Fuzzy design education: perspectives for teaching design in Brazil and the world

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1 Introduction

The new millennium of this article is the time in which we live. We call it "new" because we are currently involved in its great and rapid transformations that are altering the culture and practice of all professions in their foundations. And, as in all the critical moments that a crisis, while destabilizing what exists, "opens up new, unforeseen possibilities" (MANZINI, 2017, p. 187).

The doors that open up with these new perspectives can be both positive and negative. Inevitably, it is better to consider that they directly impact on the way of teaching to be adopted in general and in the teaching of design in particular. The new millennium unfolds and reflects a new society of fuzzy and paradoxical nature (SANTAELLA, 2017).

Many names have been used to characterize this time from a sociocultural point of view. Some authors call it Hypermodern (CHARLES, LIPOVETSKY, 2004), Postmodern (LYOTARD, 1986), or Reflective Modernity (BECK, 1997), among others. Although the authors consider peculiarities in each of these denominations, they all believe that this new society evolves in a scenario arising from the impacts of technological advancement, globalization and mundialization, capable of influencing the contemporary behavioral scenario.

On the other hand, from the point of view of economics and technology, the various authors of these fields consider that, in this new panorama, the Orange Economy[1], the Fourth Industrial Revolution[2] or even the Knowledge Economy[3] constitute their bases. Key elements of this revolution include "increasing trends in knowledge codification and the development of new technologies; the importance of R&D activities linked to the scientific base, the importance of innovation and productivity for competitiveness and GDP growth; the importance of education, the empowerment of the workforce and learning processes" (HERZOG, 2017).

This is the context that was taken as the basis for elaborating this article, associating it with the future of design education. In this sense, based on literature, references that describe it and point to new pedagogical constraints that fit it were searched.

1. Orange Economy, a term adopted by Buitrago Restrepo, P. F.; Duque Márquez, I., to spread the principles of the Creative Economy among the countries of Latin America and the Caribbean.

2. Fourth Industrial Revolution, a term coined by Klaus Schwab in 2016, as a step ahead of the Third Revolution, once it incorporates new elements, such as automation. It is associated with the term Industry 4.0.

3. Knowledge Economy is the economy in which knowledge is the main component of aggregation of value, productivity and economic growth. It is directly related to the growth of ICTs. The term was coined by Peter Drucker, in 1969.

However, talking about the future means talking about assumptions. Thus, when elaborating it, considering the next challenges for the teaching of design, the essay form was adopted in the structuring of this article. Thus, it should be emphasized that its rigor is more related to the information collected - even though it does not exhaust the various aspects pertinent to the theme - and less to the treatment given, which is embedded in subjectivity. As such, it establishes itself as a quasi-fictional narrative, according to Bruno (2016), since texts that intend to express the future necessarily have this character.

Thus, we approach the theme in a brief and free way, without exhausting it, yet presenting ideas, questions, critics and reflections that relate to what we could foresee regarding education in design in Brazil and in the world. The digression consisted, therefore, in analyzing some forces that configure the world panorama, but also seeking to count on the national peculiarities.

The text begins by presenting the new socio-cultural, economic and technological panorama, and then introduces the trends in terms of teaching that have been developing. It also addresses the profile of the new student within this context, as well as the teacher and educational institutions, taking the focus to the national reality. In the end, opposing these elements, points to questions that can guide the reflection on the teaching of design.

2 Society, culture, economy and technology in the "new millennium"

The design activity, in principle, interrelates with society, culture, economy and technology. On the one hand, the individual or his collective, on the other, the materials and processes that generate wealth. In this way, a future perspective on their teaching demands an insight into how these scenarios should develop.

Studies point out that social, economic, cultural and technological changes have been growing at an exponential rate, and in the absence of a destabilizing event, these changes will continue to unfold in the near future. Thus, in considering the new millennium, one must consider the references that are established from what we have of panorama in the present, to be able to think of a future teaching, with the temporal limitations that this represents.

2.1 The fourth industrial revolution

From the economic and technological standpoint, the importance of these changes was highlighted by the definition of the World Economic Forum's 2016 goal, called "Mastering the Fourth Industrial Revolution[4]" (WEFORUM, 2017).

This new wave, called the Fourth Industrial Revolution, transfers the cyber-physical systems from laboratories to people's everyday life, accentuating, amplifying and expanding human capacities. By its scope, it is characterized by a fusion of technologies that fade lines between physical, digital and biological spheres (BALLANTYNE, WONG, MORGAN, 2017).

The concept of Industry 4.0 – which is associated with that of the Fourth Industrial Revolution – is supported by the fact that in the future, global networks will incorporate machines, storage systems and facilities in the form of Cyber-physical Systems. From intelligent machines, storage systems and facilities capable of autonomously exchanging information, acting and controlling each other, Industry 4.0 will produce intelligent products, uniquely identified with their own history, status and alternative routes. (KAGERMAN; WAHLSTER; HELBIG, 2013 *apud* BRUNO, 2017). Figure 1 below presents the evolution that has been taking place based on this Industry 4.0.

4. There are opponents to the use of the term proposed by Schwab, because it is linked to the use of the term Industry 4.0, diffused in Germany from the 2011 project for the implantation of automated manufacture. They further claim that we are actually continuing the same process of the so-called Third Industrial Revolution.
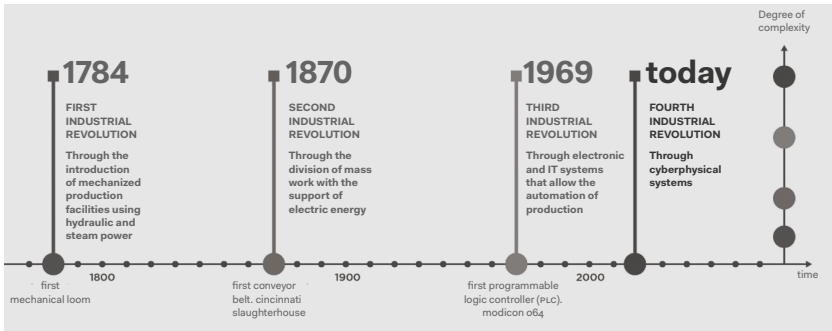

FIGURE 1 – From Industry 1.0 to Industry 4.0, based on the German Research Center for Artificial Intelligence. Source: Adapted from Nikolaus (2014) *apud* Bruno (2017).

These changes take the form of artificial intelligence and robotics, new computing technologies, virtual and augmented realities, 3D and 4D printing, ubiquitous sensors (IOT), nanomaterials and advanced materials, chain blockers and network security, geoengineering , bio-technologies, neuro-technologies, transmission, distribution and capture of energy, space technologies (WEFORUM, 2017, KIM, 2017), among others.

Although this denomination is criticized by authors who believe that we are still in the Third Industrial Revolution, defined by the expansion of digital systems, what is considered here in this chapter is the progress of this expansion in the present, with the introduction of new systems, processes and products that modify in a more advanced way the human-society relationship, especially those that automate the productive processes and the creation of new materials.

Moreover, in this context of change, a policy aimed at the incorporation of autonomous technologies has been adopted by some countries, especially in Germany, calling the application of new technologies in industry as Industry 4.0. This term is associated with the Fourth Industrial Revolution concept adopted by Schwab in 2016 at the World Economic Forum.

However, if some inhospitable working conditions are replaced by automata, jobs have been reduced in those conditions in which high technology has imposed itself. On the other hand, world production seeks lower prices and a cost structure backed by lower wages. "The process of global integration in value chains, however, has led to changes in consumer habits and learning that, driven by new business models and communication and information networks, have laid the foundations for a deep revision of forecasts. [...]" (BRUNO, 2017, p. 24).

According to Bruno (2017), the society deriving from Industry 4.0 may reverse the current logistic process, returning manufacturing activities to developed countries. An approximation between production and consumption will be intensified with a high industrial complexity. The new business models will emerge demanding highly skilled, more agile and versatile professionals (ibid, p. 24).

Considering a positive scenario, the new additive manufacturing technologies, extension of the current 3D Printing associated with the Internet of Things (IoT), will promote a considerable change in the future industrial context. In particular, IoT, by allowing better tracking of manufactured products, will help reduce the dramatic consequences of e-waste

on the environment (ibid). Besides, the development of new production systems will allow the analysis and optimization, supported by multiple data, demanding a profile of the professional oriented to the design different from the current one. "Factories that do not pollute will be able to return to cities, approaching niches of consumers - of neighborhoods, for example – if they are small [...]" (IBID, p. 46).

For this author, workers in the future will be gradually freer from routine tasks, and new technologies related to Industry 4.0 will require creative activities of greater value added. There will be an increase in real-time control of activities, which will cause changes in content and work environments. In this sense, professionals should invest in their personal and professional development, leading to the demand for continuous learning (ibid).

2.2 Knowledge society

Another term used today for the process of technological and economic development is Knowledge Society, which characterizes by an economy based on knowledge both of society as a whole and of the productive sectors within it. In this society, knowledge is the key element in the competitiveness of companies.

In a guiding document, the Organization for Economic Cooperation and Development (OECD) (2017) considers that the shift from industrial to post-industrial model based on technology leads to growth and productivity largely determined by the degree of technical progress and knowledge accumulation. For this, it would be of great importance to reimagine and redescribe the systems of future education, aiming for progress and knowledge domain to be efficiently distributed.

In this context, the OECD (ibid) also considers that not only individuals but also companies should be involved in the process for implementing the potential productivity of new technologies and long-term economic growth. Therefore, thinking about education in the new millennium presupposes considering not only the students but also the organizations - here in general - but also specifically the Universities.

However, a knowledge economy or society, by its implicit nature, can lead to educational policies and practices that, according to the theoretical clipping, may be contradictory (GUILE, 2017). We will not dwell

on such aspects in this work, but on the fact that education occupies a preponderant role in contemporary and future society.

2.3 Creative economy

Following this reasoning, we also highlight the Creative Economy and its variant, Orange Economy (IADB, 2017).

Orange Economy is the denomination assigned by the Inter-American Development Bank to the new economy that has been evolving due to the ongoing technological development. This new economy presents a shifting focus from manufacturing and heavy industry to knowledge and information, at the heart of which are creativity and collaboration, reinforcing the roles of the creative sectors (ibid), among which design participates as one of the catalysts of this change.

Its denomination is supported by the meaning of this color, which can be understood as a new productive arrangement in which economic activities are directly linked to new technologies, demanding new creative approaches in which entrepreneurship presents itself clearly (RESTREPO, MÁRQUEZ, 2017).

The Orange Economy is part of the Creative Economy concept, which includes all sectors in which products and services rely on intellectual property. For Bruno (2017), while adopting the concepts of Csikszentmihalyi, creativity, inherent in the economy of this kind, occurs when someone presents a new idea that potentially introduces change in a cultural or symbolic aspect in their environment. And, in it, design is inserted in its various modalities.

In defining the Orange Economy, Restrepo and Márquez (2017) consider it a complex matter that relies on broad concepts involving creativity, culture and economics. These two latter, often seen as diametrically opposed, however, to the Creative Economy are two sides of the same coin.

It is also worth mentioning its emergence, especially in what refers to the developing countries, which still have traditional societies and a large number of individuals who are not able to insert themselves in Post-Industrial production. For authors, the Orange Economy (RESTREPO, MÁRQUEZ 2017; IADB 2017) has great significance for those nations. For this reason, this policy has been used in several countries of Latin America and the Caribbean, reaching the multiethnic society that characterizes them.

In the case of Brazil, with its society characterized by cultural syncretism (CANEVACCI, 2016), competitive possibilities from the economy based on creativity, the Orange Economy or Creative Economy, would be possible. This is because from their contexts and with this hybrid configuration, as described by Canclini (1990), these societies bring diversity as a competitive advantage, which is a preponderant factor in creative processes, allowing the proposal of new innovative products, both for their symbolic and technological values.

It should be noted that, in this context, the hybridization of manufacturing and services is also one of the scenarios that can be considered economically promising. The shift from products to services - and vice versa - has been driving innovation, with more and more intense consumer participation in the design process. For Bruno (2017), this will lead to a shift from industrial policies to production policies, involving all actors in value chains.

2.4 Sociocultural changes

The changes that occur in the field of technology and economics determine direct impacts on socio-cultural behavior. Authors such as Tourraine, Lyotard, and Lipovetsky have pointed to a considerable shift in previously existing patterns. Postmodernity, Continued Modernity, Net Modernity or Hypermodernity, among so many names that reflect the concerns of authors who study the phenomenon of contemporary society are denominations that these authors established to characterize these changes.

Françoise Lyotard (1986) coined the term Post-Modernity, pointing to the question of the legitimization of knowledge by putting the speed with which technological changes today operate, and the outstanding role of the market in this scenario.

Focusing on the role of individuals, Tourraine (1994), in his Critique of Modernity, pointed out the emergence of the subject in contemporary times, highlighting the displacement of industry, church and state, previous regulators of social behavior in modern societies.

Using these same agents, Lipovetsky (2017) considers that the individualization in contemporary society is a liberal democratic process that characterizes Hypermodernity, having in mind its paradoxical character, in which individual and society are poles that act in friction.

In Brazil, when discussing the ethical issues of today's society, Santaella (2017) considers that the present culture is characterized by a hybridity, by a dynamic of opposites that coexist in a fuzzy way.

These diverse approaches were selected because they seek to explain the phenomenon that characterizes production, circulation and consumption of products and, consequently, contemporary design, so that it is possible to draw a future scenario in the academic professional formation.

For Figel (2017), technological changes produce a source of great concern, affecting social cohesion. Mundialization and the numerical revolution bring social alienation, which affects democracies. In this context, actions are needed in relation to education and lifelong training, aiming at a professional insertion in a society based on knowledge.

3 Teaching in the new millennium

As already mentioned, the new economic, technological and social context has been significantly altering education. Their reflexes mirror a shift from a traditional model-based economics, which considered the factors education, training and knowledge as exogenous in economic growth, to a human-capital economy, in which technology and knowledge are intrinsic to development (ROBERTSON, 2017).

However, the profile of the new egress of education in the 21st century, where technology and economics are decisive, is not a consensus. Studies regarding education for the new reality consider critical thinking, creativity and interpersonal communication as important skills to be developed in the training of future professionals. In addition, other authors point to the ability to deal with media and information, ease in appropriating technologies and adequate use of time. Opponents of this stance say that learning facts is as important as developing skills.

In 1996, the OECD highlighted a number of concerns with technological changes that pointed to an exponential growth in the future. In this scenario, higher education represents a critical factor for the innovation and development of human capital, having an important role in the knowledge economy. This is an important point in national policies, with changes in the way of teaching (OECD, 2017b).

These fundamentally different new questions lead to a new way of teaching to suit the development of the knowledge economy (GUILE, 2017).

In this sense, "learning is the answer to prosperity - for each of us, individually, and for the nation as a whole. Investments in human capital will be the basis for success in the 21st century global knowledge economy" (DfEE, 1998, p. 7 *apud* Guile, 2017)

In addition, new trends come highlighting those that include a greater number of segments of the population with respect to the student profile. This expansion presents the emergence of new actors and the need for different curricular profiles. In their practice, the use of new media and technologies has been addressed. Internationalization, competition and evaluation mechanisms respond to financial pressures, as well as new governance models (OXERA, 2017).

However, the results of the application of these new technologies are still unclear, depending on how the various actors related to them behave, in particular those that form the triad (Triple Helix) university-industry-government. What seems certain is that there will be a growing demand for creativity and inter- (trans) disciplinarity in education, in order to provide innovations (KISTMANN, 2015).

3.1 Collaboration and transdisciplinarity

Building on Lundvall, Robertson (2017) stresses that social capital-rich societies would be more successful in creating wellness networks because in them their interactive learning would be supported by more diversity and local lessons, most widespread in the economy.

Working in transdisciplinary teams, with collaboration between professionals presupposes new types of professional capacity, as pointed out by Guile (2017): the ability to present data to experts in different fields, as well as to their own customers unfamiliar with their meaning; also respond to their interpretation of these data; establish links between their respective interpretations and reach an agreement on the appropriate lines of action. The new society presents new demands and among them is the capacity of a very different importance, the emphasis given by the educational policy directed to the domain of disciplinary knowledge and the acquisition of fundamental competencies.

The traditional conception of higher education endorses the view that there is a certain content of fundamental knowledge which must be part of the curriculum and that universities have the responsibility of its

transmission. With this, the training by disciplines, associated with the scientific method as the only basis for conducting research, is consolidated. On the other hand, the postmodern conception adopts a "utilitarian" view, taking knowledge as a means to an end. From this perspective, it considers the university curriculum to be a contribution to the realization of the particular "form of society" desired by policymakers, contrarily to the role of research, which is considered as supporting the growth of industrialization.

From this standpoint, world and knowledge become the product of different ideological points of view, carrying the teaching with tension which, according to Lipovetsky (2017) represents the perspective of Hypermodernity. In this context, the emphasis on traditional acquisition based on disciplinary knowledge and the emphasis on heterogeneous, experiential and/or tacit higher education places training in a paradoxical position. On the one hand, acquiring disciplinary knowledge presupposes the development of capacities to understand the system of connections that structure and inform the disciplines. On the other hand, the importance of understanding these connections seems to be denied by the valorization of experiential and tacit knowledge, evaluated through learning diaries and portfolios (GUILE 2017).

3.2 Lifelong learning

The economy in the new context makes education based on knowledge, not information; that the use of ideas and not of physical abilities prevails in the application of technology, rather than the transformation of raw materials; or that cheap labor takes place (Robertson 2017). In this panorama, the focus is on identifying new demands of citizens who need new skills and knowledge to be able to act in the day to day. Providing professional conditions to meet these demands requires a new model of education and training, a lifelong learning model (ibid).

Figure 2 displays the major differences between the traditional teaching mode and the lifelong mode.

Traditional learning	Lifelong Learning
• The teacher is the source of knowledge • The student apprehends knowledge from the teacher • Students work on their own • All students do the same things • Tests are given to ascertain progress until students have apprehended a set of skills and are ready for the next learning • Teachers are given initial training plus counseling at work • Good students are identified as allowed to continue their studies	• People learn by doing • People learn in groups and from each other • Evaluations guide learning strategies and identify routes for future learnings • Teachers develop individualized learning plans • Teachers are lifelong learners • Initial training and continuous professional development are connected • Teachers are guides for knowledge sources • People have access to learning opportunities throughout life

FIGURE 2 – Characteristics of the traditional and lifelong learning modes, according to the World Bank. Source: Adapted from Robertson 2017.

As we have seen, in the new scenario, the acquisition of knowledge – main focus of traditional education – has new contours added. It is not enough to meet the new demands, forcing the universities, in their roles of teaching, research and extension, to adapt to more experimentation and learning-by-doing – the traditional posture of the field of design. Identifying new problems, a task of user-centered approach already addressed by design thinking, becomes a demand for all areas of applied sciences to adapt human needs to technological development.

3.3 Learning by doing: fablabs, makers and we-are-all-designers

The promotion of entrepreneurship is central to the new scenario, with the demand for an educated and specialized population with political and social infrastructures capable of managing information and activities of research and development geared towards innovation. Thus, teaching systems need to replace the model based on a teacher who transfers knowledge for that one who is able to emphasize the creativity, application, analysis and synthesis of knowledge, engaging students in a collaborative lifelong process (ROBERTSON, 2017).

One approach that has been gaining ground in this context is the FabLabs, which are part of the Maker Movement, as the vanguard of the already known "Do it Yourself-DIY" movement.

Fablabs are spaces of creativity, learning and innovation. They can be academic, public and private. The academic ones are supported by educational institutions; public by governments, institutions of

development or social groups; and the private ones are those that commercially offer spaces, machines and professionals for the development of products, charging for use.

In general, Fablabs are supported by public or private institutions, which have laboratories equipped with 3D printers, laser cutters, cutter plotters, CNC milling machines, computers with CAD digital design software, electronics and robotics equipment, and carpentry and mechanics tools. In some cases, they offer training courses for professionals or students. In some states in Brazil, they are organized in a network. The objective is to carry out projects in a collaborative way.

In this context, Anderson (2017) says that entrepreneurs and innovators are no longer at the mercy of big companies to produce their ideas and that it will be possible to design our own products using universal software, from which with 3D printers, ideas will materialize, whether at home or in workshops at a distance. He reflects: we are all designers now: manufacturing is back!

Thus, the aspects related to services are highlighted, with the emergence of new associations between platforms, marketing and manufacturing or consumption and creation. There is no longer the division between design, manufacturing and service.

3.4 The tactical knowledge

Another characteristic of this new way of teaching refers to tacit knowledge. Guile (2017) considers that by conceiving tacit knowledge as an intuitive and unconscious form of knowledge, Nonaka and Takeuchi (1997) assert that a form of tacit knowledge is the most important resource in the knowledge economy. The authors point out that this knowledge is both a form of "personal knowledge", not shared with others, and a form of "social knowledge" maintained by communities of practice in the workplace (GUILE, 2017).

This knowledge would be indispensable to the contexts based on Information and Communication Technologies, central to contemporary societies, promoting innovation by being associated with theoretical and practical knowledge (ibid).

The importance of tacit knowledge is less related to the traditional form of content-related teaching, but to a form characterized by learning by doing, typical of traditional teaching of design. It takes more into

account the behavioral aspects of learning, since this form of knowledge is established in the characteristic way of traditional innovative processes. More radical innovations are expected in today's society, what can be achieved by the collective learning.

3.5 Teaching by skills

Learning means the individual's ability to overcome obstacles and change their behavior with a positive, problem-oriented attitude (CNES-CO, 2017). In order to meet the demand for competent professionals, the new approaches related to the learning process bring the teaching by skills as a new model (SCALLON, 2015). According to Silveira (2016), the concept of competence is based on three dimensions: knowledge, skills and attitudes, encompassing not only technical issues, but also work-related cognition and attitudes.

For Scallon (2015), in the teaching by skills, four types of knowledge must be considered: knowing, knowing how to do, knowing how to be and knowing how to act (FIGURE 3).

Based on these four types of knowledge, competencies, skills and attitudes must be established according to the characteristics of the desired professional (SILVEIRA 2016).

This necessary change in the professional academic formation, including the formation by competencies, however, has not been adopted only in the university. Primary and secondary schools are already turning to this new model.

In some institutions, the focus on problem solving have been embraced. In Finland, for example, elementary education already adopts this stance, with the so-called "phenomenon learning" (G1, 2017). In Brazil, teaching by skills can already be seen in projects in public and private schools, following the guidelines of the Education Development Plan (MEC[5], 2017). Therefore, a new student will be arriving at the University with a background and attitude conceptually different from the one observed today.

5. The Brazilian Ministry of Education and Culture

to know

Knowledge

to know how to do

Practice

Self-knowledge

to know how to be

Combination of the previous
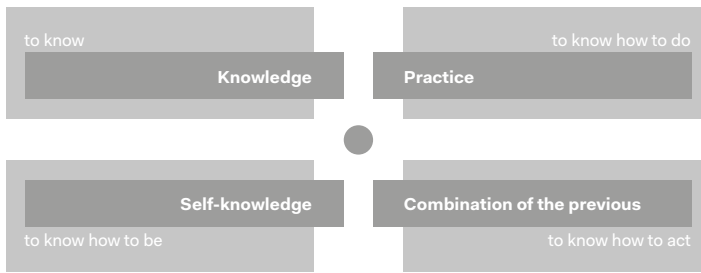
to know how to act

FIGURE 3 – Formation of knowledge and its attitudinal relationships. Source: Adapted from Scallon 2015.

This new pedagogical model relies, therefore, on the posture change of the student, the teacher and the educational institutions. It considers that the student moves from a passive condition, found in traditional teaching, to an active attitude, supported by collaborative actions, motivation for the search for knowledge, and, mainly, by a reflexive posture for solving problems related to their future professional performance. This learning demands a new way of acting on the part of the teacher, who should seek to offer activities that meet these principles, proposing an active learning. Institutions, in turn, need to provide infrastructure conditions for the process to take place (SCALLON, 2015).

The active stance of this new student comes to meet the backdrop of social, economic, technological and cultural changes in the new millennium. The acronym VUCA, for Volatility, Uncertainty, Complexity and Ambiguity, from the military area and adopted by Barret, reflects this new scenario in which future education needs to look (TAMMELA, 2016). In this sense, the National Research Council of the United States of America (2012) has established as important the adoption of a set of skills pertinent to this new reality. Figure 4 below present them.

As can be seen, the general skills to be considered in student formation, although divided into three major domains (cognitive, interpersonal and intrapersonal) are predominantly behavioral, aligned with the expectation of a professional who, rather than a problem solver, has behaviors oriented to the collective, to the responsibility, etc. Even the skills that are linked to cognitive processes are reflexive, active, relational.
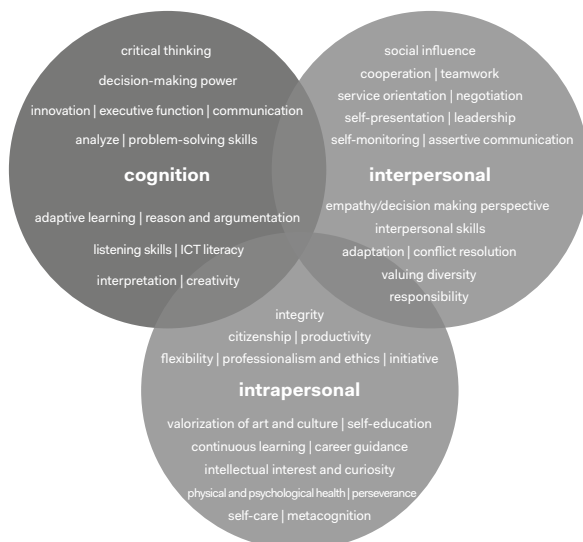
FIGURE 4 – Skills to be developed in the 21st century, according to the National Research Council of the United States of America. Source: Adapted from Silveira, 2016.

Bruno (2017) agrees by stating that the new technological and economic context will require three groups of tools to be used by workers in Industry 4.0: sensory, cognitive and motor.

Differently, because in fact what is established are skills and attitudes, Forastier (2017 *apud* CNESCO, 2017) says that education should support what he calls the core competencies. They are communication in the mother tongue; communication in a foreign language; mathematical competence and basic skills in science and technology; numerical competence; competence to learn; social and civic competencies; initiative and entrepreneurship; sensitivity and cultural expressions (ibid). It should be emphasized in this approach that the communicative, behavioral and expressive issues are aligned with the proposal of the National Research Council of the United States of America (2012).

For CNESCO (2017), learning to learn requires the acquisition of basic attitudes, that are writing and reading, calculation and matrices of attitudes for the ICTs – Information and Communication Technologies. Based on them, one should be able to research to acquire, obtain and explore, and assimilate the new knowledge and attitudes.

This requires effective management of one's learning, career and professional activity and especially the attitude of persevering in learning, concentrating for extended periods of time, and reflecting critically on one's objective and purpose in learning (CNESCO, 2017).

Students should be able to learn independently and with self-discipline, to profit from their participation in heterogeneous groups and share what they learn. They should also be able to organize their own learning and to seek advice, information and help. This positive action implies self-motivation and self-confidence to persist and succeed in lifelong learning (CNESCO, 2017).

Other studies regarding education for the new reality reinforce the critical thinking, creativity and interpersonal communication as important skills to be developed in the training of future professionals. Besides these, other authors refer to the ability to deal with media and information, ease in appropriating technologies and adequate use of time.

However, it must be considered that learning facts is as important as developing skills. Perhaps for this reason, the proposal of the National Research Council of the United States of America (2012) includes literacy in ITCs in its figure.

At the university level, an example of a competency-based approach that intensively explores the personal, cognitive and interpersonal aspects is the one currently adopted by Minerva University, a North American institution of higher education that has been innovating in the educational process. Welcoming students from many parts of the world, it is characterized, among other things, by not owning a location. Students travel across five continents to cities that will be focused by their study: "seven cities in four years[6]" (MINERVA, 2017a).

6. "Seven cities in four years". T. A.

In the training of Minerva students, the skills proposed by the National Research Council (2012) can be observed. From the identification of problems, teaching takes this approach for knowing and analyzing them, but also searching for solution models, taking positions and creating new realities. Therefore, education departs from the most elementary levels of the knowledge domain and passes to the highest, as in Bloom's Taxonomy, later complemented by Anderson, as in figure 5.
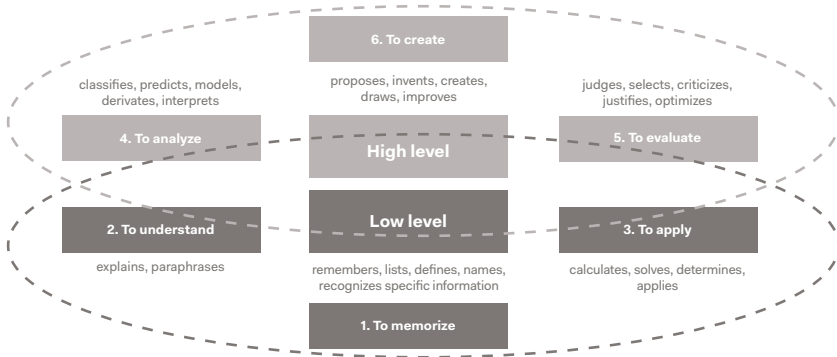
FIGURE 5 – Cognitive levels according to Bloom and Anderson. Source: Adapted from CIEF 2017

That said, the learning levels are articulated leaving the knowledge level, passing to the know-how and adopting a knowing-how-to-be and knowing-how-to-act.

In Fink's (2017) taxonomy, the cognitive aspects are grouped according to the fundamental knowledge, integration and application aspects. What Fink brings, in addition to the behavioral aspects of commitment, learning to learn and human dimension, is the fact that these aspects are interactive rather than hierarchical, focused on meaningful learning and approaching the concept of competencies established by Scallon (2015). Figure 6 below shows these relationships.

Formation by competencies (SCALLON, 2015)	Meaningful learning (FINK, 2017)
To know	Basic knowledge: information and ideas
To know how to do	Application of knowledge in new situations: critical, creative and practical thought; projectual practice
To know how to be	Self-knowledge and of others. Development of feelings, interests and values
To know how to act	Integration of knowledge from new ideas, from others'ideas, from life

FIGURE 6 – Approximation between Scallon skills and Fink taxonomy learning levels. Source: the author, 2017.

Based on these principles, in Minerva, instead of having a basic introductory course, the first year of the curriculum consists of themes that develop thinking habits, fundamental concepts (theoretical fields) that are based on four core competencies: to think critically, to think creatively, communicate effectively and interact effectively. At the end of the course, students are led to create something that is personally motivating and truly brings a novelty to the field of study. This may be through a play, a disruptive code for a computer, a business plan (Minerva, 2017b). Thus, whether students are into humanities, natural sciences or administration, for example, the curriculum has a new approach in line with the technological changes and the speed with which the available information is presented, changing the teacher's posture as the one that knows for the one who guides, collaborates (MINERVA, 2017c).

The theme has been growing in institutions that regulate design teaching in Brazil and regulate the public and private educational institutions themselves, in the face of the elements that announce a future that questions traditional practices. Active learning (SCALLON, 2015), peer-learning methods, learning by design and others are adopted by the institutions to deal with students who have constantly updated data in digital media.

Studies point to the fact that economic complexity is one of the determinants in countries' developmental stage, which is reflected in the differences observed. These are represented in the diversity and sophistication of the things that each produces, in the types of products that each one is able to manufacture. On the other hand, the accumulation of knowledge involved in this process is not available in books and, therefore, structural changes are required to initiate a learning process that considers this situation. "To expand a nation's productive knowledge, it is necessary to expand the set of activities that it is capable of accomplishing," says Bruno (2017). The existence of productive knowledge assists in the development of new products and in the evolution of productive complexity.

4 The new student, the new teacher, the new university

Considering the themes discussed above, one should think of a new student, a new teacher, and a new university. Thus, one of the great current challenges of all countries is to develop ways of inserting young people into the new labor market that develops from the new social, cultural, economic and technological configurations. Issues should be considered, such as:

- the quality and flow of professional information so that the egress can contribute to development in general;
- what conditions should be explored so that knowledge is transformed into creative processes;
- what skills and behaviors are expected;
- who will be the new students;
- what is the profile of the new teacher;
- and what conditions must be established so that the new profile of these actors and environments can meet these changes.

In addition, pedagogical proposals should identify and define the skills necessary for full personal development, civic activity, social cohesion and employability in the knowledge society; and train adults capable of acting professionally, developing and updating their competencies in the course of life (CNED, 2017).

Educational systems that rely on key competencies for lifelong education and training are then needed, as already mentioned. The mechanisms of education and lifelong learning should offer all adults real opportunities to acquire attitudes and skills. This has direct consequences on educational institutions, their teachers and students and their spaces. The new context in which teaching is inserted highlights not only common problems, but those that demand complex and diverse responses on a case-by-case basis.

In the face of internationalization, the rapid pace of change, the continuous introduction of new technologies and the high level of interconnection among countries, new graduates must have certain specific attitudes, supported by generic competencies. A paradoxical stance that needs to be addressed by educational institutions. How to be specific and general at the same time is one of the greatest challenges that the new form of teaching in general and in design needs to be addressed.

4.1 The new student

To talk about the future of design higher education means to talk about the new student that is coming. When elaborating the new teaching perspectives, to know who is she or he must be taken into account.

For AHELO[7] (2017), in 2015, more than 260 million young people in the world will be third-grade students. However, this population is decreasing. In Brazil, following the trend already observed in developed countries, it is estimated that in the future the young population will decrease in the coming years. It is considered that in 2040, those who are born, will finish graduation. In this case, the total university population will decrease from 80 to 60 million.

Youth of today will be 41 years old, modifying the panorama of this new student, as the elderly population will grow and the population pyramid will be reversed making the group over 60 years old have a prevalence over that of young people, as shown in figure 7 below.
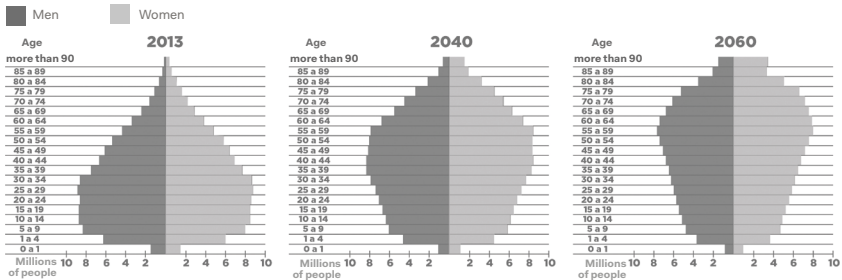
Absolute age pyramids

FIGURE 7 – Changes in population age pyramids in Brazil. Source: Adapted from Costa, 2017.

Thus, it is predicted that, in 2060, our population profile will be similar to that of France today, if no immigration flows are established. And, although the general population is expected to decline after 2040, the elderly population is expected to grow. It is estimated that the group over 60 in Brazil will be 13.8% and 33.7% in 2060. The IBGE attributes the increase in the number of elderly people to the higher life expectancy and especially the fall in the birth rate (IBGE[8], 2013).

Considering these data, as of 2043, there should be a decline in the general population. This will have likely implications for the economy with fewer people to produce and generate income. Population decline, which already occurs in many countries, will have consequences for the economy, with fewer people producing and generating income.

One of the consequences of the young population reduction is the impact on the decrease in the labor force, demanding professionals from

other countries through the process of globalization in progress, for professions that will still demand work in industries. Reflections of this context is already on the internationalization programs created in developed countries. They are also being now implanted in Brazil.

Although there are still migratory barriers, more and more students from diverse countries participate in exchanges, complementing not only their curricular training, but also broadening their cultural horizons, learning new languages and re-elaborating identities, starting with the encounter with the "other". Thus, they make it easier to look at situations outside their sociocultural universe and acquire new technologies from the study abroad.

This scenario, if confirmed, should affect the demand for courses in general and in particular for design courses, first, by young students seeking professional training. On the other hand, they constitute a new demand, considering the elderly population.

The sexagenarians, especially those in the middle class, will be in better health conditions than in the past, with a different behavioral profile, active in the labor market, using new media and social networks, and will bring new demands for personal growth. Their economic power will allow investments in new areas of knowledge, which will lead to both professional and social growth. Formerly oppressed, they must seek new job opportunities.

This new senior citizen will demand products and services as well as new kind of training. There will be transformations in the market of health services, of civil construction, and even of leisure. The country will have more and more elderly people leading active lives and the economy will have to adapt to the new consumption needs of this population (GAZETA DO POVO, 2017).

According to Kagermann *et al* (2013 *apud* Bruno, 2017), due to predictions of skilled work shortages and of ageing societies, the organization of the future of labor, of the flexible, temporal and physical types, will result in new ways of matching private life, work and professional development. In it, the development of long-term flexible careers will be present, demanding individualized training, as well as the use of the older ones with experience in lighter activities.

Although data that consider the profiles of disabled people, immigrants and people distant from the labor market for a long time, are pointed out by foreign institutions (CNED, 2017), the same can be considered to happen in Brazil.

I understand this context, the OECD (2017a) expands the concept of the student of the new century by considering that not only individuals but also

companies should be involved in the process for implementing the potential productivity of new technologies and long-term economic growth. For this future, the OECD (2017a) specifies six trends that it advises as a basis for the development of scenarios to be realized by 2020, as in figure 8.

With respect to scenarios 5 and 6, it is noteworthy that the OECD (2017a) points to the characteristic of deschooling[9]. In scenario 5, through network learning and network society. And in scenario 6, through the extension of the market model.

While in the 1970s, the idea of community-based learning networks had was regarded as revolutionary if not highly romantic. The development of new kinds of ICT infrastructures – in particular the Internet, means that this kind of scenario is highly feasible if not already partly in place, for instance with initiatives such as the EC-funded European Schoolnet (www.eun.org/) or the UK's Grid Club (www.gridclub.com). This scenario implies a thinning or diminution of formal institutional structures like schools, and an expansion of different kinds of less formal learning resources (OECD, 2017a).

9. Term coined by Ivan Illich in his book Deschooling Society, in which he proposes a series of learning experience types.

Tendency 1	Youngsters are attracted to other interests and influences outside formal school
Tendency 2	Childhood is prolonged as a result of a necessity to extend lifelong learning
Tendency 3	There is a great demand for ways of know-why, know-how and know-that knowledge, as compared to know-what
Tendency 4	There are growing disparities among groups, as a result of family formation, including families of a sole parent
Tendency 5	There is a growing individualism and a social fragmentation in society
Tendency 6	School is a learning organization, that makes learning from experimentation, diversity, innovation, the use of ITCs and of research and development

FIGURA 9 – Tendencies for teaching, according to OECD (2017). Fonte: OECD, 2017a.

For AHELO (2017), changes in the profile of the new student can be observed: they seek refresher courses in the professional life, acquiring particular knowledge or skills to meet the market requirements in disciplines offered by available providers, instead of taking courses defined by institutions.

As the data above, the new student will be very different from what we have in the classroom today.

4.2 The new teacher

The role of the teacher in the future society should also consider that students can use the Internet - when available - to access reliable and low-cost databases. This substantially changes the role of the teacher, who ceases to be the only authority in or out of the classroom.

Robertson (2017) points out that in the new knowledge-based production model, a new learning mode plays a key role: students need to learn how to learn and how to manage their own learning, now designed to support lifelong learning.

In this context the student must be able to mediate and continuously manage the innovation of the cultural machine in the circulation of capital. For this, educators should teach students how to learn. This will require the production of new pedagogical knowledge as a whole.

Thus, the educator model in the new society in which the production of knowledge, distribution and consumption are central, acquires new contours. They need to acquire new skills, related to technical aspects, but to acquire new behavioral ones as well, since the motivation to carry out the activities proposed by the students becomes central.

Another detail is the Internet, which alters the relationship between teacher and student, allowing the student to explore new territories, making teaching personalized, since in the face of a question / problem, results may differ. With this possibility, personalized learning demands a teacher who assumes a new role, as a solution builder, demanding less and working more with the students, in order to facilitate learning. Teachers will need to help students make the best choices, which involves skills such as advocating, counseling and breaking positions (ROBERTSON, 2017).

Robertson (2017) emphasizes that individualized education, favored by Information Technology, creates few opportunities for engaging with other colleagues in departments and schools, in the search for innovative and effective teaching. In this way, it is in a face-to-face contact that the processes that stimulate creativity can be explored.

In personalized teaching, there is a change in focus, which moves away from school as the only teaching institution. Thus, other forms of associations are required, such as formal and informal learning, academic and vocational learning, different ages and types of students. In it, not only educational institutions are responsible, but community and volunteering as much as private companies and businesses need to be part of the process to provide joint services (ROBERTSON, 2017).

However, he cautions against the risks of this new context and argues that competitive individualism prevents access to tacit knowledge, the basis for most innovations (ibid). Therefore, other modalities of connection between students should be sought.

These considerations lead us to think of a teacher who adopts new models of teaching, which are based on learning models from new approaches. Among these aspects, hybrid teaching is present, associating classroom teaching with distance learning.

The first of these is active learning[10], that is, the student goes from mere receiver of knowledge to the role of active constructor of it. For this, the technique called flipped classroom[11] brings to the student the search for the information needed to solve problems, exploring levels of skills from the simplest to the most complex. Figure 6 below presents in a condensed form the active learning with the flipped classroom.
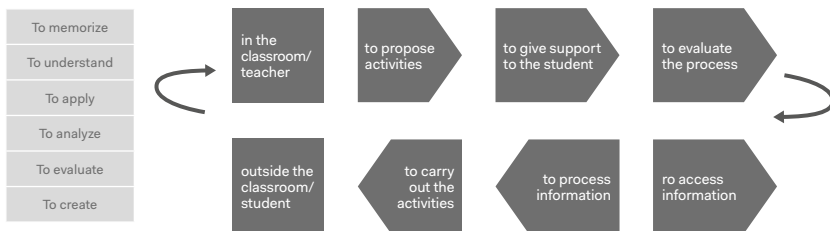

FIGURE 9 – Active learning / flipped classroom. Source: the author, 2017.

From this approach, learning from case studies, problem learning, or project-based-learning, are employed to develop the knowledge process (ELLET, 2008; SOUZA;DOURADO, 2017; MICHAELSEN; SWEET; PARMALEE, 2017).

The evaluation of the learning process also becomes different in this new context, since the process as a whole is prioritized from the formation of the necessary pre-established competencies. Diaries and portfolios are evaluation forms that can be used (VIEIRA, 2017). Likewise, assessment techniques that encourage peer instruction (PUCPR, 2017) are included.

4.3 The new university

Taken into account the Bologna Protocol (2017), one verifies the establishment of principles that are now defined and to be achieved from the studies of the signatory countries[12]:

12. Although Brazil is not a signatory, the Bologna Protocol has produced influences on education in Brazil.

(1) it is an architecture of the superior study supported in three degrees, whose denomination varies among countries: Bachelor, Master and Doctorate; (2) the adoption of a diploma system easily understood and accepted among countries; (3) the establishment of a single European credit system - ECTS; (4) an organization by semester periods and in units of education; (5) the development of transversal skills and knowledge (languages, information technology, communication techniques...) (MESR, 2017).

The fact that the comparable diploma system has the purpose of facilitating student mobility, facilitating the administration and the adequacy of students, stands out with respect to the future of teaching. Likewise, the credit system and the half-yearly. In Brazil compliance with the national curricular guidelines established by the Ministery for Education – MEC currently serves as a target for these objectives but does not yet provide for greater student mobility.

In the MEC case, according to the authors brought in and the curricular guidelines, the transversal knowledge is predicted as well as the competencies, although they are actually confused with skills. However, new orientations are presented in view of the changes that will affect societies in the future.

Initially, with respect to new entrants, institutions should be concerned with lifelong learning, with emphasis on the use of new technologies. And student autonomy and self-training are emphasized with a simultaneously specific and open approach (MESR, 2017). It is also considered that the provision of short-term programs can meet the needs of this new era and the growing knowledge-intensive economies.

For AHELO (2017), higher education institutions in the new social, economic and cultural scenario need to differentiate to meet a growing diverse users demand. Students with different profiles, through the higher education expansion policies, thanks to the growth of private education institutions, present diversity in their motivations, as well as in their expectations and career plans. For this, institutions need to be more diversified in type, owner, educational offerings and also in their mission, target group, in order to serve regional needs, with specific niches, and establishing connections with productive sectors.

> Assuming that everyone will be involved in the narratives means to say that both companies and institutions and supporting organizations with their researchers, managers, participants, guests, stakeholders and gatekeepers will be involved in the process of transformation and learning. The concept of narratives seeks to a process of shared evolution between social, technical and economic systems (BRUNO, 2017, p. 30).

For Schuetze and Slowey (2002 *apud* AHELO, 2017), the systematization of future-oriented learning must adapt to include "the assessment of prior learning; a wider range of programs; part-time learning; module-based curricula and credit systems; competence-oriented, student-centered organization of studies; and the provision of non-degree studies and continuing education"(AHELO, 2017 p. 23).

As a characteristic of the globalization process, student mobility and internationalization also play an important role in educational institutions, as a way of attending productive processes that are shared and the offer of work in different places (ahelo, 2017). It is perceived that the internationalization of education has been intensifying the need to align national policies with those of developed nations. The Bologna Protocol states:

> We reiterate our commitment to promote student-centered learning in higher education characterized by innovative teaching methods that involve students as active participants in their own learning. Together with institutions, students and staff, we will facilitate inspiring and supportive work and a learning environment. (BOLOGNA SECRETARIAT 2012 apud AHELO, 2017, p. 38).

In this way, some national institutions seek – through new internal policies – to incorporate the teaching method recommended by the OECD, as well as to be guided by international ranking. These, besides balancing the actions of educational institutions, are used as a way of valuing them, as it attracts media and public attention. Belonging to a World-Class University means, for the general public, to have a high-quality education. However, as Farias and Oliveira (2017) affirm, this results in a weakening of national policies and possibilities of offering courses with a profile more suited to the reality where they are inserted. In this sense, we consider the consequences of the neoliberal position in relation to the purposes of higher education and the reduction of university autonomy.

5 Final considerations

As discussed at the beginning of this article, this topic makes a fictional approach to design teaching in the new millennium, since the future is a narrative with no verifiable facts. It serves as speculation based on the data present, regarding the future of design education in Brazil and in general. It should also be noted that some of the sources used are relevant to the realities of countries other than Brazil but were considered because they present concepts and perspectives that can be applied to our reality, taking into account the process of globalization and mundialization.

From the standpoint of the general design perspective and its social and economic impact, design education in the new millennium will need to adapt to the growing technological evolution and the social changes that will characterize it, assuming a highly flexible, adaptive and inclusive teaching model. New challenges will appear in the global and local scenarios, which will require fast and innovative design solutions, built not just individually, but from collective processes. "Knowing how to be" and "knowing how to act" become keywords in this context. Therefore,

a more comprehensive view of the design process needs to be incorporated, coupled with a more conscious subjective and philosophical positioning. In this way, as the new horizons of teaching in general are presented, in addition to the cognitive perspectives, the interactive and emotional perspectives will play an important role in this new scenario.

It is also considered that the design of the past millennium will be complemented, not replaced by another and new design, of more comprehensive training.

At the Bauhaus, there was talk of a kind of global training that guided many of the courses in Brazil and in the world. However, the specificities were constructed in order to configure a larger approach: the design of the house, in which the formal characteristics were important, associated with the vision of a new world, which materialized in the propositions of the various works carried out by its students. From this point of view, a model that guided to a modern conception of education. It was followed by a more scientific approach, represented by the Ulmian Model, which was also diffused and appropriated by educational institutions in the area and, in Brazil, approached engineering design. A new, culturally based approach followed the modern approach, foreshadowing postmodernism in design with the Italian movements of the 1960s. And finally, in the 1990s, the strategic approach grew in the perspective of capitalist expansion. At present, still with postmodern characteristics, these perspectives are manifested concomitantly, in a fuzzy, syncretic way.

Thus, taking into account that, just as the computer did not eliminate the TV, and this one did not end with the radio, a course training in design can be considered in its broad sense as one that could turn to the qualification of *design d'autore*, with an emphasis on the knowledge of techniques and the emphasis on craftsmanship; for designers of specific modalities, oriented towards the industry and services; in the same way as for generalist designers, focusing on more strategic perspectives or hybrid forms.

With respect to how to teach, design education for the new millennium continues to focus on "knowing" and "knowing how to do", but it is mainly oriented towards a "knowing how to be" and "knowing how to act", as it stands before the challenges that new societies and technologies bring. For this, educators must, essentially, be ready to adopt a philosophical, sociological, anthropological stance in the face of design activity. From the point of view of the teacher, following the traditional method

of design in learning-by-doing, with a constructivist basis, the attitude of educators in the field of design in this new reality should be considered as a learning-by-teaching, having the workshops as a central point of the learning process, but including in them a critical view of the subject teacher or student in the process. From the student's point of view, one must think of the individual construction of scenarios and proposals in the search for a process of subjectivation of each of the students, by their "knowing to act". The teaching mode, comprehensive, explorer of the creativeness of the individuals and their ability to act in a group, requires a student profile different from the current one. Cognitive skills that explore associations to achieve innovation, as well as project managerial skills, become important in this scenario.

Methodologies that encourage students to build their own learning process require flexible curricula. Even in the specific design formations, where "know-how" stands out, it is considered important to offer independent courses, complemented by the integrative approach and the holistic perspective, as in Fink's proposal. Knowing the logistics of a sector and its technological peculiarities are important when considering the teaching from a broad point of view, when taking into account the impacts of the design in real world. And a training focused on entrepreneurship must necessarily rely on these aspects. Not just focusing on cutting-edge technologies, but also traditional technologies that still have their place. It is thus the responsibility of educational institutions, based on their specific characteristics, to choose one or another model, or a combination of them.

Designers will face problems related to social inclusion, new markets and new technologies, with their environmental and social impacts. Based on the technological scenarios, the propositions that seem to be addressing the economic model that is presented, leads us to think that proposals for teaching design should increasingly turn to experimentation, with an expansion of Fablabs and Makers movements. And hybrid training seems to be the way of teaching design to fit into the current technological and economic model.

This hybridity must be based on both the comprehensive view and the particular view. In it, designing ceases to be a domain of a single professional formation, to be a general formation. Not just designers do design. This collective action will require students' abilities different from those of the traditional ones in the specific formations, since

collaboration, teamwork, learning in teams and groups provide transversal learning. This leads us to think that perhaps the teaching of design is not linked to a specific profession, but rather to a broader, multidisciplinary doing. Thus, the teaching proposed today does not meet this future scenario.

The Labmakers and the Fablabs indicate that collective and experimental production activity should advance and bring together students with diverse interests and abilities, searching for new solutions to problems, giving agility to innovative processes. Design Thinking becomes a way of investigation aimed at proposing solutions to problems that society will demand, being incorporated by other areas, ceasing to be a skill of the designer. But technology, a subject explored in the readings that focus on the new technological scenarios, will not suffice in approaches to the graduate from design courses. It will be necessary to go further and adopt a posture with social commitment.

As a new technological paradigm does not exclude the former one, design training in the new millennium will bear a scenario that will maintain the modern characteristics; such as handicrafts, which still survive. In this sense, teaching may involve specific approaches, with a technology-based education. Without these, new experiments and the realization of comprehensive proposals will hardly be inserted in the productive world. The Orange Economy brings to the field of design teaching in Brazil perspectives on new pedagogical modalities that need to be deepened. It presents elements that intertwine with the hybrid perspective of our society. The multiracial formation and the manifestations of the traditional artisan communities serve as input for an innovative perspective, since popular strata can exploit autonomy in it.

New publics and new careers will be demanded, among them the elderly public, who should seek complementary courses or as beginners in university life. Skills already acquired should be considered in the curriculum to be elaborated, allowing customization.

Access to digital media will also mean that what matters is not where the institution is, but how it reaches this new audience. New industrial profiles, with the mini factories near the urban centers, will make universities and industries able to connect from the greater proximity between them, considering that many of the factories belong to alumni.

In conclusion, a new perspective opens up, in which the ethical dimension of the professional of the new millennium will be called. Courses focusing on specific technologies will continue to be important for attending symbolic demands, for which it is necessary to train in the arts, philosophy, sociology and history. It is important, in this context, that institutions are not carried away by their previous convictions, showing openness to new possibilities, which will certainly have an emotional impact on their teaching environment.

Therefore, one of the great characteristics of teaching in the new millennium is related to the behavioral aspects that must be explored in general education and in design teaching. Design involves not only "knowing" and "know-how", but "knowing how to be" and "knowing how to act". This demonstrates the importance of the emotional, interactive, and cognitive aspects that need to be the subject of the new design training.

REFERENCES

AHELO. *Assessment of higher education learning outcomes*. Disponível em: www.oecd.org/education/skills-beyond-school/AHELOFSReportVolume1.pdf. Acesso em: 01 out 2017.

ANDERSON, C. *Makers: a nova revolução industria*l. São Paulo: Actual, 2013.

BALLANTYNE, N.; WONG, Y.; MORGAN, G. *Human services and the Fourth Industrial Revolution:* form huITa 1987 to husITa 2016. Disponível em: https://www.tandfonline.com/doi/full/10.1080/15228835.2017.1277900. Acesso em: 01 out 2017.

BECK, U. *Was ist globalisierung*. Frankfurt am Main: Suhrkamp, 1997.

BID. *Paisagens futuras da economia laranja: caminhos criativos para melhorar vidas na América Latina e no Caribe*. Disponível em: publications.iadb.org/publications/portuguese/document/Paisagens-futuras-da-economia-laranja-Caminhos-criativos-para-melhorar-vidas-na-Am%C3%A9rica-Latina-e-no-Caribe.pdf. Acesso em: 01 out 2017.

BRUNO, F. S. *A quarta revolução industrial do setor têxtil e de confecção: a visão de futuro para 2013*. 2. ed. São Paulo: Estação das Letras, 2017.

BYUI. *The Essentials elements of team-based learning*. Disponível em: www.byui.edu/Documents/instructional_development/Larry%20Michaelsen/TBL%20Essentials.pdf. *A*cesso em: 01 out 2017.

comissão européia. *Compétences clés pour l'éducation et la formation tout au long de la vie un cadre de reference européen*. Luxembourg: Office des publications officielles de Communautés européennes, 2007. Disponível em: www.ac-rouen.fr/medias/fichier/keycomp-fr_1325755703492.pdf. Acesso em: 17 out 2017.

canclini, N. G. *Hybrid cultures: strategies for entering and leaving modernity.* Minneapolis: University of Minnesota Press, 1990.

canevacci, M. Bottega digital: etnografias ubíquas, polifônicas e sincréticas nos olhares do designer. *In:* MEGIDO, V. F. (org) *A revolução do Design: conexões para o século XXI.* São Paulo: Editora Gente, 2016. p. 144-157.

charles, S.; lipovetsky, G. *Os tempos hipermodernos*. São Paulo: Barcarolla, 2004.

cief. *Taxonomia de Bloom e Anderson*. Disponível em: www.pt.slideshare.net/ginnafa2/taxonomia-bloom-anderson/6. **Acesso em:** 01 out 2017.

cnesco. Orientation, formations, insertion: quel avenir pour l'enseignement professionel. In: *Conférence de comparaisons internationales.* Disponível em: http://www.cnesco.fr/wp-content/uploads/2017/04/Enseignement_pro_Dossier_synthese.pdf. Acesso em: 01 out 2017.

costa, F. *Pirâmides etárias brasileiras.* Disponível em: https://fernandonogueiracosta.wordpress.com/2010/12/16/piramide-etaria-brasileira/. Acesso em: 01 out 2017.

ellet, W. *Manual do estudo de caso: como ler, discutir e escrever casos de forma persuasiva*. Trad. André de Godoy Vieira. Porto Alegre: Bookman, 2008.

farias. N. de; oliveira, M. R. *Universidade de Classe Mundial e colonialismo no século XXI*. In: Anais...XI Reunião Científica Regional da Associação Nacional de Pesquisa e Pós-Graduação, 2016, Curitiba. xi anped Sul, Eixo 8, p 1-16, 2016.

figel, J. Les compétences clés pour l'éducation e la formation tout au long de la vie. In: *Competences clés pour l'éducation et formation tout au lang de l avie: um cadre de référence europée*n. Luxemburg: Office des publications officielles des Communautés eurpéennes, 2007.

findeli, Alain. *Rethinking design education for the 21 Century*: Theoretical, methodological and Ethical discussion. *Design Issues*, v. 17, n. 1, p. 5-17, Winter 2001.

fink, D. *Creating significant learning experience: an integrated approach to designing college courses*. Nova Jersey: John Wiley & Sons, 2013

forestier, C. *Formation professionnelle et employabilité*. Revue internationale d'éducation de sèvres, n. 71, avril 2016.

g1. *Por que a Finlândia está mudando o 'melhor sistema de educação do mundo'?*. Disponível em: www.g1.globo.com/educacao/noticia/2015/12/por-que-a-finlandia-esta-mudando-o-melhor-sistema-de-educacao-do-mundo.html. Acesso em: 01 out 2017.

gazeta do povo. *Dez tendências para o futuro da educação*. Disponível em: www.gazetadopovo.com.br/educacao/dez-tendencias-para-o-futuro-da-educacao-7892fycovfhuj8j2xo9qskbqb/. Acesso em: 24 mai 2021.

guile, David. *O que distingue a economia do conhecimento?* Implicações para a educação.

Disponível em: www.doi.org/10.1590/S0100-15742008000300004 Acesso em: 02 out 2017.

HERZOG, Alexander. *O que é a economia do conhecimento e quais são suas implicações para o Brasil?* - Um ensaio sobre a nova economia e o futuro do Brasil. Disponível em: www.recantodasletras.com.br/trabalhosacademicos/2926118. Acesso em: 02 out 2017.

IBGE. *Projeção da população por sexo e idade: Brasil 2000-2060*. Brasília: IBGE, 2013.

KIM, S.Y. *The fourth industrial revolution and the triple helix*. Disponível em: www.triplehelixassociation.org/wp-content/uploads/2017/07/Theme-paper-THC2017.pdf. Acesso em: 01 nov 2017.

KISTMANN, V. B. Interdisciplinaridade: questões quanto à pesquisa e à inovação em design. *Estudos em Design*. v 22(3). Edição Especial: 20 anos do Programa de Pesquisa e Pós-Graduação em Design no Brasil, 2014.

LIPOVETSKY, G. *Anotações de palestra dada na Pontifícia Universidade Católica do Paraná.* Curitiba, 2017.

LYOTARD, J. F. *A condição pós-moderna*. José Olympio, Rio de Janeiro, 1986.

MANZINI, E. Design coalitions: design for social forms in a fluid world. *Strategic Design Research Journal*, 10(2): 187-193 May-August 2017.

MEC. PDE/SAEB: *Plano de Desenvolvimento da Educação*. Brasília: MEC, SEB; Inep, 2017.

MESR. *Processus Bologne*. Disponível em: www.mesr.public.lu/enssup/dossiers/bologne/processus_bologne.pdf. Acesso em: 01 out 2017.

MINERVA. *Academics*. Disponível em: www.minerva.kgi.edu/undergraduate-program/academics/. Acesso em: 01 mai 2021a.

MINERVA. *Four-year curriculum*. Disponível em: www.minerva.kgi.edu/undergraduate-program/academics/four-year-curriculum/. Acesso em: 01 mai 2021b.

MINERVA. *The science of active learning*. Disponível em: www.minerva.kgi.edu/undergraduate-program/academics/philosophy-pedagogy/. Acesso em: 01 mai 2021c.

NATIONAL RESEARCH COUNCIL (US). *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century. Washington: National Academy of Sciences, 2012.

NONAKA, Ikujiro; TAKEUCHI, Hirotaka. *Criação de conhecimento na empresa: como as empresas japonesas geram a dinâmica da inovação*. 2 ed. Rio de Janeiro: Campus, 1997.

OECD. Organization for Economic Co-operation and Development. *The knowledge-based economy*. Disponível em: www.oecd.org/naec/THE-KNOWLEDGE-ECONOMY.pdf. Acesso em: 01 out 2017a.

OECD. Organization for Economic Co-operation and Development. *Global Forum on Productivity.* Disponível em: www.oecd.org/global-forum-productivity/country-profiles/brazil.htm. Acesso em: 01 out 2017 b.

OXERA. *UK productivity and the diffusion-machine.* Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century. Washington: National Academy of Sciences, 2012.

PUCPR. *Aprendizagem por pares*. Disponível em: **https://integra.pucpr.br/oficina-de-aprendizagem-por-pares/**. Acesso em: 12 dez 2017.

RESTREPO, B. P. F.; MÁRQUEZ, I. D. *The Orange Economy: an infinite opportunity*. Disponível em: publications.iadb.org/bitstream/handle/11319/3659/BID_The_Orange_Economy%20Final.pdf?sequence=7&isAllowed=y. Acesso em: 02 out 2017.

ROBERTSON, S. *Re-imagining and rescripting the future of education*: Global knowledge economy discourses and the challenge to education systems. Disponível em: www.researchgate.net/profile/Susan_Robertson4/publication/44836562_Re-Imagining_and_rescripting_the_future_of_education_Global_knowledge_economy_discourses_and_the_challenge_to_education_systems/links/00b7d53addbc639a77000000/Re-Imagining-and-rescripting-the-future-of-education-Global-knowledge-economy-discourses-and-the-challenge-to-education-systems.pdf. Acesso em: 01 out 2017 a.

ROBERTSON, S. *GATS and the education service industry*: The Politics of Scale and Global Reterritorialization. Disponível em: www.researchgate.net/profile/Susan_Robertson4/publication/249104814_GATS_and_the_Education_Service_Industry_The_Politics_of_Scale_and_Global_Reterritorialization/links/00b7d53addbbb5e551000000.pdf. Acesso em: 01 out 2017b.

SANTAELLA, L. S. B. *Anotações da palestra do Café Filosófico - Somos todos corruptos? Ética e o jeitinho brasileiro*. Curitiba: PUCPR, 2017.

SCALLON, G. *Avaliação da aprendizagem numa abordagem por competências*. Curitiba: Pucpress, 2015.

SILVEIRA, F. Design e educação: novas abordagens. In: In: MEGIDO, V. F. (org) *A revolução do Design: conexões para o século XXI*. São Paulo: Editora Gente, 2016. p. 116-131.

SLIDESHARE. *Taxonomia de Bloom e Anderson*. Disponível em: wwwpt.slideshare.net/ginnafa2/taxonomia-bloom-anderson/6. Acesso em: 01 out 2017.

SOUZA, S. C.; DOURADO, L. *Aprendizagem baseada em problemas (abp): um método de aprendizagem inovador para o ensino educativo.* Disponível em: www2.ifrn.edu.br/ojs/index.php/HOLOS/article/view/2880. Acesso em: 01 out 2017.

TAMMELA, J. Designer: o ser criativo, o ser inovador. *In:* MEGIDO, V. F. (org) *A revolução do Design: conexões para o século XXI*. São Paulo: Editora Gente, 2016. p. 22-39.

TOURRAINE, A. Crítica da modernidade. Petrópolis: Vozes, 1994.

VIEIRA, V. M. de. Portfólio: uma proposta de avaliação como reconstrução do processo de aprendizagem. *Psicologia Escolar e Educacional*. v.6 n. 2. Campinas, dez. 2002.

WEFORUM. *The fourth industrial revolution by Klaus Schwab*. Disponível em: www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab. Acesso em: 01 out 2017.