — which include, for example, the quality of primary and secondary institutions and students, socio-cultural norms and traditions, perception of higher education, immigration trends, job markets, political infrastructure, etc. — any mathematical model would not be particularly meaningful or have predictive power. Understanding the qualitative aspect starts with defining the “system” of higher education. A system of higher education can be defined in many ways. However, for the purposes of simplicity, as well as practicality, we borrow the definition from physical sciences, and make two assumptions: one, it has to have a clear boundary; two, this boundary can be porous or impermeable. For our purposes, we define the boundaries of the system as the geographic boundaries of a sovereign nation. This allows for tracking of economic and socio-economic indicators that regulate the system.

Experts Grapple with the Complexity of Higher Education in Developing Countries

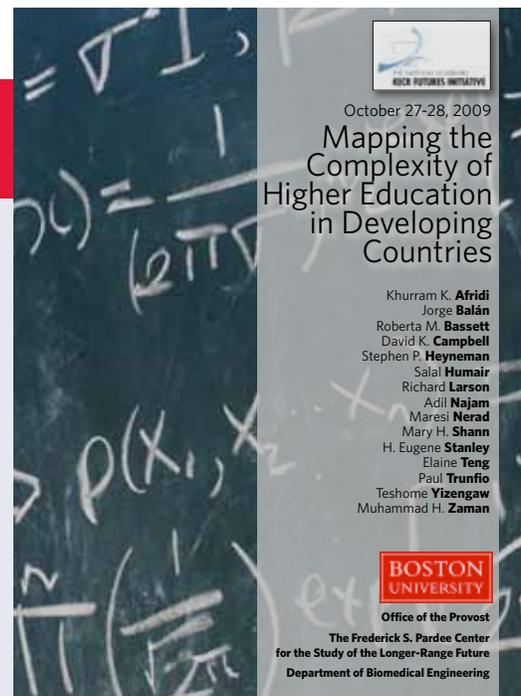
On October 27 and 28, 2009, a workshop of experts on higher education in developing countries was convened by the Boston University Frederick S. Pardee Center for the Study of the Longer-Range Future. The meeting was supported by a grant from the National Academies Keck Futures Initiative with additional support from the Pardee Center and the Office of the Boston University Provost. The meeting brought together experts in economics, public policy, education, development, university management, and quantitative modeling who had rich experiences across the developing world. These experts offered a variety of conceptual tools with which to look at the particular complexities associated with higher education in developing countries.

The meeting was convened by the authors of this paper. Participants included Dr. Khurram Afridi (Lahore University of Management Sciences,

Pakistan), Dr. Jorge Balan (Centro de Estudios de Estado y Sociedad, Argentina and University of Toronto), Roberta M. Bassett (World Bank), Prof. Stephen P. Heyneman (Vanderbilt University), Dr. Salal Humair (Harvard School of Public Health), Richard Larson (Massachusetts Institute of Technology), Prof. Maresi Nerad (University of Washington), Prof. Mary Shann (Boston University), Prof. Eugene Stanley (Boston University), Elaine Teng (Boston University), Paul Trunfio (Boston University), and Teshome Yizengaw (Higher Education for Development Africa Initiative). This policy brief builds upon and reflects on the discussion at this meeting but is not a meeting report, per se.

The authors are grateful to all who attended the meeting for the rich

discussion and their many ideas that have influenced our own; however, these reflections are solely those of the authors. The authors also acknowledge the support from the National Academies Keck Futures Initiative for our work on this topic. We are also indebted to Elaine Teng of the Pardee Center and Paul Trunfio of the Center for Polymer Studies for research assistance.



The complexity of this system is rooted in factors and events that happen within the system and in the surroundings. In many developing nations, the complexity arises from instability in financial resources, sudden political changes, unreliable infrastructure, the socio-economic factors influencing the daily lives of individuals, and problems associated with human resources,

including immigration. Outside political, social and security influences can also contribute. In addition the stochasticity (i.e. randomness or unpredictability) associated with input (primary and secondary education) and output (market) amplifies the overall complexity. While the input is almost exclusively within the boundaries of the system, the output often goes outside the boundaries. Thus immigration and emigration can contribute significantly.

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General issues versus context-specific concerns add to the complexity. Is there a unique set of parameters that regulates these complex systems in all countries, or is every country so unique in its problems that there is no common denominator of variables and parameters? There is little quantitative data available at a systems level to provide a clear answer to this question. However, the answer also depends upon the overarching goal of any modeling effort. If the desire is to understand how complexity of the socio-economic factors regulates higher education, then there are universal variables, such as economic status, existing number and size of institutions, literacy rate, and government spending that can provide a general picture for countries in a similar GDP window. However, if the goal is to influence policy in a given region, or understand the complexity of higher education in a specific population then cultural trends, religious practices and influence, and unique micro and macro political factors also need to be taken into consideration.

The lack of dependable data at a systems level invariably locks us into studying generalized parameters and overall trends rather than country-specific questions. While the lack of data is a major bottleneck, we believe that a number of key questions can still be asked that can give us an understanding of the general landscape of higher education. The first and perhaps the most fundamental question, after we acknowledge that higher education is indeed complex, is to define what is sustainability or ‘success’ in the context of higher education?

Measuring Success and Sustainability

A successful system of higher education should be able to sustain its success over time. This sustainability is tied to the output of the system. The output of a higher education system, in any country, should be graduates who are fit for purpose. As institutions of higher education are often classified in terms of research, teaching and service, sustainability in all three sectors is desirable. This means that output of the system should not be just scholars, researchers and business leaders, but also entrepreneurs at all levels, citizens exhibiting a deep civic sense, and participation in crafting a shared national vision.

From a quantitative perspective, a sustainable system should also strive to decrease the input-to-output ratio. This means that over a given time period, most students who enroll at entry level should be able to complete a degree in a period as close to the designated

length of degree as possible. However, this ratio is also controlled by input quality, input of external resources into the system, faculty quality and faculty satisfaction, gender balance in enrollment, and the education level of students' parents, to name a few. Similarly, it is controlled by the output environment, including quality of labor market, employment opportunities, availability of further education and research opportunities and so forth.

Sustainability in higher education is also dependent upon the inter-connectivity of institutions both within and outside the system. Any sustainable network, be it the world-wide web or the airlines and airports can only perform efficiently and maintain its robustness if it is well-connected. Strong connectivity allows the network to withstand poorly performing components as well as negative influences from both outside and within the system. Strong connectivity is highly desirable for higher education systems as well. Connectivity within the system, between institutions of various sizes, will allow for better use of capital and human resources without massive duplication. Interconnectivity between institutions within the system – for example, between those focusing on the liberal arts with specialized professional institutions or vocational institutes -- can also serve to attract students with a wide range of academic interests and preparedness to serve the national need. Interconnectivity also provides opportunities for distance

learning and technology-based education, which can dramatically improve the quality, reach and impact of education, as well as involve non-traditional actors such as international providers of education and NGOs.

Converting success to sustainability requires oversight of individual components and quality control mechanisms. Higher education

institutions are often created with massive capital, infrastructure, hiring of faculty, and high quality initial input; however, if they fail to produce results, inputs dwindle as outputs cannot justify the investments. Poor governance of these institutions and lack of integration into the entire system contributes to a non-sustainable higher education system. Other factors, such as poor design of a system, too much influence from the external environment and sharp and/or sudden decrease in resources also contribute to failures of higher education.

Efficient governance is not only critical for quality control but also necessary for decreasing the input-to-output ratios and creating fit-for-purpose graduates. Any one institution alone cannot reach either of these goals; effective system-level governance is needed in addition to effective institutional-level governance. Governance of the system is also tied to creating national will to meet the national need. A system of higher education will not be able to produce fit-for-purpose graduates if the general perception of higher education does not correspond to the national vision. In short, reaching a robust input/output ratio requires a concerted and coordinated effort from both within and outside of the higher education system.

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Towards Integration and Modeling

In order to tackle complex problems at the intersection of policy, society and economy, a common approach is to create tractable models where users can vary the parameters and use the outcome to influence the policymaking process. While we may agree in perceiving higher

education as a complex problem, the first pertinent question is whether there is any value in modeling a multi-dimensional and complex system such as higher education in the developing world. The answer lies in our overall objective. If we are to study individual contributors, such as local economics, immigration or local politics influencing higher education in a particular system, then the necessity of such a model may be questionable, until high quality and a large quantity of system-specific data is available. However, if we embark on a longer-range goal to understand the behavior of this non-linear system as a whole and look at how various factors contribute in shaping the system and its outcomes in a generalized manner, then quantitative modeling becomes a more potent tool.

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Quantitative modeling allows us to forecast the response of the system under various internal and external turbulences and helps in identifying appropriate policy responses that may channel the system towards some form of success and sustainability. In particular, the process of modeling the system can itself enhance our understanding of the system and can help identify the key levers that control the system and the parameters that have only secondary influences. In this regard, a quantitative approach can serve as a means to reduce the dimensionality and

complexity of the system and provide a small set of variables that influence broader outcomes and a large set of variables that only act on the periphery.

A systems-level approach invariably requires integration of all available information, looking at it as a whole and not just a sum of its parts. If we define our system with clear boundaries and then identify the metrics of success or sustainability, we can potentially create a model that will incorporate the local, national and global metrics and quantitatively describe how variations in each of those metrics would influence the overall outcome. However, there is a strong correlation in the potency of the model and availability of quality data. Given the current status of available systems-level data for higher education in the developing world, creation of a quantitative and predictive model — one that could forecast the behavior in a given country — is not feasible. Very little, if any, systems-level data currently exists, and the quality of what is available is often questionable. Given this, our best options are to 1) gather what is available, 2) identify what is needed, and 3) create a simple model that builds upon available information and iteratively expand its predictive power as more data becomes available.

Efforts to gather systems-level data should be undertaken in collaboration with an international organization (e.g., OECD, the World Bank, Asian Development Bank) that has access to the available data and the ability to influence the direction of future data gathering. The data is most likely going to be at an institutional level and may have some common components across various institutions in a given country. It is also likely that data from developing countries in one region might be available for both public and private institutions while data from other parts of the world may not be available at all. In addition, data for a given discipline may be easier to gather than for other disciplines. As a result, any scaffold of a model that can be created at this stage would have to be a generalized and limited in its predictive power. However, by using a small set of “test” countries for which

data is available, we can train our model for future applications and predictions across a broad spectrum of nations.

Part of the problem associated with existing data is understanding it across various countries and regions. This is associated with tabulating and comparing it on a level playing field. In this regard, we propose the eventual goal of creating an “index of higher education systems” where each system (as opposed to institutions within the system) is gauged across a range of parameters that can give us a sense of the system’s success and sustainability (see above). This exercise could also help in identifying the holes in available data for a specific system as well as an intuitive understanding of what the model should focus on. Such an index might also allow us to look at trends in a given geographic region and be useful in correlating success with various input parameters (such as increase in graduates with increase in the number of institutions or increase in overall spending etc.). Although valuable national and international rankings of institutions, colleges, disciplines and departments do exist, there is not such an index that might connect these various institutions into a systems assessment.

The creation of an annual index could be the first step in moving towards the subsequent creation of an initial systems-level model. Due to scarcity of country specific data, any effort is likely to be limited to a reduced model with only a handful of input parameters (three or four) and a single output. Success of an initial model, calibrated and validated through comparisons in a number of countries, would give us confidence to develop a larger, more complex and realistic model. The initial goal of any model of higher education would be to serve as a guide towards identifying which parameters are the most useful or extraneous to the core problem.

For a starting point, economic conditions of a country, the number and size of existing institutions, teacher salaries in comparison to other professional salaries in the system and national funding for higher education are likely to be useful input variables. A single output may either be output/input ratios or number of graduates entering the workforce on a full-time basis within a certain reasonable period. While a model like this may seem simplistic, it will still be able to provide useful system level information that currently does not exist. Additionally, this would also underline the importance of connectivity and cooperation within input parameters and will be scalable to a much richer network model as more data becomes available.

Once the initial available data is collected and an initial general model devised, the next – more exciting – step would be to begin deepening and applying the model to specific countries and regions. For this, reliable data will need to be obtained from a given country or a small set of countries tied together either geographically or in economic conditions. Acquiring such data would require significant fieldwork and possibly original data collection. It would also require an interdisciplinary focus and inputs from a variety of fields. While the initial investment is significant, the outcome of such a unique interdisciplinary effort would be the foundation of an intellectually rich and powerful tool to study higher education and international development.

Concluding Propositions

Based on our reflections on the discussions at the October 2009 workshop, we offer the following

“... a process of identifying what a ‘successful and sustainable’ higher education system in a developing country looks like should be initiated ...”

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propositions in terms of the complexity of higher education systems in the developing world:

1. Higher education systems are inherently complex, irrespective of the region or economic conditions of a country. Such systems in developing countries exhibit special and additional features of complexity.
2. Little to no effort has been made towards mapping the dimensions of this complexity and serious gaps may exist in the data needed to do so. However, there is a clear need to develop preliminary quantitative models that can help to develop a better understanding of such systems and to identify real policy options for meaningful future improvements in these systems.
3. Despite informational limitations, it is possible and important to begin a process that would ultimately lead to the development of such a quantitative model. To do so, a modular approach should be adopted, beginning with initial collection of existing data, moving on to filling data gaps by field collection of data in a particular country or region, running a preliminary model based on the above, and finally moving to the development of more generalizable models.
4. In order to complement the above, a process of identifying what a “successful and sustainable” higher education system in a developing country looks like should be initiated with the aim of developing a “system index of higher education” that can regularly track and assess the performance of higher education at the system (as opposed to the institutional) levels. ●