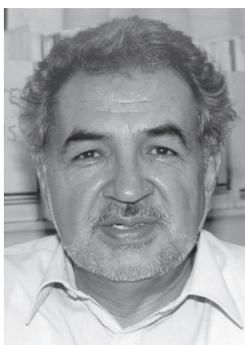


Research socially responsible: may we speak of a mode 3 knowledge production?

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Jaime Jiménez

Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, Universidad Nacional Autónoma de México, Mexico City, Mexico
jjimen@servidor.unam.mx

Abstract

A collateral effect of the globalization of the economy is the “globalization of science”. Part of the scientific production thus appears to be linked to the needs of the global markets. In the past 20 years, new alternative ways of “doing science” have emerged throughout the world whose most important characteristic is their intimate relationship with the solution of problems of local or regional communities. This paper reflects upon an experience that currently takes place in Mexico, where research is intimately linked to the learning function, and is strongly rooted into the New Information and Communication Technologies.

Keywords

Mode 3, knowledge production, social accountability, Regional Scientific Communities, development

Introduction

A collateral effect of the globalization of the economy is the “globalization of science”, in the sense that part of it works at the service of the global economy. Part of the scientific production thus appears to be linked to the needs of the global markets. However, in the past 20 years, new alternative ways of “doing science” have emerged throughout the world whose most important characteristic is their intimate relationship with the solution of felt problems linked to local or regional communities. Although they share some of the characteristics of “Mode 2” research, as defined by GIBBONS et al. (1994), they differ drastically in the sense that they really are socially responsible. These new forms

are a response to the need to make scientific research more participative, more closely linked to the groups that would be affected by its results, incorporating thus in the decision-making process, not only the researchers themselves, but also those agents that would be directly affected by its products. This paper reflects upon an experience that currently takes place in Mexico, where research is intimately linked to the learning function, and is strongly rooted into the New Information and Communication Technologies (NICT). This form of doing “research in the service of humanity” is consistent with an alternative definition of development that is not necessarily linked to “growth”, as traditionally reflected in economic statistics. Development is not a question of what one has, but of what one can do with what one

has. Development is the ability and desire to use what is available to continuously improve one's quality of life (ACKOFF, 1974). Projects like the one described here provide a sense of progress in the right direction, in the direction of true development. We call this way of knowledge generation "Mode 3", to differentiate it from Mertonian (Mode 1) and Gibbons' (Mode 2) way of doing science. Mode 3 is a mode of knowledge production whose distinctive characteristic is a commitment to be at the service of mankind.

What is development?

Development is a concept easy to grasp intuitively, however difficult to define operationally. Actually the term is associated with entire nations rather than with individuals or organizations. In practice, the meaning of development and the relevance of indicators used by international agencies, are usually taken to be obvious or self-evident. National development indicators "measure" certain aspects of inhabitants' lives that may be associated with the "standard of living", not necessarily with the quality of life. International agencies like ONU, UNESCO, FAO, the World Bank, BID, use indicators of development such as GDP per capita, real per capita income, average schooling years, life expectancy, that are gross measures of development, without any discriminatory procedure to assess how wealth, health or education are distributed among the population. This leads to the paradox that although Mexico is the 10th world economy (WORLD BANK, 2003), 53.7% of its population is at the poverty level (SEDESOL, 2002).

It would be convenient to have an operational definition of development for a construction of an appropriate measure of it. Since there is not such a thing, the indicators currently in use are based on subjective judgments. However, since consensus among those who make these judgments is not achieved, there is not generally accepted set of indicators.

The road for a nation to become developed is not clearly defined. One can select a "developed" nation as a model and try to imitate it. Since there are not widely accepted criteria of what a developed nation is, agreement on the model to follow is difficult to achieve. The decision is made by political or economic reasons rather than by a generally accepted concept of what we mean by development. A question frequently raised when a country is making efforts to select the best road to development is whether it can avoid the errors committed by developed countries in their process to reach a higher standard of living, like high levels of pollution, high population concentrations or traffic jams in the urban areas. Experience shows that one has to learn from its own mistakes. Although the problems are not the same, similar problems are confronted by countries in the process of development, and the solutions are not necessarily those adopted by more advanced countries. In conclusion, each country has first to define what development is for its inhabitants, and then design its own ways to approach it.

Development and growth

As mentioned in the introduction, development must not be confused with growth because they are not the same thing. Growth is an increase in size or number, so when the GNP of a country increases, it is correct to say that its economy is *growing*. That is not to say that the country is *developing*. Many emerging economies experience both a process of economic growth and an increase in the number of dispossessed at the same time. This phenomenon is taking place in many countries that enthusiastically take part in the global economy but maintain an unbalanced distribution of wealth. Likewise, a person may experience an increase in economic wealth while diminishing his or her quality of life, hence becoming less developed. Continuous growth of a country's economy is generally considered to be desirable if not necessary for continuous national development. This is not the case: the relationship between growth and development can only be understood when the nature of development is properly understood.

A systems approach to development

Ackoff's concept of development expressed in *Redesigning the Future* (ACKOFF, 1974) was further explored and refined in subsequent writings. In *A Prolog to National Development Planning* (GHARAJEDAGHI et al., 1986, p.18) development is defined in the following terms:

Development is the process in which people increase their abilities and desires to satisfy their own needs and legitimate desires and those of others *with what one has* (text in italics added).

It is most important to the purpose of the subscriber to maintain the clause referring to the *available means* of the original definition, since it is what gives sense to *development* in a *developing* country. Indeed, a major obstacle for development in a developing country is the lack of awareness of our people of their capabilities to transform the world around them, *with the available resources*, and this is achieved when people design their own future and the ways to approach it as is the case of the Reflection and Design Conference.

Needs are those things that are necessary for survival, for instance food and oxygen. What is needed may or may not be *desired*, for example one may need an insole because of a flat foot condition but it is something that may not be desired. On the other hand, persons may desire things they do not need, for instance to take a trip to the beach. A *legitimate desire* is one "that the pursuit or fulfillment of which does not reduce the likelihood of fulfillment of the needs and (legitimate) desires of others. Therefore, an increase in the ability or desire to harm others is *not development*, but an increase in the ability or desire to help them *is*. This implies that efforts to prevent illegitimate acts are themselves legitimate" (GHARAJEDAGHI et al., 1986, p.18, emphasis added).

Ackoff's definition of development is most suitable for societies enduring great scarcities, material and

otherwise, to engage in projects that would approach a better quality of life regardless of the reduced means available. Realization of projects based on this definition of development, gives the participants a sense of progress in the right direction.

What is taking place in the world with respect to the way science is realized? Is it going in the direction of development in Ackoff's sense? Who's getting the benefits of science? Is science expenditure properly allocated? These and other questions have been posed for the past 10-15 years. UNESCO has been highly involved with the matter and called for a world conference to revise the way science is going, in 1999. Very challenging conclusions were reached at the Conference, which are discussed next.

New 'Social Contract': the spirit of Budapest

Toward the end of the decade of the nineties of the past century, the role that science plays concerning society and development comes under serious scrutiny. In the past, science policy was based mainly on acts of faith. Faith that research activity would conduct naturally to technological innovation, which in turn would guarantee economic growth, and thus social cohesion and peace. It was believed with certain naïveté that 'what is good for science, is good for humanity', leaving science policy decisions in the hands of scientists.

Currently, such acts of faith are severely challenged in light of the fact that scientific and technological advances that have contributed to economic development, have also brought about irreversible ecological deterioration, technological disasters, and the development of massive destruction weaponry of low cost and difficult dismantling. All of the above unfortunately associated to the exacerbation of social inequality, exclusion, and the increase in the asymmetries between nations, in terms of wealth and power.

The above challenges motivated UNESCO to organize the World Conference on Science: 'Science for the 21st Century' (UNESCO, 1999a; b), in Budapest in 1999. The objective of the Conference was the formulation of a new relationship between science and society, that is, a new 'social contract' (MAYOR, 1999), based on the assumption that science is to be subjected to public scrutiny. The debate on the need for a democratic discussion of scientific priorities, the size of its budget, its institutional structure, and the use that is given to the results of scientific labor, was recuperated. It was asserted that such decisions cannot be left simply in the hands of scientists and government officials.

At the Budapest Conference, emphasis was also made on the point that scientists must not orient their research solely toward topics that appear attractive grant-wise, as are military research and research that responds to market requirements, but also topics related to general social interest. Scientific research must not be developed as isolated disciplines, but based on inter and trans-disciplinary approaches that will bring about a convergence

between natural and social sciences, as a means to understand reality fully, and to transform it. What is sought here is to confront with greater possibilities of success the challenges that the twenty-first century presents, in terms of advancing toward a society with greater liberty and equality among men around the world.

From the Budapest Conference it is acknowledged that we must create the framework for a *new social contract with science*, that is based on the participation of large sectors of society, and not only on those currently having a stake in it. A new contract where decisions are made based on large social networks. This is not to say that organizational forms for decision-making that have been perfected throughout the past and that, in general, have produced good results for the advancement of science, must be dismissed.

The objective is to obtain a wise balance between academic autonomy and social responsibility, access to results and benefits produced by science and the legitimate individual interests of those that promote it, redistribution of knowledge and copyrights, economic growth and ecological equilibrium, demands that originate in the market and those that do not, long-term and short-term projects, collective and individual interests.

The agenda for a new social contract with science appears complicated. On the one hand, it is not clear whether 'hard' scientists would be willing to yield the privileges they have traditionally enjoyed, sharing their decisions with society at large. On the other, it is not clear how social groups can involve themselves in an informed manner. The ideal situation is to identify ways that allow the points discussed in Budapest to be understood as legitimate topics of public interest, subject to new decision-making mechanisms that go beyond those that utilize experts in corresponding sectors. This set of ideas constitute the 'Spirit of Budapest'.

A new paradigm proposed for science and technology

At the end of the 20th century, some authors observed that in previous years, the way of "producing knowledge" had changed, and proposed a new model (GIBBONS et al., 1994). This new way co-exists with the traditional form, and it comprehends not only science and technology but also the social sciences and the humanities. It affects:

- What knowledge is produced.
- How it is produced.
- The context in which it is produced.
- The way in which production is organized.
- The system of rewards it activates.
- The mechanisms that control the quality of what is produced.

These characteristics are firmly articulated in the case of the "hard" sciences: physics, chemistry and biology. Inasmuch as the social sciences and humanities

have tried to imitate the “hard” sciences, similar social systems have been implemented to govern production of knowledge in these areas. To distinguish them from the traditional form, these authors denominate the new mode of knowledge production “Mode 2”, and named the classical way, “Mode 1”.

What follows are some characteristics of Mode 2, in the context of the applications:

- Problems are not restricted to a discipline or a group of disciplines (multi-disciplinary), they are trans-disciplinary.
- The work is carried out in non-hierarchical, heterogeneous and transitory organizational forms.
- No preference to university institutionalization.
- Implies close interaction of many actors.

- In light of the above, the production of knowledge becomes more socially accountable.
- Utilizes an ample range of criteria to apply quality controls.
- Mode 2 becomes more flexible and deeply affects what counts as “good science”.

In contrast, the term “Mode 1” refers to a form of production of knowledge –a complex of ideas, methods, values and norms- that has been developed to disseminate the Newtonian model to more and more fields of inquiry and insure that what is considered “established scientific (formal) practice” is observed. Table 1 compares the main characteristics of the two modes of producing knowledge, according to their authors.

Table 1 - Comparison of the characteristics of Mode 1 and Mode 2 of knowledge production

MODE 1	MODE 2
Problems proposed and resolved by a specific community	Problems proposed and resolved in the context of applications
Disciplinary	Trans-disciplinary
Homogeneity	Heterogeneity
Hierarchical organization	Heterarchical organization
Permanent	Transitory
Peer quality control	Quality control by diverse actors
Less socially accountable	More socially accountable and reflexive

Source: GIBBONS et al. (1994).

Mode 2 includes a larger group of “practitioners”, that are temporary and heterogeneous, that collaborate in a problem defined in a specific and localized context. According to this orientation, there is a potential imbalance between the *volatility* and the *permanence* of institutions that cultivate Mode 2 knowledge production. This is a new situation that appears as intermediate between stable and flexible organizational forms. The production of knowledge is each time a less self-contained activity. It is neither the “science” of the universities or the “technology” of industry. Authors assert that a fundamental change in Mode 2 consists in that *the production of knowledge is each time more a “socially distributed” process.*

Finally, Mode 2, according to its proponents, presents the following attributes in addition to those pointed out in Table 1:

- It is highly contextualized.
- “Marketable knowledge”.
- Porosity of disciplinary and institutional boundaries.
- Interchangeable scientific careers.
- Trans-disciplinarity in other than “hot” topics.
- Growing importance of hybrid fora in the configuration of knowledge.

- Fora constituted by experts and non-experts as social actors.

In conclusion, at the beginning of the 21st century we are before different forms of doing science as the proponents of Mode 2 (GIBBONS et al., 1994) have observed, however these new forms battle on different grounds: while some (Mode 2) seek mostly to satisfy demands for knowledge in favour of the global economy, which benefits a few, others are congruent with “the spirit of Budapest”, and seek to have science be in the service of the communities that give it sustenance, and aspire to a better quality of collective life. What follows shows how some put into practice “the spirit of Budapest”.

The Centre for Innovation and Educational Development (CIDE)

CIDE owes its origins to the efforts of a group of established scientific researchers, with more than two decades of experience in the educational environment, which became conscious of the need to break with the traditional methods of higher education and graduate study, as well as with the creation of new regional centres for research that truly responded to regional needs. The

end result of this effort is the implementation of research networks called “Regional Scientific Communities”.

In the beginning, the idea is advanced by the initiative of Dr Miguel Arenas, a professor of the Autonomous Metropolitan University-Xochimilco, in Mexico City, Mexico, to put in practice a model of innovative education in diverse universities throughout Mexico, based on the acknowledgement that the demand for higher education for the first 20 years of the 21st century, would not be able to be satisfied through traditional educational systems. The model is based on the *problem-based learning* methodology, which consists of reversing the pedagogic process of knowledge transmission from teacher to student, to a process of knowledge creation which starts-off with the student confronted with a real problem, where the professor acts as guide and facilitator of the learning process. Dr. Arenas finally obtains an agreement with the University of Colima, in the state of the same name, in Mexico; to have his model established side by side the traditional program, as an alternative graduate study.

After one generation, however, the University of Colima decides to end the relationship with Dr Arenas’ group, and suspends the program. Some of the graduates however, established already in higher education institutions in other parts of the country, some even at Colima, give following to the idea, and struggle to have it revived. In 1984, a group of these professors at the Autonomous University Antonio Narro in Torreón, Coahuila, give birth to CIDE, and are able to have the program established in that institution as part of the educational offer. Unfortunately, the experiment followed the same fate experienced by the University of Colima, and the program was closed definitively, although the students that were already enrolled were allowed to complete the program and obtain a degree from that institution.

CIDE thus continued as a virtual network of concerned professors aware of the lack of opportunity and access to graduate education in formal institutions for individuals unable to attend face-to-face programs. It is not until 2006 that CIDE finally obtains official recognition through the State of Sinaloa’s Ministry of Public Education and Culture, when it merges with the Justo Sierra Study Centre (CEJUS), in an arrangement that was to provide benefits for both organizations. While it allowed CIDE to obtain official recognition, it satisfied the latter’s aspiration to extend its educational offer to include higher education and graduate studies.

CEJUS in itself is another experience in innovating education which merits special mention, where this author has participated as external consultant, for more than 20 years. The Centre is created as a result of the demands of the local Parents’ Association to improve the quality of elementary education for their children. In subsequent stages, their demand broadened to include pre-school as well as post-elementary agricultural education. In part, their goal was to prevent the flight of their youth, as they were forced to abandon their community if they wished to continue studies, and relocate in the state’s capital. At

the present time, the Centre now boasts the “University of the Mountain Range”, offering bachelors’ degrees in agricultural disciplines, and is also host to the CIDE program. For more information regarding this important educational experience, see JIMÉNEZ (1992), and CEJUS’ own publication concerning its origins (COMITÉ DE PLANEACIÓN EDUCATIVA, 1980).

CIDE’s learning methodology

The CIDE model bases its methodology on the advances made by the cognitive sciences, which demonstrate that learning is achieved –specially concerning higher learning and mastering abilities– when emphasis is changed from *teaching to learning*, based on the student’s *individual and group learning* activities.

These systems consider the students’ heterogeneity of conditions, which makes it necessary to design non-uniform programs, which adapt to the special circumstances of the individual. In this way, these models guarantee the democratization of education (JIMÉNEZ et al., 2007, p.9), providing the student equal access to education as well as individualized attention, liberating education from the dogmas of traditional pedagogy so that the student is able to go through an individual process and design his/her own learning, reaching intellectual independence through the permanent exercise of critical judgement.

Given the contemporary importance of the use of information, a basic methodological principle that the method’s authors encourage in students is the search and use of information located in the frontier of knowledge, with the aim of guaranteeing that their research projects and actions are solidly grounded on data reported in the current and highly visible specialized literature.

The research problem that moves the student’s interest is searched in Internet as a first approach to identify the corresponding bibliography. Through the powerful Internet navigators, the most recent, no more than five years old, articles concerning the topic are identified, selecting, in addition, those published in the most prestigious journals, as ranked by the Science Citation Index, from “Thomson ResearchSoft”, a Division of Thomson Scientific. From here, the student selects a number of articles, placing special attention to the review material, since these works provide the “state of the art” of the discipline, a synthesis of the most recent and relevant research in the student’s area of interest.

Subsequently, the student performs what CIDE denominates “macro-reading” and “horizontal reading”, which consist of methods that provide a way to scrutinize the selected articles, with the aim of extracting the most relevant information to the student’s research. He/she also identifies the World leaders on the topic of interest, by noticing who the most frequently cited authors in the articles are.

The use of the most advanced informatic means to support the students’ research activities is notable. Most among these is the software program called EndNote®¹,

a system of administration of bibliographic resources that considerably speeds up the search and construction of bibliographic notes. With the aid of this program, students have access to the largest data bases on academic information, accessed by way of keywords, author, or title of the article.

In addition, the program builds a file of bibliographic notes for future reference, a process which takes place in an automatic manner. The program outputs a list of the most cited authors on a particular topic, that is, the topics of greater scientific relevance at the time.

With the use of this technology, the students are able to identify the more relevant papers, even those that have not yet been published (articles that have been accepted and programmed for publication at a later date). Since the program includes authors' personal data, CIDE students are able to establish personal contact with authors that are leaders in a particular field of knowledge or research thematic, thus creating their own "network of experts". One of the advantages to this personal contact is the possibility of asking for print-copies of the authors' work at no cost. Some students have gone so far as to collaborate, co-authoring articles, with the most renown authors in their field of study.

To follow-up the advances of the participants' research, socialization of knowledge sessions are organized, where students exchange experiences regarding both the learning method and the research itself. The socialization of knowledge sessions are one of the innovating contributions of the CIDE, since, in contrast with other systems based on learning, the student has the opportunity to present his advances, air doubts, propose critiques, not only before his tutor, but also before other tutors, and students that have different levels of advance. At the same time, he receives feedback at once from all participants that want to contribute, complement, or help solve important inquiries, based on their own experience and problems. At the end of the contribution/comments session, the adviser provides his expert opinion as well as his own contribution to the work of the student, collects his advances, in agreement with a previously accorded schedule, and sums up with general considerations on the results (JIMÉNEZ et al., 2007, p.11). The observations that peers make are both of form and content. The relationship among students is determined by the existence of some shared abilities, like the information gathering method, the bibliographic analysis, among others.

The tutor plays an important role in the academic life of the student. Through his advise, allowing the student to become independent in the construction and approach of his object of study, the tutor becomes a counsellor and interlocutor, aiding the student to fulfil those activities that will allow him to learn and demonstrate that he has the attributes that identify him as a Master or Doctor in Science. As part of the evaluation process, the tutor certifies the formation of the student as he validates the fulfilment of his work program (JIMÉNEZ et al., 2007, p.12). It can be observed that the feeling

of belonging is strong, since participants express having had the opportunity to belong to a scientific community committed with its objectives.

CIDE's methodology brings together the most advanced proposals that emerge from innovating, new and alternative education methods, which have recently materialized in the concepts of *open education* and *distance education*.

In essence, the defining characteristics of open and distance education, based on the model of one of the most prestigious institutions in the field, the *Open University of the United Kingdom*, are freedom in registration, of place of study, of method, and of ideas. They provide learning opportunities to all individuals that lack economic means and education certification, accepting students of any social and economic status, and place of residence.

However, alternative education must convince other institutions that its quality is equivalent to that imparted by traditional institutions, in face-to-face environments. The assumption behind the above is that to achieve social objectives of equality in access, open and distance education have to be of high quality. TORRES BARRETO (2006) enlists the principal pedagogic-cognitive characteristics that these models exhibit:

1. The system must gear the student to pinpoint, interpret and analyze his goals, both in the initial moment as well as during his interaction with the instruction program.
2. The system must formulate learning objectives so that they will become the basis for the selection of pedagogic methods, including the evaluation, so that they can be fully known, accepted or modified by the students.
3. The system must facilitate the participation of all those that want to learn without imposing traditional entrance requirements upon them and eliminate the degree or other certification as the only reward to be obtained for study.
4. With the object of obtaining the flexibility required to satisfy a broad spectrum of individual needs, the system should allow the effective and optional use of sound, television, film or printed media as vehicles for learning.
5. The system must recur to task assignment and evaluation principally to diagnose and analyze to what extent learning objectives have been accomplished. In other words, the system must be based on the student's own competences.
6. The system must be able to overcome the distance between teaching staff and students, utilizing that distance as a positive element for the development of learning autonomy.

As the same author asserts, it is not just about one more variation of traditional academic modalities, a semi-schooled, bi-modal type or integrated model variation, in which within one same system, face-to-face and off-site students share the same programs and the same teachers. The really open and innovating education system needs

an organizational and administrative structure that is different to face-to-face modes. The Regional Scientific Communities in Mexico, put precisely that in practice, and in addition, they gear the student to concentrate on a specific object of study of interest to him, that is associated to a field of work in which the student is engaged. Thus, CIDE's strategy responds to the most immediate social needs, emphasizing the principle of direct participation of stakeholders, including those that receive the benefits of science, in all levels of decision.

Regional scientific communities

CIDE constitutes itself a *learning community* whose basis is scientific activity, scientific methodology, and access to a technological platform (Endnote and other Internet tools) of the highest order made possible by current advances in informatics and communications.

CIDE's objective is to *form Regional Scientific Communities*. The community is formed on the basis of a group of "brains" whose members share an interest in scientific development, and put all their efforts to attain that objective. Generally they are individuals that belong to educational institutions, research centres, and in a small percentage, to private enterprises. In the words of one of their founders: "we are above all interested in generating 'brains' who are already involved in a professional activity (teaching, research, laboratory analysis, agriculture, farming, etc.)" It is clear that these communities do not emerge from universities, even when they are involved in research, since they exhibit different objectives.

These communities have given rise to virtual *regional research centres*, that is, facilities that are negotiated by CIDE's own members through contacts, as laboratories, to conduct experiments as needed by students, meeting rooms for the socialization of knowledge, or informal meetings. This was the case in the first institution where the program was offered, the University of Colima, where CIDE was able to use the institution's laboratory of Biotechnology, to produce important scientific results that were published in international journals. Following is a list of the Regional Scientific Communities that have been established and some of their lines of research.

Colima (1982). The community has produced in the laboratory facilities more than 20 doctoral theses that have been published in international journals. Their fields of research are: adaptation to high temperature climates and droughts, vegetable domestication, biological fertility of the soil, ecology of the rumen, plant-pathogenic interaction, in-vitro production of thyroid cells.

Torreón (1999). Research is conducted on portal hypertension of chickens, use of chromium in animal feed, degradation of cell walls by rumen organisms, immunology, dengue and malaria, animal reproduction, caloric shock proteins, pollination with bees.

Sinaloa (2001). Work is conducted on phyto-remediation and phyto-extraction of gold, entomo-patho-

genic nematodes, biotechnology applied to tuberculosis, determination of costs for the production of scientific data, bio-sensors, production of shrimp in farms, plant-pathogen interaction, construction of underground dams, territorial re-ordering, production of alternative species, populations genetics of crocodiles, eco-tourism.

Puebla (2001). Research is conducted on prionic proteins, tuberculosis.

Nayarit (in formation process). Research is conducted on tuberculosis, scientific principles of homeopathy.

CIDE is a social system of peculiar characteristics. It has been operating throughout 20 to 25 years, with positive results. Unfortunately, the experience has not been properly documented, so our "data mining" labor has been excruciating. According to LÓPEZ-PÉREZ (2004), CIDE's objective is *the formation of Regional Scientific Communities*, and it has gradually been reaching such an objective. The same informer asserts that 77 individuals have graduated from CIDE with Masters and Doctorate degrees. This is not, nor does it pretend to be, the solution to the problems of high level human resources formation for the country, however, it is a viable alternative for professionals who need to reach a higher academic degree but cannot undertake traditional graduate programs.

CEJUS has become the cohesive node of the different CIDE groups distributed throughout the country. CEJUS, on the other hand, is an alternative education project that shares many of CIDE's characteristics (JIMÉNEZ, 1992:415; JIMÉNEZ et al., 1999:171; ZÚÑIGA, 2004).

In synthesis, CIDE's experience demonstrates that it is possible to reach desired objectives with a system whose parts enjoy ample flexibility, without the need for a costly physical and human infrastructure. The "glue" that brings together the different parts of this system is, convincingly, *the motivation* that each member has for reaching his/her particular objectives, as well as CIDE's general objectives.

Mode 3 Knowledge Production: research socially responsible

How do we define Mode 3 knowledge production? It shares some of the properties of Mode 2 research but with the distinctive characteristic of being closely linked to current societal needs. It may be argued that *all science* is for the benefit of mankind. This assertion is questionable and needs to be proved. There are plenty of examples of science that directly or indirectly damages the well being of human kind.

Mexico's *Regional Scientific Communities* are innovating ways of creating knowledge. Paradoxically, the property of "social accountability" which appears in Mode 2 as a debatable aspect is really present in these new forms of doing science. Also, Mode 3 are bottom-up initiatives, whereas Mode 2 are top-down. Table 2 compares the most relevant characteristics of Mode 2, and Mode 3.

Table 2 - Comparison between the characteristics of “Mode 2” and “Mode 3”, as observed in the Mexican “Regional Scientific Communities”

PROPERTY	MODE 2	MODE 3
Problems posed and resolved in the context of applications	Yes	Yes
Trans – disciplinary	Yes	Yes
Heterogeneity	Yes	Not necessarily
Heterarchic organization	Yes	Yes
Transitory	Yes	Not necessarily
Quality control carried out by diverse actors	Yes	Yes
More socially responsible and reflexive	No	Yes
Bottom-up initiative	No	Yes

We can assert that we are before new forms of doing science that correspond to current demands of the social texture. On the one hand, Mode 2 pretends to describe how science is organized to cope with the demands of competitive knowledge, ready to use in products and services, in an economically globalized world. On the other, the Regional Scientific Communities indeed respond to real social and material regional needs. The Regional Scientific Communities, are an answer to the needs and desires of a segment of society, and implement innovative forms of learning and research better suited to the social and economic conditions of the segment that it serves.

The Regional Scientific Communities respond, in effect, to demands and needs felt by society as a whole, that is, they are *socially accountable*. Mode 2, in contrast, despite the claim to that effect, responds more readily to the needs of the market which do not necessarily take into account the needs of society.

Conclusions

The Regional Scientific Communities of Mexico are only a Latin American example of new forms of doing research. The scientists of CIDE refer to a way of organizing learning and research similar to the one practiced by them, taking place in Finland, a Scandinavian country with culture and customs quite different from the Mexican case. On the other hand, new ways of interacting between science, technology and society in which lay people work along with scientists to produce and diffuse knowledge, have been developed in France. The term “research in the wild” has been coined to refer to this new phenomenon (CALLON et al., 2003). These authors give account of the organization of muscular dystrophy patients’ relatives, to collect information about the generation and development of this terrible illness. Relatives discuss their findings with specialists, engaging in a new type of interaction in which lay citizens contribute to the knowledge of an illness of such complexity that surpasses the capacity of specialists to at least have a better understanding of the same. In this

case, interested groups show the ways research must be conducted, even demanding the specialists to explore the research lines discovered by them.

In conclusion, at the dawn of the XXIst century we are before new forms of doing science as observed by Mode 2 proponents, and Mode 3 as advanced in this paper. These new forms militate in different fronts: some (Mode 2) look to satisfy the demands for knowledge to the benefit of the globalized economy, serving the interests of a few. Others (Mode 3), like the Regional Scientific Communities, are congruent with the “spirit of Budapest”, and seek that science be at the service of those that sustain it, serving the interests of many, and leading to a better quality of collective life. Mode 3 main feature is that it seeks to solve felt needs of specific communities, hence actually being more socially accountable than Mode 2.

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About the author

Jaime Jiménez

He studied Physics at the National Autonomous University of Mexico (UNAM) and pursued a career as a researcher in Space Science at the same institution. His interest in systems in its broadest sense led him to pursue a doctoral degree under the direction of Russell L. Ackoff and Eric Trist at the Wharton School of the University of Pennsylvania. He is a full-time researcher for the Institute of Applied Mathematics and Systems (IIMAS), UNAM, since 1972. He is the founder and Head of the Mathematical Modeling of Social Systems Department at IIMAS. Currently, he is involved in research in the science and technology, education and health systems. In addition, he is specialized in development processes, participative strategic planning, quality of working life, total quality, and group dynamics associated to organizational change. He has developed and used extensively a modality of Emery and Trist's Search Conference, named the Reflection and Design Conference, as a tool for initiating robust processes of participative strategic planning. He has conducted research projects for UNESCO, OIT, and Mexican public agencies. He is editor of a Newsletter in S&T, and associated editor of "Science Studies". He is currently the President of the International Sociological Association, Research Committee 23: Sociology of Science and Technology. He has published several books and research papers in specialized journals. In terms of administrative positions, he has been Head of Department and Academic Secretary at IIMAS. He currently conducts a doctoral Seminar in Planning at UNAM. He has been in consulting for private and public organizations, national and international, since the early 1980's.