Knowledge: future challenges for Brazil

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Knowledge is the great generator of wealth in the contemporary world. For this reason, it is already commonplace to say that we live in an economy and society of knowledge. It is, therefore, opportune to analyze the situation of knowledge in Brazil, its perspective for future development and its relationship with economic development, considering greater human and social well-being.

When we refer to the generation and use of knowledge by society, we are speaking of a variety of activities that range from the generation of pure knowledge (science) and applied knowledge (technology) to the capacity to, based on this knowledge, produce wealth (innovation). We must also remember that citizens must be able to use knowledge in useful and productive manners. For this reason, quality education at all levels is essential.[1]

At the end of the 19th century, Scotch physicist Lord Kelvin (William Thompson, 1824-1907) affirmed that "what cannot be measured, cannot be improved". This phrase became popular among physicists, and emblematic among metrologists. Can it be applied literally to fields beyond the hard sciences? Certainly not. But we can modify it by saying; "what can be measured, can be improved more easily". Looking towards Brazil's future, we can work with the statistical quantification of opinions of a significant number of people, but also with indicators – and their trends – that attempt to measure reality. An inquisitive look at the future allows formulating scenarios that, if carefully constructed, can provide indications about which public policy routes are most suitable for the present.

This essay will show that the situation of education and the generation of knowledge in Brazil has changed satisfactorily in recent decades. Nevertheless, the country's economy has dragged through crisis, and economic growth rates have lagged behind developments in science and education. What is missing? It is clear that macroeconomic policies and adequate institutions are essential for economic and social development. We will limit our comments to aspects of knowledge, seeking to identify impediments to the country's development, considering as a horizon the year 2022, the bicentenial of Brazil's independence.

The dimension of knowledge in Brazil's future

Efforts of a prospective analysis of Brazil have not been very common. In 1998, the Secretaria de Assuntos Especiais da Presidência da República [Secretary of Special Affairs of the Presidency of the Republic] prepared a pioneer study denominated Brazil 2020 (Sardenberg, 1999). In the years 2004-2005, the Núcleo de Assuntos Estratégicos da Presidência da República (NAE) [The Presidential Center for Strategic Studies] conducted, in conjunction with the Centro de Gestão e Estudos Estratégicos (CGEE) [The Center for Management and Strategic Studies], the Project "Brasil 3 Tempos" (Br3T) [Brazil in 3 Moments], which studied scenarios for the country's future in 2007, 2015 and 2022, considering seven factors, one of which was knowledge. Projects of this nature are usually based on opinion studies called Delphi. In this type of study, a significant number of people give their opinions about the questions formulated. The answers are statistically quantified and analyzed in order to prepare future scenarios (see the article by Wright & Giovinazzo Spers, in this publication, for a discussion).

In the "Br3T" project, 50 issues were formulated. Among them, the five considered to be of greatest importance are listed in Table 2 of Appendix A. Of these five, the two considered most important are related to knowledge and specifically to basic education (defined here as the combination of elementary and high school education). The perception of the importance of these two issues is similar. Nevertheless, the probability of the outcome was seen quite distinctly. While the perception of the probability of achieving universal education is relatively high (59% for the year of 2022), respondents were much more pessimistic that quality education will be obtained (only 41% of those who responded, believe that this will be reached).

Other issues related to knowledge considered to be important concern investments in science, technology and innovation (2% of Brazil's GNP in 2015 and 3% in 2022), competitive participation in the international biotechnology market and the expansion of higher education. The other three of the five issues considered to be most important refer to a 50% reduction in criminality, more than 2% annual growth in employment and reduction of social inequality to a level close to that found in developing countries. Of these, that considered least probable to occur was the 50% reduction in criminality, followed by the reduction of social inequality. It is interesting to note that the five issues considered most important involved aspects of a social character: basic education, criminality, employment and social inequality; in some way, all are related.

Human development indexes

The Human Development Index (HDI) is an indicator developed in the early 1990's by the United Nations Development Program special adviser Mahbub ul Haq. It measures human development based on three parameters:

schooling, longevity and per capita income. It is, therefore, an indicator that measures three important elements of life: education, health and well being. A summary of the HDI, as well as relevant statistics, can be found in the Human Development Report (2005), published by UNDP.

The idea of using HDI as a parameter for study of the future is different from the technique for projecting scenarios with the Delphi method. It involves a comparative study of countries, which in a certain way could be described as benchmarking. Some authors for example, have worked with the hypothesis of projecting Brazil's HDI through 2022, when it would be similar to that which Spain or South Korea have today.

In 2003, Brazil's HDI was 0.792. This is the average of the indexes of life expectancy (0.76), education (0.89) and per capita income (0.73). Brazil's annual HDI growth rate was + 0.0051 per year. This was one of the highest among similar countries in terms of economic development, exceeded by that of China (+ 0.0089) and equaled by that of South Korea (+ 0,0051). If Brazil continues to evolve at this pace, we would reach 2022 with an HDI between 0.86 and 0.88. In 2002, countries with similar HDI's were Argentina (0.853) and South Korea (0.888).

Three scenarios for Brazil's HDI until 2022

Below, we will discuss three scenarios for 2022. We will consider a demographic growth rate of 1% per year over the next twenty years and analyze three scenarios with average annual GNP growth of 2%, 4% and 6%.

An analysis of the evolution of life expectancy over the past 20 years shows that it grew approximately 3.1 years per decade. Is it reasonable to assume that life expectancy will continue to increase at the same rate over the next 20 years? The statistical data presented by the Human Development Report (2005) show that in economies where the per capita income is lower than US$ 4,000 Purchasing Power Parity (PPP), life expectancy tends to increase by nine years when that income doubles. Nevertheless, in countries with per capita income above US$ 4,000 PPP, life expectancy grows only four years when income doubles. This is due to a saturation phenomenon: the higher the life expectancy, the more difficult it becomes to increase it even more. A more detailed analysis suggests that in the Brazilian case life expectancy will only grow at a rate of 3.1 years per decade even if the economy grows at a rate of 6% a year (see Appendix).

This thinking is supported by the hypothesis that nothing extraordinary will take place during the time period in question – which is not a completely safe assumption. The past decades in Sub-Saharan Africa serve as a warning that something unexpected may negatively affect the evolution of life expectancy. Many countries in that region have suffered the strong consequences of the AIDS epidemic, which is reducing life expectancy in a dramatic and shocking form.[2]

If future HDI were calculated with an average annual GNP growth rate of 4% per year, Brazil would have passed to the group of countries with a high human development index (HDI above 0.800) in the year 2005. By 2022, Brazil would have an HDI of 0.875, a ranking between that of Argentina and South Korea in 2003.

If we were to calculate the HDI expected for 2022 based on average annual GNP growth rate of 2% per year, the rate would reach 0.854, similar to that in Argentina in 2000. If, however, we would assume an average annual GNP growth of 6%, we would have an HDI in 2022 of 0.905, similar to that of South Korea and Portugal in 2003. In recent decades, Brazil had increases in its social indexes (schooling and life expectancy). But these indexes are now reaching saturation. We see, therefore, that the future development of the HDI in Brazil will depend strongly on economic growth.

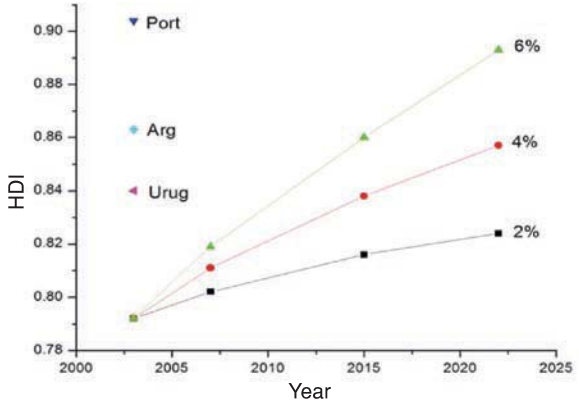

Figure 1 – Brazil's HDI evolution for the three considered scenarios: average GDP growth rate of 2%, 4% and 6% per year. Uruguay (Urug), Argentina (Arg) and Portugal's (Port) HDI in 2003 are also indicated.

Chart 1 - HDI of selected countries in 2003

Portugal	0.904
South Korea	0.901
Czech Republic	0.874
Argentina	0.863
Poland	0.858
Chile	0.854
Uruguay	0.840
Mexico	0.814
Brazil	0.792
Colombia	0.785
China	0.755

Social inequality: The Gini index

In Brazil's current stage, HDI growth is a parameter that basically measures the economic growth rate. Schooling and, to a lesser degree, life expectancy are already in the saturation phase, for this reason they change slowly (see Table B in the Appendix). It is thus possible to have a positive change of HDI without greater social equality.

To measure social inequality (which, in Brazil's case, is also associated to regional inequality), another indicator is necessary such as the Gini index, for example. This index, created in 1914 by Italian mathematician Conrado Gini, measures the degree of inequality in the distribution of individuals according to per capita household income (Hoffmann, 1998). Its value can vary from 0 (zero) (at which all individuals have the same amount of income) up to 100 (one hundred) (at which all income is appropriated by a single person). Brazil has one of the world's highest Gini indexes – nearly 59.3 (as of 2001) – which is exceeded only by a few African nations. We list, in chart 2, some indexes of selected countries, according to the Human Development Report (2005).

Chart 2 – Gini indexes of selected countries

Denmark	24.7
Japan	24.9
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Zimbabwe	56.8
South Africa	57.8
Brazil	59.3
Swaziland	60.9
Central African Republic	61.3
Sierra Leone	62.9
Botswana	63.0
Lesotho	63.2
Namibia	70.7

Even recalling that in the past decade there was an improvement in the Gini index in Brazil, it is important to recognize that it is still one of the most unequal countries in the world.

Meanwhile, it is known that one of the most effective forms of reducing inequality is by providing universal and quality education. It is estimated that nearly 50% of Brazilian social inequality is due to education. Projections of growing rates of schooling in Brazil allow predicting that inequality will begin to fall after 2007 and even more sharply after 2017 (Menezes Filho, 2006, personal communication).

Basic education

In the past 15 years, the levels of high school and college graduates and those with graduate studies in the Economically Active Population (EAP) grew surprisingly. The EAP with these educational levels grew between 4.5% and 7.8% (Table 1), and, in recent years, these trends accelerated, as shown in Table 2.

Table 1 – Education of the Economically active population (EAP) – in millions

	2001	Annual Growth 1991-2001)
EAP	84.7	+1.7%
No schooling	5.2	-4.0%
Elementary complete	47.6	-0.1%
High School Graduates	26.1	+7.4%
College Graduates	5.5	+4.5%
Master's or doctorates	0.28	+7.8%

Source: IBGE

Table 2 Graduates of the various levels of schooling

	Graduates (in thousands) 2002	Annual % growth 1998-2002
Brazil		
Elementary	2,778	3.9%
High School	1,884	5.3%
College	466	12.8%
Masters	23	15.3%
Doctorate	6.9	12.9%

Source: Inep

In 1992, one fourth of the EAP had completed high school. In 2000, this portion grew to one-third. Extrapolating the statistics allows forecasting that in 2009 half of the EAP will be high school graduates. Therefore, by 2009, Brazil will be a country with a majority of the EAP with elementary education. In that year, it will become a country where the majority of the EAP are high school graduates. Even if these numbers indicate that Brazil is still far behind developed countries in terms of basic education, it is important to recognize that, in only the past two decades, growth has been very significant.

Although schooling among Brazilians grew substantially in the past 15 years, the average GNP growth rate was approximately 2% in this period. This indicates that if we live in a society of knowledge, something seems to

be amiss. What is it? We know that improved educational rates alone are not enough to guarantee a country's economic development. The recent case of Argentina appears to demonstrate exactly this point. A country that basically resolved the issue of schooling at all levels, in a quite satisfactory manner, had its economic trajectory truncated.

The quality of basic education

As was said, the educational component in the HDI is calculated by the adult literacy rate (which in 2002 was approximately 83%) and by the percentage of the school age population in school. In terms of literacy, the Brazilian perspective for 2022 is quite positive. According to Schwartzman & Brock (2005), illiteracy among young people from 10 –25 is between 3% - 5%. These youths will be of complete working age in 2022. In the same way, the high rates of school registrations found in the country lead us to believe that this indicator should be above 92%. This indicates that the HDI for education will be in the range of 0.9 – 0.95 at that time, not representing, therefore, an impediment for the country to reach HDI levels comparable with those found in OECD nations today. An extrapolation of the data in Table 2 allows foreseeing that the universalization of basic education can be achieved by 2030. Specific actions can, evidently, accelerate this pace.

The issue related to basic education of greatest concern is that of quality. According to the Appendix, there seems to be a consensus that this is the issue of greatest priority and greatest difficulty for the country at this time. This theme was the subject of a dossier in the journal *Estudos Avançados* number 42 (Bosi et al., 2001).

A quite pessimistic diagnosis was revealed by an examination of the National Basic Education Evaluation System (Saeb) (implanted since 1990). According to this exam, the total number of students at a critical or very critical level in Portuguese language classes in the third year of high school was 42%. In Mathematics, it was 67%.

What can and should be done for this problem to be overcome? This is not the place to answer the question; a deep analysis of the problem is needed, involving society as a whole, but above all, specialists who can securely steer the course. Some points can be suggested, because there is a general consensus about them:

- Modern management practices must be incorporated in the organization of basic education. Evaluations at the national and state level are essential for us to know what is working and what is not.
- Access to new technologies, with emphasis on information technologies, distance education, continued education and digital inclusion, form a scenario of opportunities for Brazilian education.
- The family has a basic role in the education of all children. For this reason, the family itself must have a minimal structure and

education. The full-length school day (nearly nonexistent in Brazil) is also strongly related with school performance.

- The influence of the college entrance exam has been indicated as one of the reasons for the poor quality of high school education: "What defines high school education is the college entrance exam for the closest public university […] Too much is taught; for this reason, too little is learned " (Moura Castro, 2005).
- A central problem appears to be associated to the teaching staff. Better preparation of future teachers and continued education of current teachers should be part of the effort. Nevertheless, an essential issue that is more difficult to resolve is that of salaries. Brazilian society does not give value to elementary and high school teachers and this is expressed most clearly by the salaries paid to these professionals. Perhaps there is no solid evidence that paying better salaries creates more effective teachers. But it is certain that, in the long run, better salaries would attract and retain more and better talents to teaching.
- Comparisons (benchmarking) with other countries are useful. What are the best international practices? Why do Finland and South Korea stand out as the best in all competitions and quality indicators for basic education? Can we learn from them, or must we constantly reinvent the wheel?

Finally,

> Each society has the education that it desires. Ours is poor, mostly because we accept that it is so. Education has not been a real priority for society (ibid).

Higher education

The National Education Plan (published in 2001) calls for the number of registered college students to be 30% of the population from 18 – 24 years old by the end of the decade (2010). Statistics from OECD countries have higher percentages, reaching, for example, 80% in Korea.

How is Brazil evolving in this issue? It is possible to extrapolate this statistic based on data from recent years. INEP supplies data for high school and college graduates. The ratio between the number of graduates at each level is approximately the same as the proportion between registration at these levels. This concordance is high if the levels are stable. Fluctuations in the number of graduates, both in the numerator as well as the denominator, can generate slightly distinct data. In Table 3, we see that in 2003, 19.8% of high school graduates completed college. Considering the growing rate in this number in recent years, we can extrapolate the date at which the country will reach the goal of 30% mentioned in the National Education Plan: 2009, for Brazil as a whole.

Table 3 – High school and College Graduates. Percentage of the number of high school graduates who graduated college; year in which this percentage reaches 50%, extrapolated from the period 1999 -2003

	HDI	% college/HS	Year (50%)
	2000	2003	
Brazil	0.766	19.8%	2031
South	0.805	25.6%	2012
Southeast	0.804	25.0%	2014
Midwest	0.788	24.9%	2012
North	0.722	12.8%	2039
Northeast	0.681	9.8%	1062

Source: Primary data taken from INEP and IBGE.

The expansion of the offer of higher education in the North-Northeast

Nevertheless, for developed countries, the typical rate of higher education is close to 50%. As can be seen in the data in Table 3, the South, Southeastern and Midwesten regions can reach this level around 2012. What about the North and Northeast? Only in 2039 will the Northern Region have reached the level of having 50% of those who graduate high school also graduate college. Even worse, the Northeast will only reach this level in 2062.

What can be done to accelerate this indicator in the North and Northeast? This is not a simple question, nor is there a single solution. We can only make a suggestion, as a contribution. A comparison between these regions and the South and Southeast suggests that the proportion of public federal institutions is already similar. The proportion is very different, however, concerning the state and community public institutions (which in Brazil, in general, are of religious or municipal origin). While in the Southeast the number of state and community institutions is comparable to that of the federal universities – and in the South it is even higher – in the North and Northeast, these universities are nearly nonexistent. It is difficult to imagine that all of the enormous future demand of these regions can be met by federal institutions. The conclusion appears inevitable that state governments should increase the number of higher education establishments while institutions of a community character also should be encouraged. If this does not occur, there will be a trend toward growth in the private sector (through the creation of mostly for-profit institutions of questionable quality), creating an additional burden for the population, which in general is poor. It does not seem to make sense to establish the same goals for regions with realities as different as those in Central and Southern Brazil on one hand and those in the North and Northeast. These realities need specific and distinct strategies.

Expansion of post-high school technology education

Brazil has some experiences of secondary technical schools of excellent quality, such as the schools of Senai and Senac (The National Industrial and Commercial Vocational Educational Services). Nevertheless, the Brazilian tradition in post-secondary technology education is at its earliest stages. In developed countries, more than half of the graduates of post-secondary courses come from short, two- or three-year vocational and or technical courses. In highly competitive countries, such as Finland, Ireland, and South Korea, a large portion of higher education is offered within this category (Brunner & Elaqua, 2003). In Brazil, schools in this field are nearly nonexistent. Here, the mistaken notion dominates that higher education must be exclusively associated to complete Bachelor's and teaching degree programs.

In São Paulo State, the Centro Paula Souza has technical courses at the high school and post-high school level to train technicians. Recently, the São Paulo state government decided to double the number of vacancies in technician courses. The number of students reached 15 thousand, which represents only about 1% of the 1.2 million post-high school students in the State. The federal government maintains the Centros Federais de Educação Tecnológica (Cefet) [Federal Technology Education Centers]. Various other state governments also have higher education technology courses like those at the Centro Paula Souza.

Another question that should be addressed is the mission of these institutions. Despite being formally aimed at technology education, many have sought other goals, such as their transformation into a university, or into "teaching colleges".[3] It is important to note that technical and teacher training are both important, but cannot be confused.

Although they are very important in many developed countries, in Brazil there is a substantial cultural difficulty (even a certain prejudice) in relation to this type of education.

The articulation of demand for science, technology and innovation

Brazilian science and graduate studies have not stopped growing and are of good quality. Brazil graduates nearly 10,000 Ph.D.s per year. In the same way, scientific production has exceeded 1.5% of world production, while 20 years ago it was only 0.4%. Both indicators continue to grow at an annual rate of approximately 10%.

The number of patents registered by Brazilians in the U.S. Patent Office (USPO), in turn, has stagnated at 0.2%. This is a universally recognized indicator of technological innovation and a clear sign that Brazil is behind in this field (Brito Cruz, 2000).

The perception that a significant capacity to generate knowledge does not correspond to the same capacity to generate wealth is perhaps easy to understand when we analyze where our Ph.D.s are employed. In Brazil, of

every four doctors, three work in the academic sector and only one in industry. In countries with more advanced economies, the opposite is true: three work in industry for every three employed in universities. If this trend is not reversed – and this is not a simple effort – it will be difficult for knowledge to have the conditions to materialize its role as a generator of social well being.

The classic willingness of governments to invest exclusively in the supply of science technology and innovation, appears, to be something of the past (Brito Cruz & Pacheco, 2005). Successful examples, such as the frequently mentioned South Korea, appear to show that in parallel to a supply policy for science technology and innovation, it is essential to also have a policy to articulate demand in these fields. Without a reversal of this culture, Brazil will not be able to invest 3% of its GNP in science, technology and innovation, a goal reiterated by successive governments each time they take office.

For a project to be successful, it is necessary to pay attention to the development of strategic technologies. The success stories in Brazil, such as that of aeronautical technology, deep-water petroleum extraction and agribusiness, show that Brazil can achieve excellent results in such fields, as long as efforts are well articulated and have a long-term perspective. One area of great strategic importance and real potential for development (see Table 2 of Appendix A) is biotechnology. Pointing in this direction are not only the already established human resources, but also the great potential of Brazilian agribusiness in the world market, in addition to the domestic and foreign pharmaceutical markets, especially in relation to tropical diseases. A comparison with other countries such as the United States and China shows that Brazil has specialized intellectual capital precisely in these fields (Steiner, 2005).

In recent years, there was a recognized effort in Brazil to implant a culture to articulate demand. New sectoral funds, the Law of Innovation, a fiscal incentives law and efforts to create a large number of technology incubators and parks point to this campaign.

Conclusions

Educational indicators have improved, as well as scientific production and education at all levels, from elementary schools to doctoral programs. This provides the bases of human capital needed for robust social and economic development. What is lacking for this to occur? It is clear that suitable macroeconomic policies are essential, in addition to effective industrial policy and institutional reforms as well as other measures. But, in the realm of knowledge itself, important factors should be corrected or implemented to expand the advances already achieved in the education of human capital in Brazil, an essential condition for boosting the economic and social fields.

To the degree to which the current indicators of economic growth and social inequalities remain at levels of the past decade, a scenario is established

in which the probable future will be marked by three great and inter-related difficulties: the ability to offer quality elementary and high school education and reduce social inequalities and violence.

The desirable scenario for the coming decades is that of significant economic growth combined with a reduction of social inequalities. Investment in knowledge is essential. It is not a sufficient, but a necessary condition. The point made here is that it is not a question of how to expand the forms of increasing the country's capacity to generate knowledge, but how to transform knowledge into wealth and well-being for society. Some important steps to follow in the desirable trajectory are:

- Provision of quality education at all levels, with an emphasis on elementary and high school education.
- Expansion of higher education in the North and Northeast
- Expansion of technology education, principally at the post-high school level.
- Reinforcement of public policies to increase the capacity for innovation, such as a consolidation of sectoral funds, implementation of the Law for Innovation, support to entrepreneurship, technology incubators and parks, in addition to fiscal measures that promote innovation and placement of researchers at companies.

The ability to meet these four challenges is associated to structural problems and cultural conditions. For this reason it will be difficult to resolve them in just a decade and a half.

Notes

1 Elements that constitute the knowledge management base are:
- education, by the capacity to acquire and transmit knowledge;
- science and technology, by the capacity to generate scientific and technological knowledge;
- information technology, by the capacity to accelerate the processes of capturing, production and transmission of knowledge;
- innovation, by the capacity to increase competitiveness and improve the quality of life in society, through better use of knowledge.

2 The AIDS epidemic was controlled in Brazil thanks to a tremendous effort by government and society in general. But another problem is noticed here: the discrepancy between the life expectancy of men and women. In most countries, women live nearly five years more than men, but in Brazil, the difference is eight years, due to the number of violent deaths (accidents in transit, assassinations) that affect mostly male youth and adults. It is an epidemic of violence. In the countries of the former Soviet Union, the HDI also dropped since the 1990's, but less sharply than in southern Africa. In Russia, for example, the life expectancy of men, which was 70 years in the 1980's, fell to 59 in 2003, which corresponds to 13 years less than the life expectancy of women. Another revealing case is that of Colombia, which had an HDI higher than Brazil until

1995, and since then has had a lower rate. The principal reason for the difficulty in the advance of the HDI in Colombia is the political instability that the country has gone through in recent years. These examples illustrate situations of reversal of economic and social development to which a country such as Brazil is not totally immune.

3 There is a large diversity of missions among the Cefets throughout Brazil. The Cefet in Paraná, for example, has three masters and one doctoral program. Without a doubt, it is a paradigmatic case of a quality institution that sought, with reason, its transformation into a university. But this is an engineering institution, which does more than educate technicians. The Cefet in Minas Gerais also has a masters program. The mission of the technology education centers cannot be that of transforming themselves into universities. Nevertheless, the Cefet of Maranhão, which graduates more people than any other in Brazil, trains 1,500 mathematics teachers per year, according to statistics from INEP.

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Appendix

A) Some statistics from the "Brasil 3 Tempos" project:

Table 1 – The five issues considered of greatest importance, of a total of 50 issues formulated

	Probability of Occurrence		Importance of 1 – 9
	2015	2022	
a) Resolution of quality of elementary school education	32%	41%	8.8
b) Universalization of basic education	47%	59%	8.7
c) 50% reduction in criminality	30%	40%	8.6
d) Annual employment growth > 2%	40%	50%	8.5
e) Social inequality at level close to that of developed countries	31%	46%	8.5

Source: Projeto "Brasil 3 Tempos" – NAE/CGEE

Table 2 – Issues related to knowledge

	Probability of Occurance		Importance
	2015	2022	
a) Substantial improvement in quality basic education	32%	41%	8.8
b) Universalization of basic education	47%	59%	8.7
c) Investment in Science Technology and Innovation (2% of GNP in 2015 and 3% in 2022)	43%	52%	8.3
D) Biotechnology – competitive participation in international markets	48%	60%	8.1
e) College education (35% in 2015 and 40% in 2022)	42%	52%	8.0
f) Information and Communication technology (25% in 2015 and 20% in 2022)	50%	59%	7.6
g) Digital inclusion (60% in 2015 and 80% in 2022)	51%	61%	7.6
h) Important actor in crucial technologies	38%	49%	7.4
i) Important actor in nanotechnology	34%	44%	7.2

Source: Projeto "Brasil 3 Tempos" – NAE/CGEE

B) Three scenarios for the average annual growth of Brazilian GNP:2%, 4% and 6%

The HDI is an arthimetic measure of three components: education, longevity and per capita income. The parameter of education is a linear measure of the literacy rate (which has a 2/3 weight) and of the gross education rate (given a 1/3 weight). Longevity is a linear indicator that adopts the minimum age of 25 years (arbitrary) and a maximum of 85 years (the life expectation of Japanese women in 2002). The per capita income indicator is the logarhythm for income, considering US$ 100 per year as a minimum and US$ 40,000 as a maximum.

Hypothesis A – Average annual GNP growth of 2%

		Life Expectancy	Education		Per capita Income
Year	HDI	Years	Literacy	Registrations	US$PPP
2003	0.792	70.7	88.4	91	7,790
2007	0.802	71.0	90	92	8,106
2015	0.816	71.6	92	93	8,777
2022	0.824	72.0	93	94	9,225

Hypothesis B – Average annual GNP growth of 4%

		Life Expectancy	Education		Per capita Income
Year	HDI	Years	Literacy %	Registrations %	US$PPP
2003	0.792	70.7	88.4	91	7,790
2007	0.811	71.5	90	93	8,770
2015	0.838	73.0	92	94	11,100
2022	0.857	74.0	94	95	12,875

Hypothesis C – Average annual GNP growth of 6%

		Life Expectancy	Education		Per capita Income
Year	HDI	Years	Literacy %	Registrations %	US$PPP
2003	0.792	70.7	88.4	91	7,790
2007	0.819	71.9	91	93	9,468
2015	0.860	74.4	93	94	13,990
2022	0.893	76.6	95	96	17,855

ABSTRACT - KNOWLEDGE (education, science, technology and innovation) is essential for a society's economic development and well-being. In Brazil, quantitative indicators of scholastic achievement, scientific production and graduate studies have all risen significantly over the last decade. Economic and social indicators, however, have been mediocre at best. This article examines the bottlenecks that prevent knowledge from becoming a more effective driver of social and economic development, as well as some prospective results, particularly those pertaining to the knowledge dimension. Projections of the Human Development Index (HDI) up to the year 2022 are shown, revealing how much development is related to economic growth. If the trends that have been operative in Brazil over the last decades persist, the most probable short-term scenario is one of low quality primary and secondary education coupled with increased social inequality and violence. The desirable scenario, of course, is one of economic growth and decreasing inequality. But this requires, among other things, a better performance in the knowledge sector to overcome the aforementioned bottlenecks – which implies improving the quality of basic education, enhancing higher education in the country's North and Northeast, a significant increase in post-secondary technological education, and the implementation of a policy to stimulate the demand for science, technology and innovation.

KEYWORDS - Knowledge, Education, Science, Innovation, Development, Future.

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