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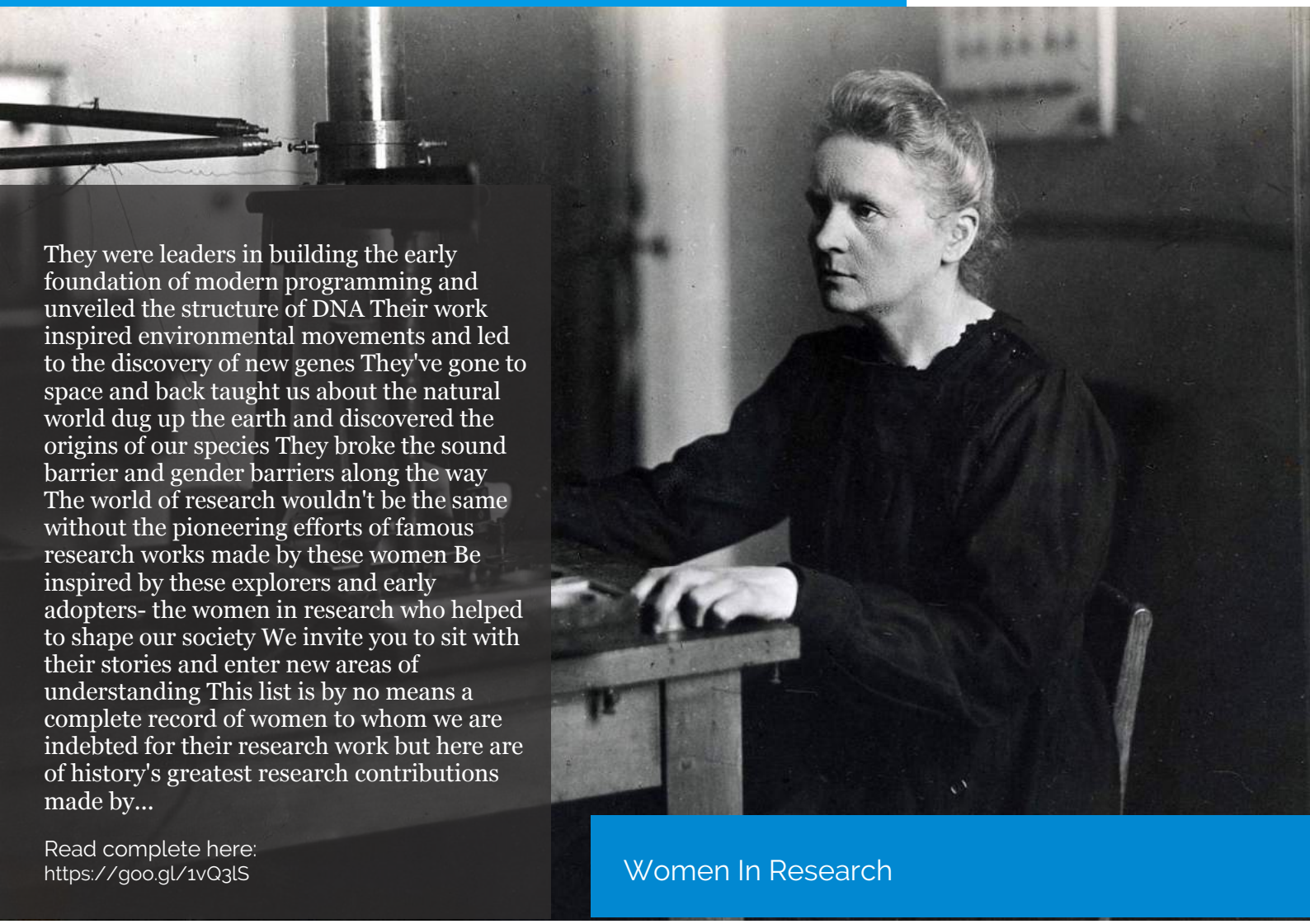

They were leaders in building the early foundation of modern programming and unveiled the structure of DNA Their work inspired environmental movements and led to the discovery of new genes They've gone to space and back taught us about the natural world dug up the earth and discovered the origins of our species They broke the sound barrier and gender barriers along the way The world of research wouldn't be the same without the pioneering efforts of famous research works made by these women Be inspired by these explorers and early adopters- the women in research who helped to shape our society We invite you to sit with their stories and enter new areas of understanding This list is by no means a complete record of women to whom we are indebted for their research work but here are of history's greatest research contributions made by...

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Educational Process as Something Dynamic

Jose Manuel Salum Tome

Catholic University of Temuco

SUMMARY

If we conceive the educational process as something dynamic, which basically combines what is given with what is emerging, we will understand that there are protagonists in it who have a fundamental role in this process, or perhaps we should say that, in this process, each and every one of the agents has a leading role.

So, talking about curriculum implies that the subject can be approached from different perspectives, some more legitimate than others, some broader than others and, what is even more notorious, some more dynamic than others.

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Jose Manuel Salum Tome

Phd Doctor en Educación

SUMMARY

If we conceive the educational process as something dynamic, which basically combines what is given with what is emerging, we will understand that there are protagonists in it who have a fundamental role in this process, or perhaps we should say that, in this process, each and every one of the agents has a leading role.

So, talking about curriculum implies that the subject can be approached from different perspectives, some more legitimate than others, some broader than others and, what is even more notorious, some more dynamic than others.

It is in these differences where the essence of the educational process is conjugated, namely, in the conception of the curriculum, so it is worth asking:

What are the educational units understanding by "development of their own curricular projects"? What are they actually doing? What curricular decisions do they make?

Not only these questions arise, but many more, not to mention that it is also legitimate to doubt the capacity and preparation of teachers and educational units to undertake a process of conscious and responsible construction of an effective curriculum.

It is interesting to approach the subject critically, not to reconsider the theoretical aspects, in which we find a wide range of postulates, but rather to revitalize the pedagogical practice in the place where it actually occurs, the classroom, and from there to enable discussion. and analysis of the problem, assuming that a paradigm change is urgent at all levels, otherwise, the entire society will suffer even more marked dehumanization.

There are many challenges and requirements that fall on the educational task, and there are many who express their opinion, judge and dare to formulate lapidary sentences on the subject of education, with no more foundation than that allowed by a fragmented look at reality, therefore Therefore, a deeper look can shed light on why it has not yet been possible to reach a more optimal level in the quality indices, nor has equity been achieved, and what is worse, it seems that all that has been said is slipping away. through the window of the classrooms to end up in the realm of abstraction, from which it will not be possible to bring what is real and everyday.

Thus, this work will also be a proposal for educational agents, a proposal that should not be kept together with others, but rather, hand in hand with the contingent, could give way to a better understanding of the problem.

Keywords: educational process, dynamic, curriculum.

Author: PhD doctor of education Catholic University of Temuco.

I. DEVELOPMENT

1.1 Curricular Conception: Starting Point

Before the Educational Reform , the existing curricular conceptions in educational institutions were characterized by being loaded with an exaggerated encyclopedia, a behaviorist approach that led to the depersonalization of the Teaching-Learning process. The lack of coherence and lack of clarity regarding the purposes pursued in the educational process made transformation necessary, giving a great boost to teacher training and investing in infrastructure, technology and others, but above all , redesigning plans and programs from their foundations.

Everything seemed to portend that new times were approaching the field of education, and that

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the already tainted atmosphere would be filled with renewed air and the demands to improve the quality of education would be met, with teachers being the protagonists of this change.

In the fundamental postulates of this reform, the constructivist approach is evident, with a dynamism that would allow the main agents of the process, the students, to build their learning.

After some years of walking with the reform, some teachers in active service have been asked about their conception of curriculum, if they have the possibility to make significant changes in it and if they can distinguish between implicit and explicit curriculum, and, we must say, I am very disappointed that only one out of ten people is capable of giving a coherent and correct answer. This research was disappointing and I wanted to know if a person who is starting their teaching career, just graduated, could give us a good definition, but their answer was that "The first year we had that branch, but I don't remember what it was about".

The teachers surveyed affirm that curricular decisions are made only in the central spheres, and that they are responsible only for decisions about how to evaluate the contents covered, their main task being "to treat the contents stipulated in the study program".

- Stenhause's proposal remains very distant , who assigns the teacher the role of researcher of the curriculum and its development, and even more, assigns him a scientific character, and compares the classroom with a laboratory. If we pay attention to the definition of curriculum that he uses, when he points out that it *is " An ordering guideline of the teaching practice and not as a set of materials or a compendium of the field to be covered. It is a way of translating any educational idea into a testable hypothesis in practice."* [1] *(Research and development of the curriculum, 1984, Chap: The teacher as a researcher).*

I agree with him in this definition, since theoretical conceptions can only be put into practice by appropriating them, namely, that having a research work on the part of the teacher, his role is expanded, and he goes from mere executor, to protagonist of the process. This would mean that the study of teaching practices and all that it implies, would not be done from outside, but would be done by themselves.

But, the tendency that is evident in the pedagogical practices, is to maintain a tradition of abstractionism, with assumptions that have been validated from the behaviorist conception, such as, that the stimuli, contents, must be to achieve an expected response, predesigned, being the center of the process what is taught, emphasizing the formal aspects. From this conception, "good students" will be those who repeat the predesigned response model, which is measurable and objectifiable, and allows the teacher to maintain authority and validates it in front of his students as superior.

As in all human actions, what is thought and how it is thought determines the product of that thought, that is, the concrete action, and if the reflective process is abandoned in favor of a "do for the sake of doing", we are left with nothing but expect poor teaching performance, and the classroom is reduced to a place where "material is passed" and " things are done", but where learning is not built. (Reductionism of learning by doing to a simple doing). The problem is described like this:

- *" Within the educational field, an anti-intellectual environment is generated, which fights against idealistic currents; concern for making school action effective; The development of child-centered pedagogy leads educators to depend on a type of rationalization oriented towards pragmatic intervention in school change. The massive dissemination of Dewey's ideas, which are misinterpreted by his followers, favored an environment whose effect was the desertion of reflection and the privilege of applied knowledge... a knowledge that privileges ideas of interest, need..."* [2] *(Research and development of the curriculum, 1984, Chap: The teacher as a researcher).*

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The educational process would have the purpose of achieving a predesigned product, making the school proactive, whose effectiveness will be determined by the achievement or not of this product. So much so, that schools are already conceived as companies, and the teacher, one more functionary within a system characterized by competitiveness, individualism and other symptoms of the dehumanization of students.

Sharing the same circumstantial scenario, there is the other ten percent of the teachers surveyed, for whom the curriculum is something dynamic that is built from a vision of life, of the student as a person and of society, given in a present that is important. in itself as a process and as an end, in which the theoretical and the practical are combined, a meeting between concrete people who build a reality, developing effective teaching practices without neglecting reflection or action, perceiving that the dialectic of this process will allow a training that does not depend only on the teacher, nor only on the student, but on each and every one of the educators.

1.2 Curriculum Development: a Necessary Challenge

We have established as the basis of the educational problem the lack of conceptual clarity existing in teachers in relation to the concept of curriculum, which leads to developing pedagogical practices that disagree between what is thought and what is done, emphasizing doing for the sake of doing, among other consequences that it entails . conceptual weakness.

We are now going to see how a conceptual change can be achieved and what needs to be changed or reinforced. The first change should lead us to think of a curriculum with academic relevance and social relevance, which allows us to focus the work on a more humanizing training, which claims the value of training from the person himself, recognizing it in all its dimensions but also valuing the multiple interactions it develops with its environment. This curricular look would require different conceptions of education and school that make it possible to manage and recreate the social and cultural processes that surround educational institutions and those that are gestated from within. This implies conceiving the curriculum with certain particularities in such a way that an integrated, coherent and flexible work is achieved.

A curriculum with these characteristics will be of permanent, participatory, flexible, creative construction, with a social approach that recognizes and energizes the contexts in which they are configured in their conceptions and practices, with transdisciplinary approaches that allow the transformations that our society requires. There are different social and community processes that do not directly include educational institutions in their dynamics, leading to rethinking the work that occurs within them; from the articulation of the curricular processes with the social and community dynamics that are managed from the educational community, that is, that move and generate processes of curricular reconstruction as a result of the social processes, of their dynamics, in a different exercise of conceiving the community relationship as an interactive and dynamic whole, in an integral dialectical relationship.

Initiating a reflection on the curricular structures and the social processes that are dynamized around the school, implies an approach to the way in which the curricular and its characteristics have been presented, in order to understand the influence and relevance of an educational work that recognizes its environment, its social and cultural milieu, but that it is not at its service, but rather is part of it.

In the development of the teaching/learning process, it is not possible to approach the once all the objectives and contents present in a certain area. On the contrary, it is necessary that there is a distribution of the contents throughout various units that follow one another in a school year, a cycle or in the complete stage, with adjustments to their present reality, and that is agreed by the unit. education and teaching team, guaranteeing the continuity and coherence of their actions and as part of the curricular project, in what we generically call sequences.

As soon as we get into this topic, we can find different ways of understanding the task of ordering objectives and content (part of the curriculum), depending on the importance we give to each type of content, the coherence between the teachers involved in the process of teaching/learning of a course group, the type of learning we choose and, consequently, the teaching model we propose; In short, the way we understand our teaching work together with the vision we have of the educational fact, of education itself. However, what must be clearly determined is whether all the curricula are equally valid, independent of the curricular model that is applied, or if, on the contrary, the curricular units of the model that is applied correspond to an open and flexible model. , such as the one we are proposing at this time, must have some characteristics that differentiate them from the others.

I understand that, in a model based on the contributions of significant learning, attention to the diversity of the students, in the autonomy of the planning of each curricular unit, logically the sequences of contents should not be rigid, nor the same for all the courses of the same educational unit. It will then be understood that each reality is not comprehensible a priori, but in the dynamics of the process itself, discarding metaphysical, ideological or any type of assumptions, giving the curriculum its most appropriate understanding and definition, namely, as a path that has been followed. to travel, in a present, building significant learning for themselves. Thus , for example, one no longer prepares for life, learning becomes life: The curriculum is development, not predetermined assumptions.

For Stenhause, *"...The ideal is that the specification of the curriculum encourages a personal research and development program on the part of the teacher, through which he progressively increases the understanding of his own work and thus refines his teaching.*

To summarize the consequences of this position: all well-founded research and development of the curriculum, whether it be the work of an individual teacher, a school, a group working in a teacher's centre, or a group operating within a the coordinating structure of a national project, will be based on the study carried out in school classes. It rests, therefore, on the work of teachers. It is not enough that the work of teachers has to be studied: they need to study it themselves." [3] *(Sacristán, J; The practice of a critical curriculum)*

The consequences of the development of the curriculum for teachers in the sense of broad depth as opposed to restricted professionalism are evident, and arise mainly from the commitment that the teacher generates in himself by systematically questioning the teaching taught by himself, with the ability to self-criticism, constant self-evaluation, studying the proper way of teaching, questioning and verifying the theory in practice through the use of the aforementioned capacities.

1.3 Cultural dialectic in the classroom: an emancipatory process

In our investigation, as in the investigations carried out by Sacristán, keeping the proportions, it is evident that the traditional categories with which the curriculum is conceived do not lead us to an emancipatory development nor to the progress of the sense of the human. It is evident in the teaching work that derives from this conception, as has already been stated, many deficiencies, of which I will now cite the technical interest, manifested in a knowledge that maintains an essential interest towards ideas. *"Theory is valued to the extent that it is practical, that is, directly applicable to practice, without the need to reinterpret it. The action is related to the product, and when the teachers' work is informed by technical knowledge, it appears as a manifestation of craftsmanship, and even mechanical work.* [4] *(J. Sacristán, The Curriculum: a reflection on the practice)*

The technical interest and the predesigned quantitative results seem to be signs of effectiveness in the school process, and if we maintain the traditional conception of the curriculum, it is. But what we really need is to establish a culture of self-assessment, a capacity

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to see all parts of the process as equally important, namely both the classroom and its near and far environment, with all its agents engaged in this constant analysis. A holistic view of the process, with a critical analysis of the teacher's work, given by the teacher himself, are guarantors of a more dynamic curricular conception.

Conceiving the curriculum as a process and development involves the teacher, the student and society as a whole, being clear that the hypotheses to develop the investigation of this process will not emerge from outside, but from the process itself. It is the teachers who, as has already been said, must develop research in their professional actions, without ignoring the classroom, but in itself.

Already around 1960, Stenhause, based on the ideas of Kurt Lewin, and the philosophical position of Habermas, proposed research in educational action, in which systematic and self-critical inquiry should be given by the teachers themselves.

We believe that, if the teacher becomes a researcher of his own work, renewing his conceptions about the curriculum, the cultural dialectic will really occur, contemplating the knowledge accumulated by all the historical and epistemological events, which gives meaning to the plans and programs established, and emerging knowledge, the product of new visions, new knowledge built in contingency, in a propitious meeting for true development and human and humanizing progress.

The action research proposed by Stenhouse would allow the teacher to be a generator of change, with the possibility of applying clear and effective solutions to the various problems and school requirements. With these parameters, the quality of education will be a necessary consequence and not a statistical requirement, thus also improving the school-community relationship, and revaluing both the role of the teacher, considered as a true professional, and the student as a real person., not a static content repository object.

With this new curricular conception, the educational process will have value in itself and what society really needs will be generated as a result: people capable of thinking independently, generators of significant changes. Let's understand the word change not as an attempt to replace some structures with others, but in the sense of a dynamic process that allows the active becoming of what the human being really needs: to be realized as such in a society that values each being in their fair measure, offering them the opportunities to develop their life in a community.

1.4 The Curricular Training of the Teacher

Today is when initial teacher training is most discussed, for all those backgrounds that provide the daily events in our schools and high schools in our country. This is how, through the evaluations that are being applied to the teachers of the municipal system, it has been possible to determine that around 41% of the teachers evaluated do not meet the expected standards, that is, they are categorized as basic. and unsatisfactory. On the other hand, from the pressures for a change to the LOCE, after a day of paralysis of the students, and from the general consensus to produce an imperative change in education, the question arises about what is the role of educational institutions that train new teachers and what is the conception of initial training and learning that they promote. It is true that there are innumerable contributions that the State has given: the full time, the radical change in infrastructure, the curricular appropriation courses, the postgraduate degrees in some subsectors, etc., for which the answer will not be long in coming.

Although teacher training is intended to show a reflection on the conception of initial teacher training and some disciplinary, didactic and pedagogical skills that every teacher should handle. Emphasis has been placed on some accessory elements so that the students of these future teachers acquire significant learning in the corresponding subsector.

The conception of initial teacher training should be framed within the paradigm of constructivism,

for which reason the teachers that every institution trains must respond to a triple dimension of learning (knowledge, ability and attitude).

A School of Education must infuse its students with professional and teacher training so that they acquire the competences of the domains of their area or specialty, the competences of the domain of the teaching and learning processes and have attitudes and actions that reflect their interest. genuine in the practice of their teaching role.

To do this, it must commit to creating spaces for teachers in training to be builders of their own curricular projects, to be competent, to develop their teaching skills, to be autonomous, committed to their work, capable of teamwork and open to change, and above all, have the ability and motivation to develop research about their own work in the classroom.

In teacher training, efforts must be made to articulate the disciplinary, the didactic, and the pedagogical; In addition, it seeks to develop the continuous nature of learning, that is, that the knowledge that is developed is anchored in previously acquired knowledge and is the basis for generating new knowledge.

From this perspective, what should be sought in each approach could be characterized as follows:

- *Disciplinary:* with emphasis on the development of conceptual and procedural competencies given by the current study programs, with various depths and extensions of levels, basic to medium, and medium to higher, in order to achieve disciplinary expertise .
- *Didactic:* with emphasis on the development of didactic skills through reflective and critical analysis of didactic proposals, both designed by the teacher and by others, and
- *Pedagogical:* with emphasis on the methodological and evaluative orientations given by the current study programs, and even by particular proposals, whether institutional, and/or personal.
- *Scientific:* Understood as the need for constant renewal and self-evaluation that emerges from within the classroom itself, namely, with an investigation - action that postulates and tests hypotheses about the problems that arise.

II. CURRENT CURRICULUM FRAMEWORK

From the dimension of know-how, the teacher in training must be able to learn to design, implement and evaluate the curriculum in didactic situations, in addition to understanding that the skills, an important part of learning, must be learned by their students, and put into practice. practice.

From the dimension of knowing how to be, it must be individually and socially responsible; In addition, capable of meeting the needs that arise from the field of dispositions towards objects, ideas or people with affective, cognitive and evaluative components, which incline people to certain types of actions, such as personal development, learning and the relationship with knowledge, relationships with others, citizen rights and duties, study discipline and personal work, teamwork, evidence management, truth and criticality, dialogue and conflict management , including the natural environment, in such a way that all areas are developed with a cognitive look at the attitude.

In this sense, what should be sought is not only to develop the evaluative aspect that is part of the attitude, but also to intentionalize the cognitive look that emerges from it, with respect to learning and its relationship with the knowledge that they develop.

Like the dimension of knowing how to be, they articulate the values and beliefs with the behavior that we expect a teacher should have in the exercise of their teaching function, so that the institutional and social environment of the school or high school is a place that favors the meeting and does not hinder the interactions within the educational unit.

From the dimension of wanting to do, this teacher must be a committed and active participant in the educational change that is to be implemented, but must also be reflective, not impulsive, in such a

way that it demonstrates all the skills acquired in their training, and also demonstrates all its expertise in the specific area in which it has been prepared.

As expressed by Grundy, S; *"First, the attitudes and practices of teachers must become more firmly based on educational theory and research. Second, the professional autonomy of teachers must be expanded. Third, the professional responsibilities of teachers must be expanded"* [5] *(p. 256 Product or praxis of the curriculum).*

Based on the above, I have wanted to show the importance of teacher training and the conception of learning that can be extended to practically all educational tasks, not only from the dimensions addressed in the previous lines.

As a way of concluding, I want to reflectively express an aspect of real importance that is not often treated in curricular topics and that is closely linked, it is evaluation as well as Planning. What about the evaluation? The evaluation is more than a qualification, it is a permanent process, which feeds back the teacher's work. It is left as open questions to be taken into consideration in the initial teacher training, and in the learning conceptions that these new teachers will handle. What is the role of the teacher from this perspective? What evaluation approach do you want to deliver to these teachers so that they have a management according to the curricular needs of the heterogeneity of students and schools where they will practice?

2.1 The Ethical View of the Problem

From the perspective of what should be, and of the values that should be present in the educational process, we can observe at least two causes that make the problem that we have raised serious:

1. The relationship between the means and the ends is unknown or confused: indirectly, by transforming the teacher into a "technician" who applies what is given, he generates a level of frustration that prevents him from being happy with what he does , he instrumentalizes himself and his students. This is an ethical problem because the human being is an end in itself, and should not be objectified or another human being objectified.

The way out of this problem has already been mentioned, but it is necessary to dwell on it: *"The exciting consequence that action research has for teachers is that it offers practicing professionals a greater degree of autonomy and responsibility for their own working practices, and to provide students with students with whom they work, more authentic learning experiences" (* Grundy, curriculum, product or praxis. page 258)

2. Individualism as a prevailing value: Today's society is marked by a growing individualism, which goes against the essence of the human being, social by nature, and the classroom is no stranger to this: students are privileged that achieves the highest performance and subtly or clearly, those who do not give the expected answers are discriminated against, obviously, without making an analysis of why some students do not reach the expected levels, or they are classified as bad students, bad courses. This is an ethical problem that violates the fundamental rights of people, such as equality, and we believe that it would be solved when the professionalism of the teacher is understood and assumed as such and the student is understood and assumed as a person, with all what that implies.

3. Assessments: Every human being is an axiological being, with an estimative conscience, and this sometimes leads him to dogmatisms that are difficult to overcome, and that affect his work and relationship with others. Thus, in the case that we are analyzing, the assessment of work is of singular importance. Being a professional or being a technician in the classroom will lead to different considerations, to different visions of life, and, of course, to approach the pedagogical task with high vision or with mediocrity.

If we emphasize the ability that human beings have to critically analyze what they think and do, dogmatism is overcome, and therefore stagnation.

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There are many other points that we could cite in this regard, but these three are the fundamental ones, since they make explicit the need to also reflect on what is the professional and personal ethics of the teacher, and update the value perspectives, rescuing the fundamentals of the pedagogical task : A job between people and for people.

III. CONCLUSIONS AND REFLECTIONS

In my opinion, it is assumed that + one is the theoretical conception of things and processes, and the other is the process itself, which is evidenced when I hear, for example, that something is supposed to be happening, or that someone is expected to take care of it, and in reality, that assumption is just that, assumption, and that someone is not really present either, then I realize how far we are from the essence of the process. It seems complicated, but it is not, it is just a discrepancy between the theoretical and the concrete reality, where learning by doing is reduced to a mere functionality, to a marked doing without due reflection.

We then show two extremes: Thinking without doing.... Doing without thinking..., and its golden mean, in Aristotelian language or adequate measure to rescue the essence of the educational process: Thinking and doing to think again.

When we enable a real meeting between people who recognize themselves as parts of a whole, with different but valid points of view, and the teacher assumes that the content is not paramount, but rather the learning process, and learning not for the future , but for the here and now, when we assume the social role that corresponds to us, of awakening the capacities of the students, mainly the capacity to assume the challenge of learning by themselves... only then will we have reconciled the theoretical plane with the plane.

In this way, the need and commitment to reflect on the teacher's work becomes an ethical need, in which constant self-evaluation, open-minded discussion, and the values of respect, social responsibility mark the pattern of this reflection.

In addition to the above, there is an urgent need to create effective spaces for reflection on the actions of teachers in the classroom, as a way of expanding knowledge and for teachers to become researchers of their own practices, not waiting that others set the guidelines to find solutions to the problems that arise in the classroom, but that the solutions emerge from their own hypotheses verified in the field itself.

We must say, quite clearly, that teachers are not prepared to take on this challenge, either because of weakness in their training, or because of stagnation in their professional development. The truth is that a change is urgently needed, a change of paradigms in the curricular conception, which must be understood as a dynamic process, in which the role of the teacher rescues his professional level and a change in society, which should not sue education the development of a product determined a priori, but must give the process the role it deserves.

Finally, I conclude then that quality in education should not be a statistical requirement, but a necessary consequence of a process that recovers its essence: *a process that trains people with autonomy of thought.*

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Geographical Indications as an Instrument of Public Policies and Environmental Governance

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ABSTRACT

Geographical Indications are an intellectual property right characterized by being a product or service coming from a certain region, which, in the Brazilian case, has either become known as a center of production, extraction or manufacture, or because of its unique natural and human characteristics. Given this, the protection of the environment can emerge as one of its impotent functions, from the moment that, to maintain the status quo of natural factors, such as climate, soil, vegetation and many others that are proper to the region and essential for the effectiveness of the product or service, it is necessary to develop elements of environmental protection. Thus, this article intends to study and prove that Geographical Indications can be used for the protection of the environment through the promotion of public policies and environmental governance.

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Geographical Indications as an Instrument of Public Policies and Environmental Governance

Indicações Geográficas como Instrumento de Políticas Públicas e Governança Ambiental

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ABSTRACT

Geographical Indications are an intellectual property right characterized by being a product or service coming from a certain region, which, in the Brazilian case, has either become known as a center of production, extraction or manufacture, or because of its unique natural and human characteristics. Given this, the protection of the environment can emerge as one of its impotent functions, from the moment that, to maintain the status quo of natural factors, such as climate, soil, vegetation and many others that are proper to the region and essential for the effectiveness of the product or service, it is necessary to develop elements of environmental protection. Thus, this article intends to study and prove that Geographical Indications can be used for the protection of the environment through the promotion of public policies and environmental governance.

Keywords: geographical indications; environmental public policies; natural resources governance.

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RESUMO

As Indicações Geográficas são um direito de propriedade intelectual que se caracterizam por ser um produto ou serviço proveniente de uma determinada região, que, no caso brasileiro, ou se tornou conhecida como centro de produção, extração ou fabricação, ou em razão de suas características naturais e humanas únicas. Diante disso, a proteção do meio ambiente pode emergir como uma de suas impotentes funções, a partir do momento em que, para manter os *status quo* dos fatores naturais, como clima, solo, vegetação e muitos outros que são próprios da região e essenciais para a efetivação do produto ou serviço, se faz necessário o desenvolvimento de elementos de proteção ambiental. Sendo assim, este artigo pretende estudar e comprovar que as Indicações Geográficas podem ser utilizadas para a proteção do meio ambiente através da promoção de políticas públicas e de governança ambiental.

Palavras chaves: indicações geográficas; políticas públicas ambientais; governança de recursos naturais.

I. INTRODUCTION

Geographical Indications are characterized by being a product or service coming from a certain region, which has either become known as a center of production, extraction or manufacture, or because of its unique natural and human characteristics. The first are called Indications of Origin; and the second, Designations of Origin.

The Signs of Origin, as Geographical Indications are also named, have, in addition to these two characteristics – which will be studied in due course – several functions that are usually attributed to them. The first, is the function of origin, since these products or services, in order to be produced or provided, need to respect specific rules and norms of procedure. In view of this, a second function arises, which is of quality. Thus, once proper standards are followed, there is a reflection on the quality of the product itself, since a series of rules of procedure, hygiene, technical

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specifications, among others, must be observed, so that there is no mischaracterization of the geographical indication itself. Finally, there is also a function of distinctiveness, once the seal of origin ends up distinguishing and making unique the certified product or service, through a Geographical Indication.

Although it is not usually or typically assigned to the institute of Geographical Indication, a new function can be assigned to it: that of protecting the environment. The very elements that characterize them, especially the Designations of Origin – the human and natural factors, which will be seen in detail later – need to remain invariable, to guarantee the maintenance or the very existence of the products or services.

Thus, environmental protection emerges as a function, from the moment that, to maintain the *status quo of* natural factors, such as climate, soil, vegetation and many others that are proper to the region and essential for the Geographical Indication, efforts from all social and economic sectors of that locality are necessary, so that such characteristics remain static. Therefore, it would not be enough not to harm the environment; actors involved must protect it, at the risk of making the existence of the Geographical Indication unviable.

In this way, this work is aimed at studying and proving that the protection of the environment is, yes, a function of the Geographical Indication and that this judicial institute can be used in the promotion of public policies and *Environmental Governance.*

II. METHODOLOGY

Regarding the methodology, the present study used the deductive method. Thus, it began with the general premises regarding Geographical Indications, Environmental Public Policies and Natural Resources Governance, in order to, after analyzing the challenges imposed by this new reality of climate change, conclude about the possibility or not of applying the proposed hypothesis.

As for the purpose/objective, this is an explanatory work, because the object of this research is intended to identify which factors contribute to identify the challenges and possible solutions, in the face of litigation caused by the intersection between Geographical Indications, Environmental Public Policies and Natural Resources Governance, which are currently verified.

Regarding the approach, the present thesis adopts the qualitative approach, since the analysis will be made subjectively, through a broad study of the object, by the action- research. Qualitative research is understood as one that works with reality data, which cannot be quantified, operating through the comprehension, interpretation and treatment of data, about the essence or nature of the object of research.

As for the procedure, the present research is characterized as bibliographic and documental, because it seeks to understand what is in the state of the art, making use of the existing information both in the doctrine and in the jurisprudence, to verify the possibility to apply the above pointed issue, but also to use documents to better understand the problems pointed out.

III. GEOGRAPHICAL INDICATIONS

In current Brazilian legislation, there is not, as will be seen, a definition of the concept of Geographical Indication. The norm is limited to indicating and conceptualizing the species of possible geographical indications in the Brazilian State.

The normative text in which the referred concepts are inserted is Law No. 9,279 of May 14, 1996, that[1] regulates the rights and obligations related to Intellectual Property. That is, GI's, in Brazil, are a modality of Intellectual Property[2]. In this step,

[1] BRAZIL. National Law No. 9,279, Industrial Property Law (LPI), of May 14, 1996. It regulates rights and obligations relating to industrial property. Available at: http://www.planalto.gov.br/ccivil_03/leis/l9279.htm. Accessed: 28 Jan 2022.

[2] REIS, Livia Liberato de Matos. Indicação Geográfica no Brasil: determinantes, limites e possibilidades. 2015. 270 f.

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that law was responsible for the harmonization between the national legal system and the TRIPS agreement[3].

Among the novelties provided by the TRIPS Agreement, in regard to nomenclature, was significant the adhesion of the expression Geographical Indication and the institution of Designations of Origin[4]. It is also worth mentioning an interesting particularity, about which the national legislation provides not only products, but also services, both for Indication of Origin, as for Designation of Origin, distancing itself, at this point, from international legislation[5].

Thus, the aforementioned law, in article 176, states that: "The Indication of Origin or the Designation of Origin constitutes a Geographical Indication". As can be seen starting from a simple reading of the normative text, there is no proper reference for what is, in Brazilian legislation, a Geographical Indication[6]. This task ends up being transferred to the doctrine, which does not collaborate with the chimera of conceptual harmonization.

The law, therefore, leaves us no alternative but to proceed with the analysis of the concept of GI species. In article 177, there is reference to the first of them, which is the Indication of Origin, as stated in the text of the legal provision: "The geographical name of the country, city, region or locality of its territory, which has become known as a center of extraction, production or manufacture of a certain product or provision of a certain service, is considered an Indication of Origin."

In article 178, there is mention to the second, that is, the Designation of Origin: "Designation of origin is considered the geographical name of a country, city, region or locality of its territory, which designates a product or service whose qualities or characteristics are due exclusively or essentially to the geographical environment, including natural and human factors."

Marcos Fabricio Welge Gonçalves states that "a preliminary analysis, in these two figures, allows us to define as Geographical Indication the geographical name that designates product or service".[7]

The primary difference between these two GI species lies in the fact that Denominations of Origin require for a quality or characteristic that is peculiar to a product or service to exist, that is linked to its origin, including, in this aspect, factors not only natural, but also human[8].

Thus, two aspects which deserve to be highlighted in the concept of Denominations of Origin are perceived. The first refers to the qualities or characteristics that designate the product or service. And the second aspect is that these qualities or characteristics must be exclusively or essentially attributed to the geographical environment, including natural factors (soil, climate, humidity, geological formation, wind, flora, fauna, etc.) and human factors (culture, know-how, etc.).

Tese (Doutorado) – Instituto de Geociências, Universidade Federal da Bahia, Salvador, 2015, p. 82.

[3] CHIMENTO. Marcelo Rutowitsch. Indicação Geografica na imprensa: cenários e desafios. 2015. 219 f. Tese (Doutorado) - Programa de Doutorado em Propriedade Intelectual e Inovação, Coordenação de Programas de Pós-Graduação e Pesquisa – Instituto Nacional da Propriedade Industrial – INPI, 2015, p. 38.

[4] FRÓES, Carlos Henrique de Carvalho. Indicações geográficas e marcas constituídas por nome de lugares. Revista da Associação Brasileira de Propriedade Intelectual. Rio de Janeiro, n. 56, jan.-fev. 2002. p. 66-68.

[5] GURGEL, V. Aspectos jurídicos da Indicação Geográfica. In: LAGES, V.; LAGARES, L.; e BRAGA, C. (orgs.). Valorização de Produtos com Diferencial de Qualidade e Identidade: Indicações Geográficas e certificações para competitividade nos negócios. Brasília: Sebrae, 2006. p. 65. Disponível em: https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/indicacao-geografica/arquivos-publicacoes-ig/desenvolvimento-sustentavel-indicacao-geografica-valorizacao-de-produtos-2007.pdf. Acesso em: 03 jul. 2015.

[6] GONÇALVES, Marcos Fabrício Welge. Propriedade Industrial e Proteção dos nomes geográficos: indicação geográfica, indicação de procedência e denominações de origem. Curitiba: Juruá Editora, 2008, p. 52.

[7] *Ibid.*

[8] LOCATELLI, Liliana. Indicações Geográficas: a proteção jurídica sob a perspectiva do desenvolvimento econômico. Curitiba: Juruá, 2008, p. 229.

If there is no characteristic/quality that derives from human or natural factors linked to the geographical environment, that grants peculiarity (*a plus*) to a product or service and, therefore, distinguishes them from their peers in the market, there will not even be a Denomination of Origin[9].

Already the Indications of Origin require only a notoriety or recognition of the origin of a particular product or service[10]. Functionally, there is a relation between the geographical name and the products or services, since that one must serve to nominate, as stated in article 177 of Law No. 9,279/1996, a "center of extraction, production or manufacture of a certain product or provision of a certain service".

This connection can, in turn, be established in three different ways, as the site or region can be a center of extraction, production, or manufacturing. Therefore, there is no influence, according to the definition in the Brazilian legislation, of geographical or human factors on the products or services[11]. The geographical name, in the Indications of Origin, in the words of Pontes de Miranda, only situates the product[12].

Once this conceptual point is overcome, we move on to the core of this work, which is the study of the use of Geographical Indications as an instrument of public policies and Environmental Governance.

IV. GEOGRAPHICAL INDICATIONS AS AN INSTRUMENT OF PUBLIC ADAPTATION POLICIES

According to Celina Souza, there is not a single or better concept of what a Public Policy is[13]. However, some doctrinaires venture to define it. Thomas Dye, in 1984, said that is whatever the government chooses or not to do[14]. However, according to Peter Bachrach and Morton S. Baratz in 1962, doing nothing about a problem would also be a form of public policy.[15]

Harold Lasswell goes further and states that, when talking about public policies, one must, with regard to their decisions and analyses, answer the following questions: who wins what, why and what difference does it make?[16] . It would also be, according to Celine Souza, when "democratic governments translate their purposes and electoral platforms into programs and actions, which will produce results or changes in the real world."[17]

In recent years, the increase of temperature in the planet, caused by high emissions of greenhouse gases in the atmosphere, has been recurrent in international discussion panels. As a consequence, climate change has been constantly present in the news, because of atypical natural events, all over the planet.

To illustrate, in Brazil, for example, floods have occurred more frequently, throughout the country. In addition, hurricanes, typhoons, heat waves, harsh winters, droughts and substantial temperature differences are noticed, everywhere in the world. These natural phenomena are the so-called climatic extremes, which cause serious consequences not only to natural ecosystems, but also to man and his well-being[18].

Such changes in climate have caused an unprecedented environmental crisis, but their origin is not only due to natural events. It must also be understood under the social bias, since, as Julia Lopes da Silva and Patrícia Rodrigues

[9] GONCALVES, *op. cit.*, p. 57.
[10] LOCATELLI, *op. cit.*
[11] GONCALVES, *op. cit.*, pp. 55-56.
[12] MIRANDA, Pontes de. Tratado de Direito Privado, v. 16 e 17. Campinas: Bookseller, 2002, p. 343.
[13] SOUZA, Celina. Políticas Públicas: uma revisão da literatura. Sociologias, Porto Alegre, ano 8, nº 16, jul/dez 2006, p. 24.
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[14] DYE, Thomas D. Understanding Public Policy. Englewood Cliffs, N.J.: PrenticeHall, 1984.
[15] BACHRACHB, P. e BARATZ, M. S. "Two Faces of Power", American Science Review 56, 1962, pp. 947-952.
[16] LASWELL, H.D. Politics: Who Gets What, When, How. Cleveland, Meridian Books. 1936/1958.
[17] SOUZA, Celina, *op. cit.*, p. 26.
[18] MARENGO, J. A.; NOBRE, C. A.; SELUCHI, A. E.; CUARTAS, A.; ALVES, L. M.; MEDIONDO, E. M.; OBREGÓN, G.; SAMPAIO, G. A seca e a crise hídrica de 2014 – 2015 em São Paulo. Revista USP, 106, 31–44, 2015. https://doi.org/10.11606/issn.2316-9036.v0i106p31-44

Amora explain, [19]it stems from a series of sociopolitical factors, such as public policies, international agreements and geopolitical disputes.

These choices of society, based on decision-making, individual and collective engagement, in addition to today's international relations that generate direct effects on climate, also provoke a serious ethical crisis, since the actions taken now can compromise the future of the species on the planet[20].

Climate change is not, however, a reality of the present. In the past, over the course of the 4.5 billion years of earth, there have been several radical changes in climate. Periods of climatic stability were interspersed with large glaciations; warm periods, caused by the greenhouse effect and even desertification[21]. These changes, therefore, are events that occur naturally and normally on the planet, resulting from geological factors[22].

However, during the current geological era, Holocene ("Recent Totality"), human activities have gradually grown, to the point of "becoming a significant geological force," capable of being compared to the "great forces of earth." The expansion of human activity on earth, the great process of urbanization, the great use of natural resources and the impacts on the soil and atmosphere, in a global and generalized way, attribute to human beings a prominent role in Geology and Ecology, at a level that is given to the current geological era the denomination of "Anthropocene[23]". [24].

Although it is not known exactly where the "Anthropocene" begins, João Ribeiro Mendes proposes to consider its beginning, in the last part of the eighteenth century, which, according to the author, was when the effects of human activity on earth began to be[25] noticed.

Alongside the causes, climate change is occurring and is a reality. The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report 2022 states that impacts of climate change are increasingly being felt in all regions of the planet, not just the poorest. The truth is that climate change is already underway and will not be stopped or annulled. What is needed, now, is to understand which planet one wants to live in: with more or less impacts and risks caused by climate change[26].

[19] SILVA, J. L.; SAMORA, P. R. Os impactos da crise hídrica sobre a população do município de Campinas/São Paulo (2012-2016). Revista Brasileira de Gestão Urbana, pp. 1–14, 2019. Disponível em: https://doi.org/10.1590/2175-3369.011.e20170210. Acesso em: 01 jan 2022. As autoras trazem um exemplo: "merece destaque é a dificuldade de acesso à moradia digna por grande parte da população em função da lógica capitalista que opera nas cidades, o que causa diversas alterações dinâmicas e estruturais aos centros urbanos e aos ecossistemas naturais. Em função disso, inúmeras consequências são observadas em todo o país, como ocupação de áreas ambientalmente sensíveis, desmatamento, poluição, enchentes, periferização etc., que estão interligadas e atingem tanto o meio ambiente quanto a sociedade. Constata-se, portanto, a necessidade de integração de ações mais adequadas e menos destrutivas, de forma a garantir a manutenção das cidades e dos ecossistemas".

[20] BOFF, Leonardo. Sustentabilidade: o que é: o que não é. Petrópolis: Vozes, 4. ed., 2015.

[21] EEROLA, Toni Tapani. Mudanças Climáticas Globais: Passado, Presente e Futuro. Apresentação no Fórum de Ecologia e no evento Mudanças Climáticas: Passado, Presente e Futuro, organizados pelo Instituto de Ecologia Política na Universidade do Estado de Santa Catarina (UDESC), Florianópolis, em 2003. Disponível em: https://cetesb.sp.gov.br/proclima/wp-content/uploads/sites/36/2014/04/eerola_mc.pdf. Acesso em: 14 mar. 2022.

[22] YOUNG, G.M. The geologic record of glaciation: relevance to the climatic history of Earth. Geoscience Canada 18, 100-106. MURCK, B.W.; SKINNER, B.; PORTER, S.C. Environmental geology. New York : John Wiley & Sons, Inc., 1996, 535 p. MERRITS, D. ; DE WET, A. ; MENKING, K. Environmental geology. An Earth system science approach. New York : W.H. Freeman and Company, 1997, 452 p. EEROLA, T. Climate changes at the Neoproterozoic-Cambrian transition. In : ZHURAVLEV and RIDING, R. (Eds.) The Ecology of the Cambrian Radiation. Columbia University Press, New York, 2001, pp. 90-106.

[23] This term was consolidated by Paul Crutzen &Eugene Stoermer in the year 2002, through the article The "Anthropocène".

[24] MENDES, J. O "Antropoceno" por Paul Crutzen & Eugene Stoermer. Anthropocenica. Revista De Estudos Do Antropoceno E Ecocrítica, 1, 2020. Disponível em: https://doi.org/10.21814/anthropocenica.3095. Acesso em: 13 mar. 2022.

[25] *Ibid.*

[26] IPCC, 2022 : Climate Change 2022 *: Impacts, Adaptation and Vulnerability* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, Roberts DC, Tignor M.S., Poloczanska E.S., Mintenbeck K., A. Alegría, Craig M.D.,

In this way, climate change is a global threat and is, according to Anthony Giddens, "a more urgent, more serious and deeper dimension of the environmental crisis of the twenty-first century."[27]

Given this, the changes in climate that occurred in recent decades should be the object of concern for the State, and, therefore, the construction of effective national and international public policies needs to turn its eyes to this issue[28].

In this step, the State must act as catalyst and facilitator, in addition, in regard to climate change, join efforts to obtain guarantees, which, according to Anthony Giddens, can be achieved through a more direct action of the State[29].

In his book, the cited author lists a series of actions in which the State can guide its actions. Among them, helping the population to think in advance, with planning; deal with the risks of climate change, together with the other risks existing in the contemporary society, as such environmental risk intersects with others, at the local, national and international level; promote the "political and economic convergence, as the main driving forces of climate change and energy policy".[30]

The author goes on to state that the State must intervene in the markets, so that the polluter-pays principle, which represents the internalization of negative externalized, is institutionalized and "act against business interests that aim to stop initiatives related to climate change"; leave the agenda regarding climate change at the top of the list of political objectives, maintaining agreements between opposing political parties, so that an environmental policy is always maintained[31].

What's more, it needs to "develop an appropriate economic and fiscal framework to move toward a low-carbon economy; prepare for adaptation to the consequences of climate change and integrate local, regional, national and international aspects of the climate change policy[32].

Thus, Giddens, when relating such policies that can be developed by governments, highlights the impact and magnitude of the consequences of climate change in humans, an issue that he points out to be urgent. However, before entering into public policies, which reconcile with the epistemological scope of this work, some concepts should be analyzed.

There are two types of actions that can be taken to reduce the impacts of human activities on climate[33]. The first of these is through mitigation actions, combating the causes[34], using, for example, clean development mechanisms – CDM. The second, through the implementation of measures to adapt to climate change, reducing socio-environmental vulnerabilities[35] and preparing to face the effects[36].

Regarding adaptation, Carlos Afonso Nobre describes, in a generalized way, that it refers to "adjustments in ecological or socioeconomic systems, in response to current or projected climate changes, resulting from practices, processes, measures or structural changes".[37]

Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press.

[27] GIDDENS, Anthony. *A política da mudança climática*. Trad. de Vera Ribeiro. Rio de Janeiro: Zahar, 2010. p. 7.

[28] BOLSON, Simone Hegele. Climate change and the politics of adaptation by Anthony Giddens : in search of a preventive model to combat the effects of climate change in the semi-arid region of Northeast Brazil. Revista Direito Ambiental e sociedade, v. 2, n. 1, 2012, p. 81. (p. 77-96)

[29] GIDDENS, Anthony, *op. cit.*, p. 106 ss.

[30] *Ibid.*

[31] *Ibid.*

[32] *Ibid.*

[33] ANDRADE, Helenice Vieira de. Mapeamento das Políticas Estaduais de Adaptação das Cidades às Mudanças Climáticas no Brasil. Rev. Geogr. Acadêmica v.11, n.2, 2017. Disponível em: https://revista.ufrr.br/rga/article/view/4358/2366. Acesso em: 14 mar. 2022.

[34] RODRIGUES FILHO, Saulo et al. O CLIMA EM TRANSE: POLÍTICAS DE MITIGAÇÃO E ADAPTAÇÃO NO BRASIL (CLIMATE IN TRANCE: MITIGATION AND ADAPTATION POLICIES IN BRAZIL). Revista Brasileira de Climatologia, [S.l.], v. 19, out. 2016. ISSN 2237-8642. Disponível em: <https://revistas.ufpr.br/revistaabclima/article/view/48874/29382>. Acesso em: 16 abr. 2022. doi:http://dx.doi.org/10.5380/abclima.v19i0.48874.

[35] ANDRADE, Helenice Vieira de, *op. cit.*

[36] RODRIGUES FILHO, Saulo et al *op. cit.*

[37] NOBRE, Carlos Afonso et al. Vulnerabilidade, impactos e adaptação à mudança do clima. In: Mudança do Clima. Cadernos NAE: nº 3. Brasília: Núcleo de Assuntos Estratégicos da Presidência da República, Secretaria de Comunicação de Governo e Gestão Estratégica, 2005, p. 149.

In a more tangible form, it can be defined as the "adjustments and changes to be made in food production and agriculture, human health care systems, housing programs and infrastructures", with the objective that the coexistence of "societies with climate events resulting from global warming and climate change do not endanger human life".[38]

In this way, adaptation to climate change must be dealt with in a local way, in whose sphere its effects are felt more vigorously, being also the instance in which people, through the modification of "human settlements, agricultural practices and aspects related to ways of life and subsistence in different localities", have adapted to climatic variations in the course of history. However, this adaptation to climate change must always be supported by the policies of the higher hierarchical levels[39].

Given this, it is questioned what the perspectives for the adoption of Public Policies that aim to adapt or mitigate climate change are.

According to Ricardo Ojima and Eduar do Marandola Jr, Public Mitigation Policies are only palliative, not being able to generate a change in the pattern of consumption, production or urban management. On the contrary, adaptation policies are capable, since they are long-term measures aimed at establishing a sustainable model[40]. Moreover, adaptation is linked to the idea of climate justice, by understanding that "the causes of climate change, its impacts and the adaptive and response capacity are not equally distributed in the world".[41]

However, despite the definitive insertion of environmental issues in the agenda of the States, we observed both at national and international level, an accented adoption of public policies aimed at mitigation[42].

It is in this context that Geographical Indications emerge, as an appropriate instrument for the implementation of public adaptation policies. This intellectual property asset, by valuing the production of agricultural products and services, enables the insertion of the dynamics of sustainability in the production systems and in the environment, in addition to allowing a socio-economic, cultural and ecosystem preservation development in their regions of origin[43].

In this way, Geographical Indications, understood as products or services of certified origin, establish high standards of quality and origin, allow sustainable practices to be introduced within the mode of production and consumption, in order to enable policies to combat climate change to be addressed, from a local perspective, with the preservation of economic development and regional cultures.

Added to this, there is the fact that they are consolidated products and of recognized history, allowing public policies aimed at them to be long-term and more likely to establish a sustainable model and climate justice.

Corroborating these assertions, the IPCC's Sixth Assessment Report evidences, in its summary for public policy promoters, that viability options for adapting to climate change include "strengthening local and regional food systems and community-based adaptation, improving lives and livelihoods,

[38]MARTINS, Rafael D'Almeida. Equidade na adaptação às mudanças climáticas. Política & Sociedade; Florianópolis Vol. 10, Ed. 19, 2011, p. 336.

[39] *Idem*. Governança climática nas cidades: reduzindo vulnerabilidades e aumentando resiliência. Revista Geográfica Acadêmica, (UFG), v. 4, p. 5-18, 2010. Disponível em:<http://www.http://pt.slideshare.net/martinsrafael/governana-climtica-nas-cidades-reduzindo-vulnerabilidadese-aumentando-resiliencia. Acesso em 23 mar. 2022.

[40] OJIMA, R., MARANDOLA Jr., E. Indicadores e políticas públicas de adaptação às mudanças climáticas: vulnerabilidade, população e urbanização. *Brazilian Journal of Environmental Sciences (Online)*, (18), 16-24, 2010. Disponível em: http://rbciamb.com.br/index.php/Publicacoes_RBCIAMB/article/view/364 MORE CITATION FORMATS. Acesso em: 23 mar. 2022.

[41] RODRIGUES FILHO, Saulo et al., *op. cit, p. 83.*

[42] *Ibid.,* pp. 82-84.

[43]YOKOBATAKE, Kazuo Leonardo Almeida; LOPES, Keny Samejima Mascarenhas; PINHEIRO, Rafael Silvio Bonilha. DENOMINAÇÃO DE ORIGEM E INDICAÇÃO GEOGRÁFICA DE PRODUTOS AGRÍCOLAS. IX Fórum Ambiental da Alta Paulista, v. 9, n. 7, 2013, p. 70-79.

particularly of marginalized and low-income (high-confidence) groups."[44]

The report also provides for effective adaptation solutions, coupled with public policies that support "cultivar improvements, agroforestry, community-based adaptation, agricultural and landscape diversification, and urban agriculture."[45]

In addition, public policies should include "agroecological principles and practices, a management based on fishing and aquaculture ecosystems", and should also be guided by other approaches that work with natural processes, as they help and maintain security, nutrition, health and well-being, livelihoods and biodiversity, sustainability and ecosystem services[46].

Thus, we verified that solutions to adapt to climate change must be developed on guidelines that privilege the food systems; in products or services that convey trust and have quality and safety, that is, certificates; observe the regional and local mode of production; protect biodiversity and be sustainable.

As seen, Public Policies that assist in adapting to climate change are also developed within the scope of Geographical Indications.

V. THE ROLE PLAYED BY GI IN THE NATURAL RESOURCES GOVERNANCE PROCESS

At this point, we will address how GI can stand out as an important intellectual property asset that effectively participates in the governance of natural resources.

But what, especially, is this governance about? By initial understanding, it is stated that it relates to the concept of collaboration. It is, in essence, the formation of collaborative networks, which unite different sectors and actors, such as the Market, the State and the Civil Society, in order to achieve objectives that are common to all[47].

[44] IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, pp. 23-25. "Considering climate change impacts and risks in the design and planning of urban and rural settlements and infrastructure is critical for resilience and enhancing human well-being (high confidence). The urgent provision of basic services, infrastructure, livelihood diversification and employment, strengthening of local and regional food systems and community-based adaptation enhance lives and livelihoods, particularly of low-income and marginalised groups (high confidence). Inclusive, integrated and long-term planning at local, municipal, sub-national and national scales, together with effective regulation and monitoring systems and financial and technological resources and capabilities foster urban and rural system transition (high confidence). Effective partnerships between governments, civil society, and private sector organizations, across scales provide infrastructure and services in ways that enhance the adaptive capacity of vulnerable people".

[45] *Ibidem*. Effective adaptation options, together with supportive public policies enhance food availability and stability and reduce climate risk for food systems while increasing their sustainability (medium confidence). Effective options include cultivar improvements, agroforestry, community-based adaptation, farm and landscape diversification, and urban agriculture (high confidence). Institutional feasibility, adaptation limits of crops and cost effectiveness also influence the effectiveness of the adaptation options (limited evidence, medium agreement). Agroecological principles and practices, ecosystem-based management in fisheries and aquaculture, and other approaches that work with natural processes support food security, nutrition, health and well-being, livelihoods and biodiversity, sustainability and ecosystem services (high confidence). These services include pest control, pollination, buffering of temperature extremes, and carbon sequestration and storage (high confidence). Trade-offs and barriers associated with such approaches include costs of establishment, access to inputs and viable markets, new knowledge and management (high confidence) and their potential effectiveness varies by socio-economic context, ecosystem zone, species combinations and institutional support (medium confidence). Integrated, multi-sectoral solutions that address social inequities and differentiate responses based on climate risk and local situation will enhance food security and nutrition (high confidence). Adaptation strategies which reduce food loss and waste or support balanced diets33 (as described in the IPCC Special Report on Climate Change and Land) contribute to nutrition, health, biodiversity and other environmental benefits (high confidence).

[46] *Ibidem*.

[47] KAPUCU, N. ; YULDASHEV, F. ; BAKIEY, E. Collaborative Public Management and Collaborative Governance : Conceptual Similarities and Differences. European Journal of Economic and Political Studies, 2(1), 2009, p.39-60

In the 1990s, the concepts of "collaborative public administration", "network administration" and "new public administration" emerged, demonstrating a change of course in the way of administering the public good. With this, the importance of collective decision-making is highlighted, removing the public administration from the solitary task of managing the State and transitioning to a collaborative model[48].

Kapucu, Yuldashev and Bakiev go further and propose an even broader concept than just collaborative management. For them, collaborative governance aims at the participation of citizens, through mechanisms and institutions, of social problems, in a decentralized and non-hierarchical way, and also counting on partnership and e-governance projects[49].

It would be, therefore, the union of several social actors or "stakeholders" (social actors of interest) in the process of discussion and decision-making. According to Ribeiro, "it is about building an institutional system of cooperative actions between Levels of Government and between these and the actors of the Civil Society and the Market."[50]

Moreover, the evolution of society and the intense participation, as said, of a multiplicity of actors, in the various sectors of life, make it almost impossible for governments to continue to play a primary role in the decision-making process, exempted from a corporate, territorial, urban, digital, environmental governance, among others[51].

Thus, the concept of governance today, according to Ralf-Eckhard Türke, adapts perfectly to the complexity, dynamism and diversity of the modern society, in which social conditions are complex and multivariate. [52]

With regard specifically to Environmental Governance, which is the institute in which this work is specifically inserted, the concept follows the same pattern. In this way, the complexity of environmental problems makes the decision-making processes in relation to them demand greater coordination, which brings together not only the State, but also the whole society[53].

Maria Carmen Lemos and Arun Agrawal ensure that the term Environmental Governance refers to the set of processes, mechanisms and organizations, through which political actors influence environmental actions and results. They also affirm that governance is the same as government, but the result of joint actions between states, communities, companies and NGOs[54].

In addition, international agreements, national policies and their legislation, local decision-making structures, transnational institutions and

[48] *Ibidem.*

[49] *Ibidem.*

[50] RIBEIRO, Luiz Cesar Queiróz. Metrópoles, Reforma Urbana e Desenvolvimento Nacional. Sociedade e Estado, 2007, p. 26. Disponível em: https://silo.tips/download/metropoles-reforma-urbana-e-desenvolvimento-nacional-luiz-cesar-queiroz-ribeiro. Acesso em: 19 abr 2022.

[51] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecília. Governança Ambiental e Indicação Geográfica: O Caso da Denominação de Origem Manguezais das Alagoas. DRd – Desenvolvimento Regional em debate (ISSNe 2237-9029) v. 9, Ed. esp. 2, p. 229-247, dez. 2019, p. 231.

[52] TÜRKE, R. Governance : systemic foundation and framework. Berlin : Springer, 2008, p. 1. 'Complexity', 'Dynamics', and 'Diversity' are omnipresent in today's discourse on governance. They refer to the fact that social conditions in modern societies are perceived as multi-layered and complicated. Social issues are being addressed by multiple actors ; governments are not necessarily playing a primary role anymore. A multiplicity of actors is involved, expressing individual interests yet having unequal capacities to exert influence. Resolutions for governing issues are the result of various interacting factors that are rarely wholly known. Knowledge, experiences, and interests are dispersed over many actors constantly changing their roles and relationships. Actor dependencies and constellations increasingly differ from global to local and from sector to sector. Diversity cumulates as these processes gain speed as well as intensity.

[53] MOURA, A. M. M. Governança ambiental no Brasil: instituições, atores e políticas públicas. Brasília: Ipea, 2016. Disponível em: https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/160719_governanca_ambiental.pdf. Acesso em: 16 abr 2022.

[54] LEMOS, M. C. ; AGRAWAL, A. Environmental Governance. Annual Review of Environment and Resources, 31(1), 2006, p. 297–325, p. 298-299

environmental NGOs are part of the Environmental Governance process[55].

Therefore, for Environmental Governance to be effective, there is no need for only State institutions to be involved. Consumers, corporations and non-governmental organizations can and should also exercise power and authority over policy-making and decision-making processes on environmental issues. In this process of reformulation of Environmental Governance, both multinational institutions and the emergence of new actors on a local scale favor the development of environmental decisions[56].

However, says Albert Weale that governments continue to maintain their importance for environmental protection, since they meet the so-called vital conditions for there to be a proper governance of biodiversity, to implement sustainability and to get closer to environmental goals[57].

Policies aimed at the management of natural resources perform two important functions. The first refers to the strategic role of promoting positive results through its use and the second is to reduce negative impacts on the biodiversity[58].

As stated in previous points, Biodiversity has "intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of the biological diversity and its components", as stated by the Convention on Biological Diversity itself, in its preamble[59] . However, countries such as Brazil, which are rich in biodiversity, do not have many examples of success in the commercial use of active ingredients that are linked to it[60].

In this same section, Carlos A. Joly *et tal* affirms that development of products linked to biodiversity should be a vocation for the Brazilian, maintaining, however, a role of mere exporter of raw material. In the same vein, they state that the "added value to the products from the Brazilian biodiversity is still very low, since they are used and marketed in their raw form".[61]

How to change this reality? How to add value to biodiversity and enable this wealth to effectively generate more opportunities? The answer lies in the development of Environmental Governance.

The exclusivity, attributed to governments, in the organization and implementation of decisions in this sector has not been effective, to the extent that new problems linked to the economy, society, but mainly to the environment, require, as said, a joint networked response. In Brazil, more specifically, Environmental Governance is very poorly structured[62].

There is no other alternative, other than the entry of other non-state actors, who ally themselves with the States, so that new techniques of

[55] *Ibidem*. "More specifically, we use "environmental governance" to refer to the set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes. Governance is not the same as government. It includes the actions of the state and, in addition, encompasses actors such as communities, businesses, and NGOs. Key to different forms of environmental governance are the politicaleconomic relationships that institutions embody and how these relationships shape identities, actions, and outcomes (4–6). International accords, national policies and legislation, local decision-making structures, transnational institutions, and environmental NGOs are all examples of the forms through which environmental governance takes place".

[56] LIVERMAN, Diana. Who governs, at what scale, and at what price ? Geography, environmental governance, and the commodification of nature. Ann. Assoc. Am. Geogr., v. 94, 2004, p. 734–738, p. 735.

[57] WEALE, A. Governance, government and the pursuit of sustainability. In : ADGER, W.; JORDAN, A. (Eds.). Governing Sustainability. Cambridge : Cambridge University Press, 2009, p. 55-75.

[58] GATTO, Deivdson Brito ; CLAUZET, Mariana ; LUSTOSA, Maria Cecilia, *op. cit.,* p. 233.

[59] BRAZIL. Decree No. 2,519, of March 16, 1998. Promulgates the Convention on Biological Diversity, signed in Rio de Janeiro on June 5, 1992. Available at : http://www.planalto.gov.br/ccivil_03/decreto/D2519.htm. Accessed: 20 Apr 2022.

[60] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecilia, *op. cit.,* p. 233.

[61] JOLY, C. A.; ALHADDAD, C. F. B.; VERDADE, L. M.; OLIVEIRA; M. C.; BOLZANI, V. S.; BERLINCK, R. G. S. Diagnóstico da pesquisa em biodiversidade no Brasil. Revista USP, v. 89, 2011, p. 114-133, p. 126.

[62] BREDARIOL, T.; VINHA, V. Instituições e governança ambiental: uma revisão teórica. Revista Iberoamericana de Economía Ecológica, v. 24, 2015, p. 153-162, p. 154.

command and control of the biodiversity are implemented, thus exercising a decentralized response[63].

In this way, the construction of systems that are multicenter and hybrid bring great importance to "local agendas of sustainable development and achievement of good Environmental Governance".[64] Thus, the ultimate goal of Environmental Governance, according to Nathan J. Bennett and Terre Satterfield, is for it to be robust, that is, legitimate, connected, and polycentric.[65]

It is at this very point that Geographical Indications are inserted, insofar as they are goods or services that are produced, extracted or manufactured at a local level, that use raw material from local biodiversity, through local communities, and that collaborate with social and economic development also at the local and/or regional level. Thus, they must participate, together with other state and non-state actors, in the decision-making process and environmental organization.

Geographical Indications are embodied, therefore, in the possibility of adding value to natural resources, through the commercialization of products or services, and not only of raw material.

To analyze this contribution, Maria Carmen Lemos and Arun Agrawal, from the University of Michigan, in the United States, observed some trends, through four themes, that corroborate the roles of communities, State and Market, in the process of Environmental Governance, focused, more closely, on the importance of Geographical Indications.

The analysis begins with the theme of Globalization and Environmental Governance.

The authors claim that Globalization interconnects the world. However, in regard to the economy, this movement profoundly impacts environmental processes at all levels – local, regional, national and global and such a context, that is, produces positive and negative consequences for the environment.

From the negative point of view, the interconnection and interdependence between markets can lead to the intensification of the use and depletion of natural resources, given the increase in demand. As a consequence, more waste can be released into nature.

From the positive point of view, there can be a greater spread of good environmental policy initiatives, thus contributing to the development of a new Environmental Governance regime, through institutions and organizations. As an example, the authors cite that "more efficient use and transfer of technology, freer flow of information, and new institutional arrangements based on public-private partnerships have the potential to contribute positively to Environmental Governance[66].

Through the positive perception of globalization, Geographical Indications emerge as a commercial asset of goods and services, which are specific to a given territory, thus being able to promote the conservation of natural resources and, even more, cause a decrease in the negative points that permeate the so-called globalizing movement[67].

Another important topic is about individual and market instruments (*Market- and Agent-Focused Instruments*). As explained earlier, the new governance model reduces the participation of the State in the process of organization and

[63] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecilia, *op. cit.,* p. 234.
[64] *Ibid.*
[65] BENNETT, N.J.; SATTERFIELD, T. Environmental Governance : A practical framework to guide design, evaluation, and analysis. Conservation Letters, 2018, p. 1-13, p. 9.
[66] LEMOS, M. C. ; AGRAWAL, A., *op. cit.,* p. 300. "Observers of globalization also argue in favor of its potentially positive impacts on economic equity and environmental standards through a virtuous circle and the diffusion of positive environmental policy initiatives. Clearly, the globalization of environmental problems has contributed to the creation and development of new global regimes, institutions, and organizations dedicated to environmental governance. More efficient use and transfer of technology, freer flow of information, and novel institutional arrangements based on public-private partnerships have the potential to contribute positively to environmental governance".
[67] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecilia, *op. cit.,* p. 235.

decision-making regarding the environment, causing non-State actors to participate more actively, thus stimulating new market and individual mechanisms.

There is no longer dependence on organizational and hierarchical control, what is intended now is to "mobilize individual incentives in favor of environmentally positive results, through a careful calculation and modulation of costs and benefits associated with specific environmental strategies." As an example, one can cite ecotaxes and subsidies based, on a combination of regulation and market incentives, voluntary agreements, certification, eco-labeling, and informational systems[68].

It is in this context that Geographical Indications come in, as a market instrument, since they constitute products and services that have a certificate of origin, that obey quality standards and have as one of their functions the protection of the Environment[69].

To Lemos and Agrawal, there would be a superiority in relation to these instruments, because of their economic efficiency in implementation. However, for them to reach the maximum of their potential, in benefit of the environment, an institutional leadership of the State is necessary[70]. Thus, according to Deivdson Brito Gatto, Mariana Clauzet and Maria Cecília Lustosa, Geographical Indications in Brazil are an example of "institutional development of protection of this registry with positive repercussions in the regional economy".[71]

Decentralized *Environmental Governance* is another hot topic. According to Lemos and Agrawal, it is at a subnational level that most of the important changes occur with regard to Environmental Governance. Previously, it was thought that maintaining centrality in the processes of using natural resources avoided market failures and the negative externalities they were associated with.

However, facts such as disbelief in the actions of the State – up to now considered the reliable guardian of nature – the fall of the economies that depended on a centralized state, the pressure exerted by the greater integration of economic activities across national borders, the decline of international aid, and the fiscal crises in many developing countries emphasized the ability of communities and other smaller-scale social formations to manage natural resources [72].

Given this, Geographical Indications emerge as an important intellectual property asset, since its own constitution is based on the request for registration by subnational actors, which demonstrates an autonomy in relation to the former centralizing actor[73].

Finally, the cross-sectional scale (*Cross-Scale Environmental Governance*), which refers to the multi-cited complexity of environmental problems, which, due to, has multiscale - spatial, sociopolitical and temporal- characteristics.

[68] LEMOS, M. C.; AGRAWAL, A., *op. cit.,* pp. 305-307. "Primary sector commodities such as coffee, timber, and energy provide familiar examples of ecolabeling and certification schemes (81–83). Both ecolabeling and certification schemes are forms of voluntary agreements wherein producers agree to meet environmental standards related to production and marketing activities. Such standards may be the result of work by third party actors, an industry association, or even the government. The operation of these schemes hinges upon the idea that consumers are willing to express their preferences related to cleaner energy or greener products through their choices in markets and through a willingness to pay higher prices. Perceptions about environment-friendly preferences among consumers have led many corporations to adopt certification mechanisms and advertising campaigns that represent both real and cosmetic shifts in how corporate actors govern their environmental actions".

[69] This function will be analyzed in more detail in the next chapter.

[70] LEMOS, M. C.; AGRAWAL, A., *op. cit.,* p. 305-308.

[71] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecilia, *op. cit.,* p. 233.

[72] LEMOS, M. C.; AGRAWAL, A., *op. cit.,* p. 302-305. "Three distinct justifications for decentralization of environmental governance are available. It can produce greater efficiencies because of competition among subnational units; it can bring decision making closer to those affected by governance, thereby promoting higher participation and accountability; and finally, it can help decision makers take advantage of more precise time- and place-specific knowledge about natural resources".

[73] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecilia, *op. cit.,* p. 236.

Initially, with regard to space, it is known that problems related to the environment have a ubiquitous nature, that is, they do not know political borders. Thus, environmental disasters that occur in Brazil, for example, can be felt all over the planet. Therefore, it may be a dissociation in the causes and consequences of environmental problems.

Socially, in second place, "cross-scale environmental problems affect and are affected by institutionalized decision-making at the local, subnational, national, and transnational levels." In this way, multilevel governance mechanisms neutralize this fragmentation.

Regarding the temporal aspect, in turn, Lemos and Agrawal highlight two major obstacles. One is what they call "*contemporism,"* which refers to the "tendency to disregard the well-being of future generations and believe in the power of technology and technological change to take care of environmental degradation and scarcity," and the uncertainties about the long-term causes and effects in the environment[74]. [75]

Thus, in relation to Geographical Indications, this trend also applies, to the extent that it has the power to stimulate non-state actors to be interested in the conservation of the environment, since it is who confers value to goods and services. Thus, for this property asset to exist, natural factors must remain constant over time[76].

Well. The four trends described highlight the reconfiguration of Environmental Governance, which provides the emergence of alternative institutional forms, notably those that recognize the "social roles played by communities, states and markets, and/or in the result of the existing relations between these actors." It is in this field that Geographical Indications emerge, as an important asset not only of intellectual property, but also of Environment.

VI. CONCLUSIONS

Thus, they possess the aforementioned intellectual property right – Geographical Indications, the ability to enable public policies to protect the Environment to be practiced. However, as described, public mitigation policies are palliative, not having the capacity to generate a change in the pattern of consumption, production or urban management.

Contrary to what happens with mitigation policies, adaptation policies are more effective, since they are measures that tend to observe a long-term perspective, thus aiming to establish a sustainable model. In addition, adaptive policies are linked to the idea of climate justice, since it identifies which really the causes of climate change are, as well as their impacts, adaptive and response capacity, not being equally distributed in the world.

Geographical Indications are configured as a suitable and appropriate instrument in the implementation of public policies of adaptation, because, in addition to valuing the production of agricultural products and services, they also enable the insertion of the dynamics of sustainability in production systems and the environment, also allowing for a socio-economic, cultural and ecosystem preservation development, in their regions of origin.

That said, Geographical Indications allow the introduction of sustainable practices within the mode of production and consumption, aiming to

[74] LEMOS, M. C.; AGRAWAL, A., *op. cit.,* p. 309. Contempocentrism, in part a consequence of high market discount rates, is the tendency to disregard the welfare of future generations and believe in the power of technology and technological change to take care of environmental degradation and scarcities. It means humans are likely to "spend" the environment now and discount the future heavily (33, 104). Coupled with the seeming high costs of action that will shift existing trajectories of economic development, the uncertainty surrounding the science of causes and effects of environmental degradation often leads to a "do nothing until we know more" attitude–strongly reflected in the contemporary policy positions of some nations that are the largest emitters of greenhouse gases. Many of the impacts of global climate change on humans and ecosystems are still undetermined, and the design and implementation of policies necessary to reduce emissions are both economically and politically quite costly.

[75] *Ibid.*, pp. 308-309.

[76] GATTO, Deivdson Brito; CLAUZET, Mariana; LUSTOSA, Maria Cecilia, *op. cit.*, p. 236.

enable policies which combat climate change to be approached from a local perspective, with the preservation of economic development and regional cultures.

Added to this is the fact that they are consolidated products of recognized history, allowing public policies aimed at them to be long-term and more likely to establish a sustainable model and climate justice. Therefore, public policies that help to adapt to climate change are also developed within the scope of Geographical Indications.

As for the issue of Environmental Governance, which, in order to be effective, requires, in addition to the State institutions for being involved, consumers, corporations and non-governmental organizations can and should also exercise power and authority over the processes of policy formation and decision-making in environmental issues.

Thus, in the process of reformulating Environmental Governance, both multinational institutions and the emergence of new actors on a local scale favor the development of environmental decisions. In this way, the construction of systems that are multicenter and hybrid ends up by bringing great importance to the local guidelines for sustainable development, which legitimizes, connects and further strengthens the system.

In this way, Geographical Indications are goods or services produced, extracted or manufactured at a local level, using raw material from the local biodiversity, through local communities, and collaborating with the social and economic development also at the local and/or regional level. Thus, they must participate, together with other state and non-state actors, in the decision-making process and environmental organization.

Added to this agenda is the possibility that Geographical Indications have to add value to natural resources, through the commercialization of products or services, and not only of the raw material.

With this desideratum, some justifications stand out and allow Geographical Indications to appear as an important instrument of Environmental Governance. The first refers to a commercial asset of goods and services, which are specific to a given territory, thus being able to promote the conservation of natural resources and, even more, cause a decrease in the negative points that permeate the so-called globalizing movement. The second stands out as a market instrument, since they constitute products and services that have a certificate of origin, that obey to quality standards and that have as one of their functions the protection of the environment.

According to the third justification, Geographical Indications emerge as an important intellectual property asset, since their own constitution is based on the request for registration by subnational actors, which demonstrates an autonomy in relation to the former centralizing actor. Finally, they have the power to encourage non-state actors to take interest in the conservation of the environment, since it is the environment that gives value to goods and services. Thus, for this property asset to exist, natural factors must remain constant over time.

Therefore, Geographical Indications can appear as an instrument of environmental public policy and in the governance of natural resources.

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ABSTRACT

STEM education is a useful tool in promoting 21st-century competencies, such as cultural awareness, critical-thinking and problem- solving skills. Having these skills prepares students for a competitive, global marketplace. Teachers play a crucial role in providing quality STEM education, and teachers require high levels of self-efficacy and STEM pedagogical content knowledge to impart quality levels of instruction. We examined the relationship between self-efficacy and STEM pedagogical content knowledge. Results showed higher self-efficacy was related to higher STEM pedagogical content knowledge. Implications are discussed.

Keywords: stem education; preservice teachers; self-efficacy; stem pedagogical content knowledge.

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ABSTRACT

STEM education is a useful tool in promoting 21st-century competencies, such as cultural awareness, critical-thinking and problem-solving skills. Having these skills prepares students for a competitive, global marketplace. Teachers play a crucial role in providing quality STEM education, and teachers require high levels of self-efficacy and STEM pedagogical content knowledge to impart quality levels of instruction. We examined the relationship between self-efficacy and STEM pedagogical content knowledge. Results showed higher self-efficacy was related to higher STEM pedagogical content knowledge. Implications are discussed.

Keywords: stem education; preservice teachers; self-efficacy; stem pedagogical content knowledge.

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I. THE SELF-EFFICACY OF PRESERVICE TEACHERS IN STEM PEDAGOGICAL CONTENT KNOWLEDGE

The quality of STEM education is directly related to the knowledge, pedagogy and self-efficacy of the teachers who are responsible for driving instruction. Teachers who have a strong understanding of STEM concepts and pedagogy can effectively engage students in hands-on, inquiry-based learning experiences that promote critical thinking, problem-solving, and creativity. On the other hand, if teachers lack the necessary knowledge and skills, they may struggle to effectively teach STEM subjects, leading to disengagement and limited learning outcomes for their students.

Preservice teachers' content knowledge and self-efficacy are direct indicators of their performance in the future classroom (Cervone et al., 2020; Koutsianou & Emvalotis, 2019; McLean et al., 2019; Nasir et al., 2019). Studies also reveal that teachers spend more time teaching in the content areas where they feel most confident and may even neglect some content altogether due to discomfort (Bybee, 2010). If preservice teachers are not properly prepared to teach STEM as a cohesive unit of 21st-century skills, they may devote less time or omit STEM content altogether.

STEM is a widely used acronym developed for science, technology, engineering, and mathematics (Jong et al., 2021). It is a term utilized from preschool to postgraduate levels to describe related content, higher education majors, and occupations (Marrero et al., 2014). STEM education is critical for the United States to compete in a global marketplace (Dejarnette, 2016; Peterson et al., 2011). The rationale for STEM education is often focused on the need to prepare students to have the required 21st-century skills necessary for economic security, environmental impacts, and competitiveness in a global marketplace (Du Plessis, 2020; Koehler et al., 2013). STEM education prepares students to be "actively engaged citizens of society" in the future (Du Plessis, 2020, p.1466). Issues such as national

security, disease, climate change, and energy efficiency need STEM competent citizens to innovate potential solutions (Du Plessis, 2020). In essence, students need strategies and skills to solve problems that may not currently even exist (Barrett-Zahn, 2019).

Teachers require STEM-related skills and knowledge to provide effective STEM instruction (Yildirim & Şahin-Topalcengiz, 2018, p.4). Quality STEM education and instruction prioritizes hands-on, real-world, and authentic experiences for genuine problem-solving opportunities for students (Siekmann, 2016). To engage students in STEM education, schools require programs that integrate engineering and technology into the curriculum of mathematics and science (Kennedy & Odell, 2014). Focusing on inquiry, design, and innovation utilizing technology is another example of quality STEM instruction (Kennedy & Odell, 2014). Teachers must also recognize and celebrate the accomplishments of their students in STEM (Yildirim & Şahin-Topalcengiz, 2018).

In order for teachers to be able to produce and deliver this type of curriculum, teacher preparation programs need to include a solid foundation of teaching STEM in the classroom (Dejarnette, 2016). There is a plethora of information regarding STEM careers, the lack of diversity in STEM fields (including college majors and occupations), and how/why STEM education is vital to remain competitive in a global economy (Hutton, 2019; Perna et al., 2010). Teachers' instructional practices play a crucial role in addressing these needs by helping students learn in STEM classes and develop their aspirations to pursue STEM careers (Guzey et al., 2014).

However, teachers commonly use the pedagogical methods they are most comfortable with, and these may not be aligned with best practice for teaching STEM. Further, teachers tend to spend less time teaching content that they do not feel they know well, which contributes to teachers spending less time teaching students STEM in the classroom (Sterling, 2006). A lack of knowledge in STEM content and best practices for teaching STEM adversely affects teachers' self-efficacy when providing STEM instruction (Epstein & Miller, 2011).

II. SELF-EFFICACY AND TEACHING

Preservice teachers must believe in their abilities to teach successfully in the classroom (Michael et al., 2020; Yildiz & Arici, 2021). Self-efficacy directly correlates to the learning environment they will provide their students (Koutsianou & Emvalotis, 2019; Pearman et al., 2021). Teachers with higher levels of self-efficacy have been shown to utilize more teaching strategies, display stronger classroom management skills and create opportunities for student-centered learning (Jamil et al., 2012; Kaygısız et al., 2020; Nasir & Iqbal, 2019). Teachers with high self-efficacy are more flexible in their instruction, open to new ideas and strategies, and display higher motivation levels (Chen et al., 2021; Masri et al., 2021; Michael et al., 2020; Pearman et al., 2021). Educators with higher self-efficacy are more likely to approach problems as challenges to conquer and new information to be attained (Salar, 2021).

As teacher self-efficacy increases, so does their beliefs in their students' abilities (Pearman et al., 2021). Yildiz and Arici (2021) acknowledge teachers' self-efficacy directly correlates to their student's self-efficacy. When teachers with high levels of self-efficacy believe in their students, student achievement and even student self-efficacy increases (Michael et al., 2020; Moawad & Corkett, 2021). Research has shown that a teacher's self-efficacy determines the amount of time spent teaching a subject, therefore, how much time a student is allotted to learn a topic (Chen et al., 2021). Students of teachers with high self-efficacy tend to have higher levels of motivation, engagement and display appropriate classroom behavior (McLean et al., 2019). Students with high self-efficacy teachers also benefit from lower anxiety levels and stronger problem-solving skills (Jamil et al., 2012).

In contrast, teachers with lower self-efficacy tend to teach with more teacher-centered strategies, such as reading from a textbook and having students fill in worksheets (Kaygısız et al., 2020).

In teacher-centered instruction students are passive while the teacher is active. Lectures, note taking, and students sitting quietly at their desks is much of a teacher-centered approach to education. The teacher is the authority figure, students are submissive, and there is no collaboration. Educators with lower self-efficacy may also experience more self-doubt and have a limited ability to persevere through challenges (Salar, 2021). McLean et al. (2019) found a relationship between teacher self-efficacy and teacher burnout that may impact teacher perception of student behavior.

III. SELF-EFFICACY IN STEM TEACHERS

Research on teachers regarding their beliefs, attitudes and efficacy around teaching STEM show that they find value in STEM education and are more likely to have interest in teaching STEM and to learn more about teaching STEM when they have high self-efficacy. In a study of K-12 engineering and technology teachers, Asunda and Walker (2018) found K-12 teachers had mixed reactions to STEM education but acknowledged its importance. Some teachers reported high levels of self-efficacy, while others reported difficulty assessing students in STEM education and problem-based learning. Teachers articulated they had limited knowledge on how to teach STEM effectively. Positive attitudes toward STEM is important as it is related to an increase in explicit instruction of the integrated STEM approach and participation in authentic STEM activities (Çetin, 2021).

Other research has demonstrated that when teachers have an interest in and experience with STEM activities they have greater self-efficacy (Çetin, 2021; Chen et. al, 2021; Salar, 2021). Teachers with higher self-efficacy also tend to be those who are interested in more training around STEM. Chen et al. (2021) showed that preservice preschool teachers' STEM self-efficacy was positively correlated to their pedagogical beliefs and desire for further STEM learning or professional development (PD). Engaging in PD around STEM may further increase teacher self-efficacy. For example, Nathan et al. (2011) found that after PD in integrated STEM education, teachers' self-efficacy for teaching STEM significantly increased.

PD is often focused on teaching both content and pedagogy. In STEM this is referred to as STEM pedagogical content knowledge (STEMPCK). Although the literature has shown that increased PD leads to higher teacher self-efficacy and this in turn is related to more interest in STEM, it is unclear if higher self-efficacy is related to STEMPCK. Feeling more confident in one's ability to teach STEM is certainly important, however if this confidence is without strong knowledge in both STEM content and pedagogy, it may have unintended detrimental effects such as not preparing students in the way that they need to be. This study examines the relationship between preservice teachers' self-efficacy and STEMPCK.

IV. METHODS

4.1 Participants

Preservice teachers enrolled in teacher preparation programs in the United States were the target population for this study. A total of N=64 preservice teachers participated. The survey participants were primarily between the ages of 18-24 (97%), female (92%) and most identified as White (84%). The participants reported being enrolled in a range of teacher preparation programs including Educational Studies, Middle Grades 4-8, Middle Grades 4-8 dual Pre-K-12 Special Education, Music Education K-12, Pre-K-4 Early Grades, Pre-K-4 Early Grades dual Pre-K-12 Special Education, and Pre-K-12 Special Education and Secondary Education. The majority (56%) were enrolled in a Pre-K-4 Early Grades teacher preparation program.

4.2 Instrumentation

The STEM Pedagogical Content Knowledge Scale (STEMPCK Scale; Yildirim & Şahin-Topalcengiz, 2018) was used to rate preservice teacher's knowledge of STEM content and pedagogy. The STEMPCK scale consists of 56 items that are rated on a 5-point Likert scale anchored at 1=Strongly Disagree to 5=Strongly Agree. The STEMPCK scale provides an overall score as well as six subscale scores: pedagogical knowledge (PK),

science, technology, engineering, mathematics, and 21st-century skills. Acceptable reliability for the overall scale and subscales have been shown to range from α=.78 to α=.95 (Yildirim & Şahin-Topalcengiz, 2018).

Schwarzer & Jerusalem's (1995) Generalized Self-Efficacy Scale was used to measure preservice teachers' self-efficacy around teaching. The scale has 10 items rated on a 4-point Likert scale anchored at 1=Not at All to 4=Completely True. Data from participants in 23 countries has demonstrated that the scaled is unidimensional and reliability with Cronbach alpha ranging from α=.76 to α=.90 (Schwarzer & Jerusalem, 1995).

4.3 Procedures

All procedures were approved by the Institutional Review Board at the authors' university. Student were recruited from four universities in Southeastern Pennsylvania in the United States. One of the schools is a public university, while the other three are private, religiously affiliated higher education institutions. A faculty or staff member at each college and university distributed an email invitation to their students enrolled in teacher preparation programs. If interested, students used a link provided in the email to access both the consent form and the surveys used in this study. As such, all data was collected electronically and the identity of all participants was anonymous.

V. RESULTS

Table 1. shows preservice teachers' average scores on the STEMPCK scale. The overall score was *M*=3.76 showing general agreement across items on the scale. The subscale average scores were highest for pedagogical knowledge (PK, *M*=4.26) and 21st century skills (*M*=4.43). Preservice teachers also had average scores in the agreeable range for the mathematics subscale (*M*=3.73) and technology subscale (*M*=3.62). The average scores for science (*M*=2.93) and engineering (*M*=2.90) were both in the disagreeable range.

Table 1: Descriptive Statistics for STEMPCK scale and subscales

	Mean	SD	Minimum	Maximum
STEMPCK	3.76	0.43	2.84	4.57
PK	4.26	0.40	3.25	5.00
Science	2.93	0.78	1.22	4.44
Technology	3.62	0.75	1.71	5.00
Engineering	2.90	0.71	1.57	5.00
Mathematics	3.73	0.78	2.00	5.00
21st-Century	4.43	0.40	3.57	5.00

Preservice teachers had an average self-efficacy score of *M*=3.27(0.27) and this was significantly correlated with overall their scores on the STEMPCK scale. There was a moderate, positive, and statistically significant correlation, *r*=.46, *p*<.001. As STEM pedagogical content knowledge increased, self-efficacy also increased in this sample of preservice teachers.

Table 2 shows the correlations between self-efficacy and the six subscales of the STEMPCK Scale. Self-efficacy was strongly and significantly correlated with each subscale (*p*s<.05) except for engineering and mathematics (*p*=.18). The strongest correlations existed between self-efficacy and PK knowledge (*r*=.50) and 21st century skills (*r*=48). Moderate positive correlations existed between self-efficacy and science (*r*=.33) as well as self-efficacy and technology (*r*=.33). However, the correlations with self-efficacy were weaker for engineering (*r*=.16) and mathematics (*r*=.23).

Table 2: Research Question 3 – STEMPCK and Self-efficacy Correlation of Subscales

1. PK	Pearson's *r*	—						
	p-value	—						
2. Science	Pearson's *r*	0.45	—					
	p-value	< .001	—					
3. Technology	Pearson's *r*	0.34	0.35	—				
	p-value	0.006	0.004	—				
4. Engineering	Pearson's *r*	0.28	0.63	0.46	—			
	p-value	0.02	< .001	< .001	—			
5. Mathematics	Pearson's *r*	0.28	0.57	0.37	0.55	—		
	p-value	0.02	< .001	0.002	< .001	—		
6. 21st-Century	Pearson's *r*	0.59	0.32	0.35	0.31	0.28	—	
	p-value	< .001	0.008	0.004	0.01	0.02	—	
7. Self-Efficacy	Pearson's *r*	0.50	0.33	0.33	0.16	0.23	0.48	—
	p-value	< .001	0.006	0.008	0.18	0.06	< .001	—

Correlations between Self-Efficacy and STEMPCK Subscales (N=64)

VI. DISCUSSION

If students are to remain in the proverbial STEM pipeline and gain essential 21st-century skills, they must be properly prepared. Students require teachers with passion, drive, and high levels of self-efficacy. Teacher self-efficacy is a direct indicator of student achievement, and teachers' own experience with subjects like science and mathematics can determine the amount of time spent on that content (Thomson et al., 2018). Teachers with high levels of self-efficacy are more likely to try different instructional strategies and provide opportunities for authentic hands-on student-centered learning (Cheung et al., 2019). The need for professional development in schools demonstrates that teachers are not coming into the classroom prepared to integrate STEM as a tool to promote 21st-century competencies (Nowikowski, 2017).

Preservice teachers with high levels of self-efficacy are more successful in the classroom (Michael et al.,2020). Motivation, flexibility, and adaptability are also characteristics of teachers with high levels of self-efficacy (Chen et al., 2020; Masri et al., 2021). Pearman et al. (2021) found that as teachers' self-efficacy increases, so does their beliefs in their students' abilities, and, in turn, if teachers believe in their students' abilities, student achievement and student self-efficacy also increase (Moawad & Corkett, 2021).

Overall, the preservice teachers in this study reported high self-efficacy, which is encouraging given that higher self-efficacy is related to positive outcomes. The purpose of this study was to examine if self-efficacy was related to STEMPCK. The results showed this to be the case. As preservice teachers' STEMPCK knowledge increases, their self-efficacy also increases. Prior research has shown that teachers' with higher self-efficacy are more motivated to teach STEM, however there was a gap in understanding whether they were also prepared to teach STEM. The results of this study show that preservice teachers with higher self-efficacy were also well prepared to teach STEM as higher scores in self-efficacy were related to higher scores of pedagogical knowledge, science, technology and 21st century skills.

These findings are not without limitations. The data came from one geographical location, which limits generalizability. The study also did not include a measure of preservice teachers' motivation for teaching STEM. Future research could replicate this study in other locations and include measures of preservice teachers' motivation for teaching STEM. By including

measures of motivation with a larger sample, analysis could examine the path of the relationships between all three variables.

VII. CONCLUSION

This study has found that the more STEM pedagogical content knowledge preservice teachers have, the higher their self-efficacy. These results are encouraging as preservice teachers will be preparing students to solve ongoing problems including the need for renewable energy, growing national security as technology advances, and continuing to combat disease in an increasing human population.

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European Innovation Policies and Innovation Systems: A Literature Review

Clara Meneses

ABSTRACT

This article recognizes the stages of the evolution of the European Union's innovation policy, exposes which frameworks are applied in research on EU innovation policies, and presents a literature review on the subject within the new institutionalism and the innovation systems approach. The methodology encompassed qualitative, exploratory, descriptive, bibliographic, and documentary research. An overview of the literature is presented, particularly examining theories and models on innovation developed from the late 1980s and early 1990s when the study of institutional systems and networks became more common. The literature on innovation can elucidate how it emerges, bringing a greater understanding of this phenomenon and, thus, a greater ability to find legal mechanisms for regulation and designs for its promotion. This study seeks to identify the research trends and examines the explanatory power of the systemic approach. It points out a gap in the literature, proposing an interdisciplinary research agenda that combines legal knowledge and the systemic approach.

Keywords: public policy; innovation policy; literature review; innovation systems; european union.

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Políticas de Inovação da União Europeia em Visão Sistêmica: Uma Revisão de Literatura

Clara Meneses

ABSTRACT

This article recognizes the stages of the evolution of the European Union's innovation policy, exposes which frameworks are applied in research on EU innovation policies, and presents a literature review on the subject within the new institutionalism and the innovation systems approach. The methodology encompassed qualitative, exploratory, descriptive, bibliographic, and documentary research. An overview of the literature is presented, particularly examining theories and models on innovation developed from the late 1980s and early 1990s when the study of institutional systems and networks became more common. The literature on innovation can elucidate how it emerges, bringing a greater understanding of this phenomenon and, thus, a greater ability to find legal mechanisms for regulation and designs for its promotion. This study seeks to identify the research trends and examines the explanatory power of the systemic approach. It points out a gap in the literature, proposing an interdisciplinary research agenda that combines legal knowledge and the systemic approach.

Keywords: public policy; innovation policy; literature review; innovation systems; european union.

RESUMO

Este artigo reconhece as fases da evolução da política de inovação da União Europeia, expõe quais enquadramentos são aplicados nas pesquisas sobre as políticas de fomento da inovação (innovation policies) comunitária e apresenta uma revisão de literatura sobre o tema dentro do novo institucionalismo e da abordagem dos sistemas de inovação. A metodologia empregada ostenta elementos de pesquisa qualitativa, exploratória, descritiva, bibliográfica e documental. Apresenta-se um panorama da literatura, examinando particularmente teorias e modelos sobre inovação e seus reflexos nas políticas públicas a ela dedicadas, a partir do final dos anos 80 e início dos anos 90, quando se tornou mais comum a inclusão de ideias pertinentes a redes e sistemas. A literatura sobre inovação pode elucidar os modos como esta emerge, trazendo maior compreensão sobre tal fenómeno e, assim, maior capacidade para se encontrar mecanismos jurídicos de regulação e de desenho de programas adequados ao seu fomento. Em seguida, o trabalho busca identificar quais são as tendências de pesquisa nesses estudos, caso estejam delineadas. Por fim, este artigo examina o poder explicativo da abordagem mapeada e, diante de uma lacuna investigativa, propõe uma agenda de pesquisa interdisciplinar que combine conhecimentos jurídicos aos lindes dessa abordagem.

Palavras-chave: políticas públicas; políticas de inovação; revisão de literatura; sistemas de inovação; união europeia.

I. INTRODUCTION

This article offers a literature review of research on innovation policies in the European Union (EU) within the framework of the new institutionalism and the innovation systems approach. The research is part of broader interdisciplinary studies encompassing law and public administration in the field of public policies to support researchers and decision-

makers in developing legal instruments to regulate and promote innovation.

The review examines theories and models developed in the late 1980s and early 1990s when ideas on networks and systems became more common. It offers an overview that emphasizes innovation theories and models and their impact on public policies addressing the issue and may contribute to an increased understanding of how innovation emerges.

The EU understands innovation policy as "[...] the interface between research and technological development policy and industrial policy and aims to create a framework conducive to bringing ideas to market."[1] The implementation of the "EU Framework Programmes" is in line with the shift from an understanding of innovation as a linear process to an understanding of it as a complex system, presented as an open model[2] where companies increasingly trust the state and the cooperation with others for knowledge inflows, coming primarily from fundamental research.

This is a qualitative, exploratory, descriptive, bibliographic, and documentary research focused on innovation policies or systems built based on the new institutionalism – an approach where institutions and relationships between them are at the center of explanations for innovation and other social phenomena. A systematic bibliographic review was conducted, gathering studies published from 2007 to 2019. Also, a complementary narrative bibliographic literature review without specifying a publication period was carried out to include both classic and current studies on innovation relevant to the scope of the research.

This article is divided into five sections, including this introduction. The next section addresses the methodology employed, followed by section three, which exposes the focus of the literature examined – the EU public innovation policy, outlining the objectives of community policies. The fourth section addresses the proposed theoretical framework and the research results. The theoretical approaches most used by the literature are identified in order to place the innovation systems approach among the main analytical models of innovation. Subsequently, the study lists instruments available to explore this field of knowledge, points out its current research direction, and inquires which objects or subtopics have attracted research attention and how the literature on the subject has developed. The fifth and final section draws the research conclusions and limitations.

II. METHODOLOGY

This research adopted data collection methods based on bibliographic, systematic, and narrative research and documentary analysis of legal documents. Bibliographic research is an investigation based on published books and scientific articles[3], and Corbin and Strauss consider it equivalent to technical literature, such as research reports, theoretical articles, and written scientific production[4]. In turn, documentary research can be understood as nontechnical literature.

For the literature review, two techniques were combined. The organization and discussion of innovation policies were carried out based on a systematic bibliographic review which was pre-defined and is detailed below[5]. This review focused on studies published from 2007 to 2019. As mentioned previously, the systematic bibliographic review focused on studies on

[1] PARLAMENTO EUROPEU. Política de inovação. Bruxelas: Parlamento Europeu, set. 2022, p. 1. Fichas temáticas sobre a União Europeia. Retrieved October 26, 2022, from https://www.europarl.europa.eu/ftu/pdf/pt/FTU_2.4.6.pdf.

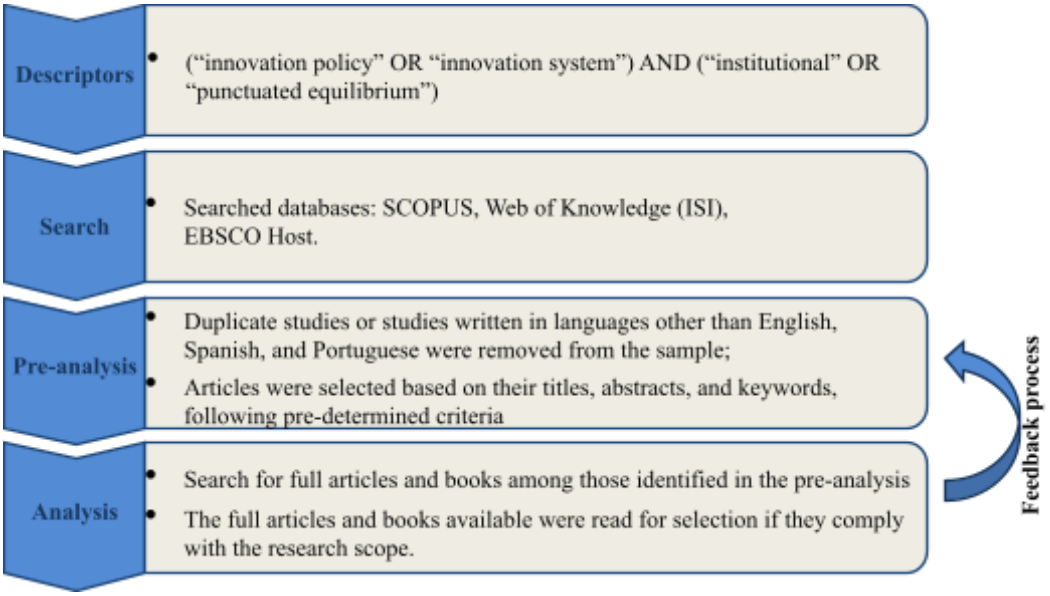
[2] ARNOLD, E. Understanding the long-term impacts of the EU framework programme of research and technological development. Enschede: University of Twente, 27 Oct. 2011. Inaugural Lecture. Retrieved October 26, 2022, from https://ris.utwente.nl/ws/portalfiles/portal/5120113/oratieboekje+Arnold.pdf.

[3] GIL, A. C. Métodos e técnicas de pesquisa social. 5. ed. São Paulo: Atlas, 1999.

[4] CORBIN, J.; STRAUSS, A. Basics of qualitative research: techniques and procedures for developing grounded theory. 3rd ed. Thousand Oaks, CA: Sage Publications, 2008.

[5] BOTELHO, L. L. R. CUNHA, C. C. A.; MACEDO, M. O método da revisão integrativa nos estudos organizacionais. Gestão e Sociedade, Belo Horizonte, v. 5, n. 11, p. 121-136, May/Aug. 2011.

innovation policies or innovation systems built explicitly from the new institutionalism or the theory of punctuated equilibrium, also neo-institutionalist, and this was reflected in the choice of search terms. Figure 1 summarizes the procedures.



Source: Elaborated by the authors

Figure 1: Stages of the systematic bibliographic review

This process consisted of the following steps:

- The first step was the choice of search terms. Some tests were performed leading to the selected terms. The descriptors used were: ("innovation policy" OR "innovation system") AND ("institutional" OR "punctuated equilibrium").
- In the second stage, the descriptors were applied to a search in three databases: SCOPUS, Web of Knowledge (ISI), and EBSCO Host. The search identified the descriptors in the titles, abstracts, or keywords of articles and books. When the database allowed it, the search results were limited to books or scientific articles published in peer-reviewed academic journals. The search considered studies published from 2007 to 2019. The result was exported to EndNote bibliographic management software. This step was completed in November 2020;
- In the third step, duplicate files and those published in languages other than English, Spanish, or Portuguese were removed. A pre-analysis of titles, abstracts, and keywords was conducted to mine the data and identify and remove the studies that addressed the subject only marginally or tangentially. Therefore, at this stage, articles focused on the following topics were removed: innovation in the public service; innovation in universities; research policy; purely or quantitative studies in economics; innovation 4.0 linked to specific technologies (such as nanotechnology, blockchain, artificial intelligence, and Internet of Things); innovation demand; specific studies on public procurement; studies on Asian countries, the United States, Russia or another context other than EU countries, when not comparative with the EU; focus on regionalism within the EU; focus on the relationship between actors promoting innovation (such as Open Labs and clustering); and inter-firm innovation. Removing an article addressing one of these topics at this step did not prevent the article from being reconsidered later if its relevance for this research was verified. Articles addressing the following topics were considered: public innovation policies in the EU; broad studies (comparative or not); focus on government incentives for private sector innovation; studies in the field of Public

Administration or Public Policy; qualitative studies; studies that explicitly addressed the theoretical framework of innovation; studies that contained an explicit analysis model or research design; observed institutional changes;

- In the fourth stage, we searched the full text of the books and articles selected for an in-depth evaluation. On the few occasions when it was not possible to find the complete text directly from the databases, the studies were set apart for future thorough searches. The material retrieved was separated into two groups: studies published from 2015 to 2019 and published before 2015. When these articles and books cited a relevant study for this research, the reference was noted down to be evaluated in a new interaction, forming a recursive cycle of theoretical deepening (feedback process) until reaching a satisfactory level of knowledge.

In the search in scientific databases, 1333 texts were found. This represents the gross number of results returned in the three databases. After removing duplicate articles and those in languages other than English, Spanish, or Portuguese, this number was reduced to 968 studies. The selection through titles, abstracts, and keywords reduced this number to 90. It was not possible to find the full text of two articles, reducing the number to 88. Table 1 summarizes the evolution of the systematic review.

Table 1: Summary of the systematic bibliographic review about innovation policies

Databases	Studies found by applying descriptors	Studies that remained after removing duplicates and in languages other than English, Spanish, or Portuguese	Selected studies after analysis of titles, abstracts, and keywords	Studies with the full text available	Selected studies	Feedback process
SCOPUS	787	968	90	88	88	Continuing
Web of Knowledge (ISI)	512					
Ebsco Host	34					
Search		Pre-analysis		Analysis		

Source: Elaborated by the authors

A complementary narrative bibliographic review was carried out in a second moment, considering studies regardless of publication date. The intention was to include classic studies addressing innovation (most dated from the early 90s) and more recent ones, selected by relevance to the research scope.

The narrative or traditional bibliographic review consisted of selecting and analyzing books and articles from electronic journals using the criteria of relevance and pertinence with the research[6]. Some relevant references cited by the authors analyzed in the fourth stage of the systematic review constituted a starting point for the complementary narrative bibliographic review, mainly because they were repeatedly cited in different scientific works and demonstrated an impact in the field. Thus, other works were included to reach a comprehensive overview of the current research.

Given the complex scenario of EU policies to understand and delimit which community innovation policies would be considered in the literature review (i.e., which innovation policies are an object of study in the EU), it was necessary to consult a multitude of sources and documental and legal analysis, such as information on the

[6] BOTELHO; CUNHA; MACEDO, 2011.

Community Support Frameworks, thematic community legislation, institutional information published on the entities' websites, data from the monitoring of innovation by the European Commission, documents referring to the financing process and the European Semester, among others. Among the normative acts, the following stand out: Treaty of Rome (1957), Single European Act (1987), Council Regulation (EEC) 2052/1988, Council Regulation (EC) 1083/2006, Treaty on the Functioning of the European Union (2006), the Treaty of Lisbon (2007), Regulation (EU) 1.301/2013 of the European Parliament and of the Council, and Regulation (EU) 1.291/2013 of the European Parliament and of the Council.

III. EUROPEAN UNION INNOVATION POLICIES

This section presents the EU community innovation policy, highlighting its characteristics. It offers a synthesis of the evolution of innovation policy in the European Union, mentioning the most relevant years, especially the year 2000 when the theme of innovation gained a central position among the EU's development strategies (both the Strategy of Lisbon and the Europe 2020 Strategy).

An alternative denomination for this section could be "Europeanization of innovation policies," as a growing process of institutionalization of the EU and incorporating its policies and influence for its Member States. One could say there has been an EU innovation policy since 1984, the year of the first "R&TD Framework Programme." It was the first time a common European approach to an innovation policy was evidenced.[7] It was carried out by member states, through which the EU became an important funder of innovation activities, encouraging and influencing projects developed in collaboration between member states, most notably after 2000. Since then, many "R&TD Framework Programmes" have been completed. The eighth was the so-called Horizon 2020, a financial instrument of the EU that aims to ensure Europe's global competitiveness[8].

The EU has two economic and social development programs that stand out in the current century – the Lisbon Strategy (2000-2010) and the Europe 2020 Strategy (2010-2020)[9]. They mark two distinct phases of community policies. In Barcelona in 2010, the EU countries agreed to establish a target of spending 3% of the GDP on research and development (R&D). Out of this 3%, two-thirds should come from the private sector.

In 2005, the Lisbon Strategy changed its financing instruments and coordination mechanisms. On December 13, 2007, the Treaty of Lisbon was signed, the legal basis for European research and innovation policy and the European Research Area (ERA). However, before it entered into force, scheduled for December 2009, a global financial crisis impacting member states occurred in 2008, leading to a decrease in total investment in R&D and innovation in the EU. In December 2008, the European Council announced an economic recovery plan, reaffirming that economic recovery and growth necessarily passed through the implementation of the Lisbon Strategy[10].

In 2010, the European Commission inaugurated the "Innovation Union" initiative to guide innovation policy until 2020, based on coordination and soft law mechanisms, gradually introduced alongside pre-existing national innovation policies. It is one of the seven flagship initiatives of the Europe 2020 Strategy, approved in June 2010, for a smart, sustainable, and

[7] ARNOLD, 2011; KALISZ, D. E.; ALUCHNA, M. Research and innovations redefined. Perspectives on European Union initiatives and strategic choices on Horizon 2020. European Integration Studies, [Kaunas], v. 35, n. 6, p. 140-149, 2012.

[8] EUROPEAN COMMISSION. A timeline for Horizon 2020: Parliament and Council negotiations on the basis of the Commission proposals. Brussels: European Commission, 2011. Retrieved October 26, 2022, from http://ec.europa.eu/research/horizon2020/Index_en.cfm.

[9] COMISSÃO EUROPEIA. Europa 2020: a Comissão propõe uma nova estratégia económica para a Europa. Bruxelas: Comissão Europeia, 3 mar. 2010. Comunicado de Imprensa IP/10/225. Retrieved October 26, 2022, from https://ec.europa.eu/commission/presscorner/detail/pt/IP_10_225

[10] EUROPEAN COMMITTEE OF THE REGIONS. The Lisbon Strategy in short. Brussels: European Committee of the Regions, 2020. Retrieved October 26, 2022, from https://portal.cor.europa.eu/europe2020/Profiles/Pages/TheLisbonStrategyinshort.aspx

inclusive economy. The European Commission aimed to improve conditions and access to European co-financing research and innovation projects[11]. The smart economy involves investing in education, research, and innovation; sustainable means an economy based on low carbon emissions; and "inclusive" refers to social cohesion, job creation, and the reduction of poverty and inequalities[12]. Another four flagship initiatives of the Europe 2020 Strategy are also linked to innovation: a digital agenda for Europe; resource efficient Europe; a new industrial policy for the globalization era; and an agenda for new skills and jobs.

However, in March 2010, the European Commission postponed the deadline for reaching the 3% target for 2020. Finally, in 2020, a pandemic with a great economic impact occurred. According to data from Eurostat in 2019, the EU average for public investment in R&D was 0.25% of GDP. Concerning private investments, the European average was 1.48%[13]. Currently, the Commission monitors compliance with the national investment target in innovation in the context of the so-called European Semester.

The European Semester[14] provides a framework for policy coordination by EU member states, guiding the discussion of their economic-budgetary plans. It also promotes monitoring at specific moments throughout the year. Member state governments provide the plans, and based on them, the Commission may present general and country-specific recommendations.

After the launch of the Europe 2020 Strategy and the Innovation Union initiative, there was a shift of focus from industrial policy to research policy. The expectation was the inclusion of research activities developed in universities and the primacy of this type of entity in the national innovation system. Furthermore, since the Sixth Framework Programme, the structuring effect on national innovation systems has been more evident, transferring from the project or specific objective to the national level[15]. A Framework Programme, although it is formally "one" program, actually consists of many subprograms directed at different themes, although the transversality of innovation financing can systematize its objective[16].

Three major guiding phases of community policy can be observed. The first, before 2000, the goals were less ambitious and aimed at increasing networks and stimulating activities at the national level. The two other phases occurred in the period established for this research: one from the beginning of the 2000s until around 2010 – this research emphasizes the period after 2007 – and another from 2010 to 2019, considering the years between 2010 and 2012 as a transition period[17].

Scholars such as Queirós and Carvalho, referring to research policy, divide the first phase into two others: (1.1) from the post-World War II period to 1970, characterized by sparse intergovernmental cooperation in strategic sciences; and (1.2) from 1970 to 1990, with the creation of the Framework Programs, a new instrument of Europeanization to increase the competitiveness of the EU through technological innovation[18]. Then, the period after the 2000s is considered a single phase with a new model of Europeanization.

[11] KALISZ; ALUCHNA, 2012.

[12] PARLAMENTO EUROPEU, 2022, p. 2.

[13] EUROPEAN COMMISSION. GERD by sector of performance and type of expenditure. Luxembourg: EUROSTAT, 2022. Retrieved October 26, 2022, from https://ec.europa.eu/eurostat/databrowser/view/RD_E_GERDCOST__custom_1639730/default/table?lang=en

[14] COMISSÃO EUROPEIA. O Semestre Europeu. Bruxelas: Comissão Europeia, [2018]. Retrieved October 26, 2022, from.https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester_pt

[15] EUROPEAN COMMISSION. The European Semester explained. Brussels: European Commission, [2022]. Retrieved October 26, 2022, from https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/framework/european-semester-explained_en

[16] ARNOLD, 2011, p. 4.

[17] ARNOLD, 2011; QUEIRÓS, A.; CARVALHO, T. The europeanisation of science and technology policies: a literature review. *In*: INTERNATIONAL TECHNOLOGY, EDUCATION AND DEVELOPMENT CONFERENCE, 13., Valencia, Spain. Proceedings [...]. Valencia, Spain: Iated-Int Assoc Technology Education & Development, 2019, p. 5575-5584.

[18] QUEIRÓS; CARVALHO, 2019.

In the second phase, since the 2000s, there has been a growing tendency to support non-technological innovation projects, which can be seen by the growth in the set of incentive instruments. This occurs mainly and particularly in topics such as marketing, design, and organizational innovation, with a growing, but still not preponderant, space for other non-technological activities relevant to innovation, such as encouraging technology transfer and the development of skills that contribute to the innovation. In this phase, peer pressure and naming and shaming Europeanization mechanisms are used more frequently and represent greater pressure on the conduct of member states, even if it is not cogent. The so-called Open Method of Coordination (OMC) was adopted, which, as defined by the European Commission, is an intergovernmental method of cooperation that does not imply legal obligations on the part of the member states. In that decade, from the economic crisis of 2008 to 2012, there was generally a decrease in funding for collaborative R&D projects in EU countries[19].

The third phase was marked by the direction of the strategy around the so-called Research and Innovation Strategies for Smart Specialization (RIS3), considered a guideline to political priorities of community innovation[20]. As mentioned above, since 2010, the focus of industrial policy has shifted to research policy and the promotion of basic research activities carried out in universities. This new framework represents a continuation of the systemic approach to innovation and an emphasis on non-technological innovation. On the other hand, it improves the policy to reinforce innovation networks and consider the particularities and strengths of each country (or region) because resources are now concentrated in areas where each member state has advantages. This strategy is controversial due to the potential path-dependent reinforcements. However, it also seeks to facilitate the insertion of companies in international innovation networks and collaboration between entities from different innovation systems, boosted by instruments to encourage the formation of clusters. Thus, it tends to adhere by reinforcing the power already established in the areas of specialization.

Adopting this strategy proved to be both forceful and inclusive. Forceful because it is established top-down from the EU political institutions as a condition for access to structural funds[21]. It is inclusive or participatory because member states are responsible for identifying the strengths and weaknesses of each region to channel resources to certain economic areas in which the country has greater advantages compared to another country or region. In other words, the definition of specialization to allocate resources comes from the member states, with the participation of regional and local economic agents, reinforcing regional and local power. It is possible to observe a movement away from the selection and support of the so-called national champions to implement strategies that respond to interest groups and supposedly benefit from greater political sustainability.

The following instruments were encouraged: collaborative R&D programs, to the detriment of individual R&D projects; incentives for business entrepreneurship; initiatives on the public demand side; creation or encouragement of innovation networks and clustering; competitive selection of projects from research institutions; incentives for non-technological innovation in general[22]. The current challenges indicate a) the need to coordinate innovation and research policies between member states and b) a trend toward decentralization. Table 2 summarizes the three phases mentioned.

[19] IZSAK, K.; RADOSEVIC, S.; MARKIANIDOU, P. Lessons from a Decade of Innovation Policy: what can be learnt from the INNO Policy TrendChart and The Innovation Union Scoreboard. Brussels: European Commission, June 2013.
[20] EUROPEAN COMMISSION, 2011.
[21] EUROPEAN COMMISSION, 2011.
[22] IZSAK; RADOSEVIC; MARKIANIDOU, 2013.

Table 2: Phases and characteristics of the community innovation policy

	1st phase Before 2000	2nd phase From 2000 to 2010	3rd phase After 2010
Milestones	Accession to the EU and adaptation	2008 Crisis	• Period of *troika* • Europe 2020 Strategy and the initiative Innovation Union • Horizon 2020 • Period 2014-2020
Characteristics	• Less ambitious goals • Stimulate activities at the member state level • Focus on industrial policy	• Change from the linear view to the systemic view of innovation • Growth of the set of instruments to promote innovation • Focus on industrial policy	• "Smart specialization" strategy • Regionalization of • community policies • Focus on research policy
Instruments	• Technological innovation projects • Instruments dedicated to improving networks • Mission-oriented funding	• Non-technological innovation projects • Incentive to marketing, design, organizational innovation, and other non-technological activities relevant to innovation, such as encouraging • technology transfer and skills development that contribute to innovation • Promotion of business entrepreneurship • Collaborative R&D programs, to the detriment of individual R&D projects • Promoting collaboration between public and private entities in R&D projects and trying to get companies involved • Initiatives on the public demand side from the middle of the decade	• A certain continuity of the instruments from the previous phase, with a growing set of instruments • Non-technological innovation projects • Creation or incentive to innovation networks and clustering • Competitive selection of research institutions' projects to be funded by R&D public programs • Strategy direction established by the EU and its choice of priorities • Identification of regions by member-states

Source: Elaborated by the authors

Considering the phases that the community innovation policy went through, the next section addresses the literature review.

IV. THEORETICAL STRANDS OF INNOVATION POLICIES

This section starts from the assumption that innovation generates economic development and benefits a country[23]. However, innovation is so ubiquitous, transversal, and interdisciplinary that any claim to map it in its entirety would be too ambitious. This subsection presents an overview

[23] SCHUMPETER, J. Theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle. Cambridge, MA: Harvard University Press, 1934; OECD. The OECD Innovation Strategy: getting a head start on tomorrow. Paris: OECD Publishing, 2010.

of the literature, particularly examining theories and models on innovation and its impact on related public policies from the late 1980s and early 1990s when it became more common to include ideas about networks and systems. The literature on innovation discusses how it emerges, expanding the comprehension of this phenomenon and the ability to find legal mechanisms for regulating and designing programs suitable for its promotion.

The theoretical foundations for innovation studies are the research works of Schumpeter[24] and two main theoretical approaches familiar to the interdisciplinary science of public administration, public policy, and economics: neoclassical economics and evolutionary economics (or neo-Schumpeterian economics). These two theoretical approaches share the premise that innovation generates economic growth, and they recognize the importance of public policies in promoting science and technology. Investigations on the relationship between innovation and the country's performance and economic growth are abundant[25]. From there, they follow different paths.

Neoclassical economics studies the functioning of the market. This perspective identifies that the need to encourage innovation results from market failures. The logic is that the state must address these failures since companies do not have enough incentives to innovate. This theoretical approach reflects a linear view of innovation where public policy should handle market failures by promoting scientific knowledge through basic research. Thus, investing in universities and research institutes would almost automatically result in innovation for the market. Scientific research is expected to generate economic progress almost automatically in a one-way flow, being transformed into engineering and production and, thus, into new marketable products. Because it is structured in a linear model, this view underestimates aspects related to the transformation of scientific knowledge into market innovation and economic value[26].

The second theoretical approach is evolutionary economics. Its premise is that decision-makers cannot deal with all aspects and process all information rationally and, therefore, resort to simplifications, automatic behaviors, and heuristics. Evolutionary economists recognize that innovations will always occur and generate diversity, which is reduced by selection. Thus, based on diversity, the elements more adapted to the circumstances will remain, leading to improvement within specific environmental stability[27].

If natural mutations are random and, therefore, not necessarily more advantageous in biology, the same cannot be expected of government actions. Public policies, directed and intentionally, aim to change reality to encourage the most advantageous innovations for competitiveness, given the national and community circumstances. Thus, "the evolutionary approach is particularly suited for analyzing historical processes. Evolution and history are both a complex mixture of random factors, or contingencies, and more systematic tendencies."[28]

In public policy and its intersection with law, the evolutionary approach is the most widespread, which adopts the theoretical framework of the new institutionalism. Although there is a trend of convergence between neo-institutionalist currents, it is possible to observe a dividing line: on the one hand, there are studies on innovation, such as those included in the economic policy book "Varieties of Capitalism." These studies rely on the architecture of economic and non-economic incentives at play in each country or group of countries being compared, approaching the new institutionalism of rational

[24] SCHUMPETER, *op. cit.*

[25] VERSPAGEN, B. Innovation and economic growth. *In*: FAGERBERG, J.; MOWERY, D. C.; NELSON, R. R. (ed.). The Oxford Handbook of Innovation. New York: Oxford University Press, 2005, p. 487-513.

[26] FAGERBERG, J. Innovation policy, national innovation systems and economic performance: in search of a useful theoretical framework. Oslo: TIK Centre for Technology, Innovation and Culture, 2015; MAKÓ, C.; ILLÉSSY, M. Innovation policy review: National and European experience. Brussels: QuInnE, May 2015. QuInnE Working Paper 1.

[27] VERSPAGEN, 2005, p. 487-513.

[28] *Ibid.*, p. 497.

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choice[29]; on the other hand, there are studies that combine traits of the new sociological and historical institutionalism, as is the case with the theoretical approach of innovation systems[30]. For this majority line, which has become paradigmatic in the field, innovation is understood as a phenomenon that occurs within a national system, which evolves historically and bears characteristics of being path-dependent.

The best-known example of path-dependence is the QWERTY keyboard. The choice of organizing the letters in this specific order is not the best but it has a justification based on the history of the development of the device and it is difficult to change at this point. The permanence of the QWERTY keyboard is not explained by its efficiency, but by historical selection processes that lead to path-dependency. These dependencies are important for technology, institutional processes, and understanding the evolution of national innovation systems (NISs):

> *Since countries differ economically, and different industries have different requirements with respect to knowledge, skills, finance, etc., the "knowledge infrastructure" that evolves in response to these needs through interaction with policymakers tends to get a distinct national flavor, which may be further strengthened by historical differences in political and institutional systems. This is not necessarily a problem as long as the country's specialization pattern doesn't give reasons for concern. However, if change is needed, such inherited patterns may easily turn counterproductive*[31].

Joseph Schumpeter was the author who set the theoretical bases for the study of innovation[32]. As a precursor of this idea, based on evolutionary theory, he identified business activity as the main driver of innovation and economic development. Innovation was divided into four stages: invention, stricto sensu innovation, diffusion, and imitation. According to Schumpeterian theory, economic growth occurs during the diffusion of innovation. Freeman explains diffusion as "[...] the period when imitators begin to realize the profitable potential of the new product or process and start to invest heavily in that technology."[33]

Neo-Schumpeterian theorists continue to develop the precursor theory in line with evolutionism and the development of the systemic view of innovation, whose exponents were Freeman[34], Lundvall[35], Nelson[36], and others discussed below. The innovation systems approach expands the traditional linear view of innovation mentioned above. For the practice of government decision-makers, the systemic view implies different public policy designs: instead of directing resources to sectoral science or qualification policies. it requires a coordination effort to foster innovation in a transversal and diffuse way among the various governmental areas.

Freeman was a pioneer in adopting the term "national system of innovation" in the late 1980s. The author defined this system as "the network of institutions in the public and private sectors

[29] DONATIELLO, D.; RAMELLA, F. The innovation paradox in Southern Europe. Unexpected performance during the economic crisis. South European Society and Politics, [London], v. 22, n. 2, p. 157-177, 25 May 2017; HALL, P. A.; SOSKICE, D. (ed.). Varieties of capitalism: the institutional foundations of comparative advantage. New York: Oxford University Press, 2001; MAY, C.; SCHEDELIK, M. Comparative capitalism and innovation policy: complementarities and comparative institutional advantage. Journal of Economic Policy Reform, [London], v. 24, n. 4, p. 456-471, 2019.

[30] LUNDVALL, B.-Å. Innovation as an interactive process: from user–producer interaction to the national system of innovation. *In*: DOSI, G. *et al.* (ed.). Technical change and economic theory. London: Pinter, 1988, p. 349-369; LUNDVALL, B.-Å. National systems of innovation: towards a theory of innovation and interactive learning. London: Printer Publishers, 1992; NELSON, R. R. (ed.). National innovation systems: a comparative study. New York: Oxford University Press, 1993.

[31] EDLER, J.; FAGERBERG, J. Innovation policy: what, why, and how. Oxford Review of Economic Policy, [New York], v. 33, n. 1, p. 2-23, Jan. 2017. p. 10-11.

[32] SCHUMPETER, 1934.

[33] FREEMAN, C. The economics of industrial innovation. 2nd ed. London: Francis Pinter, 1982, p. 2.

[34] FREEMAN, C. Technology policy and economic performance: lessons from Japan. London: Printer Publishers, 1987.

[35] LUNDVALL, 1992.

[36] NELSON, 1993.

whose activities and interactions initiate, import, and diffuse new Technologies"[37] and the concept was disseminated in the 1990s by Lundvall[38] and Nelson[39] in subsequent empirical studies. This concept already recognized the role of institutions in innovation but highlighted new technologies as a means for innovation. Nelson's work suggested a methodological framework for comparing national innovation systems (NISs) across countries, dividing them into large high-income countries, smaller high-income countries, and lower-income countries[40].

Seminal works of new institutionalism were published in the early 1990s, namely "Institutions, Institutional Change and Economic Performance" by Douglas C. North[41], "Rediscovering Institutions" by James B. March and Johan P. Olsen[42], and "Governing the Commons" by Elinor Ostrom[43].

These studies provided a paradigm shift in socioeconomic studies at the time. Instead of focusing on how economic and social variables determine politics, using variables such as class structures and economic power, the neo-institutionalist approach pointed out that the character of political institutions of society largely determines its social and economic development[44].

As is often the case with widely used terms, the concept of NIS is used ambiguously, as noted by Edquist and Hommen. Several authors adopted the term NIS, but each one defined it slightly differently from the others, and resolving this question around a single definition has become somewhat unlikely[45]. According to Edquist and Hommen, "there is, therefore, a need for theoretically based empirical research to 'straighten up' the approach and make it more 'theory-like,'"[46] which suggests comparative studies of diverse NIS and on determinants of innovation.

The authors incorporated the characteristics they deemed most relevant in innovation – or factors that influence it[47] – so it is challenging to distinguish what is essential and what is circumstantial in the concept. Table 3 presents some authors and their conceptual nuances, with perspectives that can be broad, narrow, or even not expressed or defined.

[37] FREEMAN, *op. cit*, p. 1.
[38] LUNDVALL, *op. cit*.
[39] NELSON, *op. cit*.
[40] NELSON, *loc. cit*.
[41] NORTH, D. C. Institutions, institutional change and economic performance. Cambridge, UK: Cambridge University Press, 1990.
[42] MARCH, J.; OLSEN, J. Rediscovering institutions: the organizational basis of politics. New York: The Free Press, 1989.
[43] OSTROM, E. Governing the commons: the evolution of institutions for collective action. Cambridge, UK: Cambridge University Press, 1990.
[44] ROTHSTEIN, B. Good Governance. *In*: LEVI-FOUR, D. (ed.). The Oxford Handbook of Governance. New York: Oxford University Press, 2012, p. 1-13.
[45] EDQUIST, C.; HOMMEN, L. Comparing national systems of innovation in Asia and Europe: theory and comparative framework. *In*: EDQUIST, C.; HOMMEN, L. (ed.). Small country innovation systems: globalization, change and policy in Asia and Europe. Cheltenham, UK: Edward Elgar Publishing, 2008, p. 1-28.
[46] *Ibid.*, p. 1.
[47] *Ibid.*, p. 1-28; NIOSI, J. National systems of innovations are "x-efficient" (and x-effective): Why some are slow learners. Research Policy, [Amsterdam], v. 31, n. 2, p. 291-302, Feb. 2002.

Table 3: Concepts and perspectives of the national innovation system (NIS)

Author	Broad perspective	Narrow perspective	Element(s)/dimensions highlighted in the concept of NIS	Comments
Freeman (1987)		X	"The network of institutions in the public- and private-sectors whose activities and interactions initiate, import, modify and diffuse new technologies."[48]	It focuses on networks, and although it recognizes the participation of public and private institutions, the concept is restricted to those directly linked to new technologies
Lundvall (1992)	X		"[...] 'the structure of production' and 'the institutional set-up [...]. The elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge... and are either located within or rooted inside the borders of a nation state."[49]	NIS integrated into the broader socio-economic system
Edquist and Lundvall (1993)	X		"The national system of innovation is constituted by the institutions and economic structures affecting the rate and direction of technological change in the society."[50]	Focus on constituents (leading institutions of whatever type) that can alter the direction and speed of socio-technological change
Nelson and Rosenberg (1993)		X	"Organizations supporting R&D – i. e. they emphasized those organizations that promote the creation and dissemination of knowledge as the main sources of innovation. Organizations disseminating knowledge include firms, industrial research laboratories, research universities and government laboratories. [...] The set of institutions whose interactions determine the innovative performance of national firms."[51]	NIS could be considered an equivalent of national I&D Systems

[48] FREEMAN, 1987, p. 1.
[49] LUNDVALL, 1992, p. 10.
[50] EDQUIST, C.; LUNDVALL, B.-Å. Comparing the Danish and Swedish systems of innovation. *In*: NELSON, R. R. (ed.). National innovation systems: a comparative analysis. New York: Oxford University Press, 1993, p. 267.
[51] NELSON, R. R.; ROSENBERG, N. Technical innovation and national systems. *In*: NELSON, R. R. (ed.). National innovation systems: a comparative study. New York: Oxford University Press, 1993, p. 5-6.

Niosi et al. (1993).		X	"[...] A national system of innovation is the system of interacting private and public firms (either large or small), universities, and government agencies aiming at the production of science and technology within national borders."[52]	While recognizing the broad participation of different institutions, it maintained the focus on science and technology, reflecting the vision of the period in which the work was produced
Niosi (2002)	X		"NSIs is thus a set of interrelated institutions; its core is made up of those institutions that produce, diffuse and adapt new technical knowledge, be they industrial firms, universities, or government agencies. The links between these institutions consist of flows: knowledge, financial, human (people being the bearers of tacit knowledge and know-how), regulatory, and commercial."[53]	The author develops the concept, including institutions more deeply involved, networks, information flows, and stages of innovation (production, diffusion, and adaptation)
Edquist and Hommen (2008)	X		"Determinants of innovation processes – i. e. all important economic, social, political, organizational, institutional and other factors that influence the development and diffusion of innovations."[54]	Maintains Edquist's (1997) definition. Focus on innovation activities (although science still does not know for sure what are the main determinants of innovation) and not on constituents (leading institutions)
Costa (2016)	X		"Innovation is ubiquitous, and its sources come from different institutions. Therefore, different agents must interact in a systemic learning process rather than a unidirectional or linear one. [...]. Thus, information exchange among agents is fundamental, establishing channels through which the flow of information occurs, playing a relevant role in the innovation process."[55]	The author focuses on networks and interactions

Source: Elaborated by the authors based on Niosi[56]

[52] NIOSI, J. *et al*. National systems of innovations: in search of a workable concept. Technology in Society, [Amsterdam], v. 15, n. 2, p. 207-227, 1993. p. 212.
[53] NIOSI, 2002, p. 291.
[54] EDQUIST; HOMMEN, 2008, p. 7.
[55] COSTA, A. B. Teoria econômica e política de inovação. Revista de Economia Contemporânea, Rio de Janeiro, v. 20, n. 2, p. 281-307, May/August. 2016. p. 293. Our translation
[56] NIOSI, 2002.

The narrow perspective is limited to activities carried out by public entities dedicated to science and technology. The broader perspective encompasses all competencies that are cross-cuttingly related to innovation. In this research, the broad perspective of NIS is adopted to the point of recognizing and addressing the influence of Europeanization and its possible institutional changes at the heart of the innovation system.

After understanding the innovation system (or the scenario in which the government acts), we move on to the concept of the actions per se, i.e., the concept of public policies that promote innovation, henceforth "innovation policies." The term may mean both public polices intentionally designed to foster innovation and public policy that promotes it directly or indirectly, even if in an area different from its fields par excellence (science and technology), which reflects the variation between the broad and narrow perspective discussed above regarding the NIS.

Adopting the term innovation policy in the literature already hints at the model adopted in each research. This is because the term emerged later and gained acceptance concomitantly with adopting the systems view. Before that, public policy was seen in segments of science, technology, and industry, in common terms at the time, such as science policy, technology policy, and industrial policy, which were associated with innovation to be later incorporated by it. According to Fagerberg, the focus in the 1960s was on encouraging science, believing that promoting science would necessarily lead to innovation. After that, the popularity shifted to technological and political expression[57].

Currently, those terms are more used when referring to a specific area with defined contours, while the current reference to the political terminology of innovation denotes the transversal idea about innovation, referring to several communicating areas and including their sectoral interactions.

This terminological advance is relevant because, as May and Schedelik observed, innovation and technology are distinct, and innovation policies need to go beyond the realm of pure knowledge to be effective: "successful innovation policy does not necessarily lead to more labs and more cutting edge technology, but to actively shaping the institutions in which innovation processes take place."[58] Innovation is a new or improved product or process that differs significantly from previous ones and has been made available to potential users (products, i.e., goods or services) or brought to use by the innovator (processes, i.e., technological or organizational improvements)[59]. It does not occur in isolation but is integrated into a system. Despite this advance, the linear view of innovation resists in the field of public policy practice since the systemic view brings more challenges to governments in formulation, implementation, and public policy coordination.

In addition to this challenge, the systemic view teaches a lesson: that the context matters, and it is reckless to disregard it to simply copy from one country to other measures adopted in industrial policy, hoping for a similar result. Each country has a national innovation system with its own characteristics that must be considered. "It is also implied that there are no universal policy solutions or instruments that can be effectively implemented independently from the concrete context of the given country."[60]

A system is formed of components and the relationships among them. They must constitute a coherent unit with its own function and limits, which means it can be differentiated from the environment. The unit's properties belong to all the components, and these properties are different from those observed in the components individually. In the case of the innovation system, research has not yet developed sufficiently to list all its components and relationships, and the list

[57] FAGERBERG, 2015.

[58] MAY; SCHEDELIK, 2019, p. 456.

[59] EDQUIST, C. *et al.* (ed.). Public procurement for innovation. Cheltenham, UK: Edward Elgar Publishing, 2015; OECD; EUROSTAT. Oslo Manual 2018: guidelines for collecting, reporting and using data on innovation. 4th ed. Luxembourg: OECD Publishing, 2019.

[60] MAKÓ; ILLÉSSY, 2015, p. 7.

of the most important ones varies geographically[61].

The study by Fagerberg stands out in the literature based on a systemic view. The author portrays the reciprocally interfering elements in the technological dynamics, and the NIS is the result of locally and globally influenced processes of knowledge, skills, demand, finances, and institutions[62]. The processes, sectoral government policies, and the innovation management system (or strategic innovation management system) are observed as something dynamic.

Fagerberg points out five main NIS processes that influence innovation: knowledge, skills or competence, demand, finance, and institutions. Public policies can influence these same processes and also receive feedback from technological dynamics, making such influence reciprocal. By "technological dynamics," we mean innovation, diffusion, and use of technology. These dynamics result from external and internal factors arising from business sector activities and relationships with other social subsystems. "Society" includes government, interest groups, and non-governmental organizations. At the governmental level, the policies that influence come from different areas, demonstrating the transversal nature of innovation: research, education, health, defense, industry, regional development, public finance, justice, and others, depending on the context of each country[63].

In addition to the literature on NIS, it is important to present the models of the triple helix, multilevel perspective (MLP), clustering models (also derived from the evolutionary theoretical approach), and innovation systems.

Etzkowitz and Leydesdorff created the triple helix model[64], "[...] an innovation model in which the university/academy, industry, and government, as primary institutional spheres, interact to promote development through innovation and entrepreneurship."[65] It studies the communication network and expectations that recreate the institutional arrangements between those three spheres, often creating new organizational formats such as incubators, accelerators, and technology transfer offices. It may be considered an analytical tool that assigns a third mission to universities to contribute to economic development[66].

Later developments presented quadruple and quintuple helix models, including civil society and the environment. These models were represented by partially overlapping circles, intersections, and relationships between them and reflected the discussion and incorporation of other leading actors[67].

In turn, MLP was born in the Netherlands, is specific to political science and international relations, and is more concerned with the study of innovation in topics related to the energy transition, changes in the socio-technical system, and those linked to sustainability[68]. MLP starts from the premise that emerging a new technology and changing a given socio-technological paradigm depends on the interaction between processes at multiple levels. Change occurs through coevolution processes and coadaptation

[61] EDQUIST; HOMMEN, 2008, p. 1-28.
[62] FAGERBERG, 2015.
[63] FAGERBERG, *loc. cit*.
[64] ETZKOWITZ, H.; LEYDESDORFF, L. The Triple Helix – university-industry-government relations: a laboratory for knowledge based economic development. EASST Review, [Amsterdam], v. 14, n. 1, p. 14-19, Jan. 1995.
[65] ETZKOWITZ, H.; ZHOU, C. Hélice Tríplice: inovação e empreendedorismo universidade-indústria-governo. Estudos Avançados, [São Paulo], v. 31, n. 90, p. 23-48, 1º maio 2017. p. 24-25.
[66] ETZKOWITZ; LEYDESDORFF, 1995; ETZKOWITZ, H.; LEYDESDORFF, L. The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations. Research Policy, [Amsterdam], v. 29, n. 2, p. 109-123, Feb. 2000.
[67] CARAYANNIS, E. G.; CAMPBELL, D. F. J. 'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem. International Journal of Technology Management, [Geneva], v. 46, n. 3-4, p. 201-234, 23 Feb. 2009; GALVAO, A. et al. Triple helix and its evolution: a systematic literature review. Journal of Science and Technology Policy Management, [Bingley], v. 10, n. 3, p. 812-833, 2 Oct. 2019.
[68] GEELS, F. W. Micro-foundations of the multi-level perspective on socio-technical transitions: developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory. Technological Forecasting and Social Change, [Amsterdam], v. 152, 119894, Mar. 2020.

within and between layers of the three levels: micro, concerning niches; meso, relevant to the regime; and macro, referring to the international context[69].

According to this theory, regime change happens when there is a temporal coincidence between niche innovation and the pressures from the macro level on the regime to destabilize it and provoke a window of opportunity for the transition[70]. Niches are spaces created to promote and protect innovation. The technological regime can be explained as the set of practices and rules supported by the incumbent actors and their meso and macro relationships. Finally, the macro (contextual) level encompasses macroeconomics, cultural patterns, geopolitics, resources, interests, geographic conditions, climate, and other more general elements.

Some assumptions based on Nelson and Winter[71] are added from the differentiation between the levels. First, the macro level, called landscape, tends to change slowly and with difficulty, generally due to exogenous factors. Second, at the opposite extreme are the niches, terrain for experimentation and emergence of new technologies and radical changes. Although the niches are the gateway for "novelties" in the system, they need compatibility with the broader technological regime and its political-institutional support (the meso level) to be established. The meso level has a structure based on the past and, therefore, is more resistant to incorporating changes. So, a radically new technology, even if successful, may not go ahead if the regime does not accept it. In this sense, the state's role in facilitating this process of acceptance of new technologies by the regime – so-called strategic niche management or transition management – is crucial[72].

Although MLP is used to explain changes in the technological paradigm and is focused on the point of view of the company and the networks rather than policies and public administration, it explains how innovation leads to changes in paradigms and, by understanding these changes, brings lessons for the study of innovation policies. One of these lessons is suggested by Geels[73]. The author demonstrates that innovation is generally considered as coming from new companies, i.e., start-ups that are part of the new technological paradigm and seek to modify the dominant paradigm controlled by established traditional companies (the "incumbents"). However, innovation is also born in incumbent companies that dedicate part of their activities to the new emerging paradigm. Rather than being seen as a hindrance to change, public decision-makers can see such companies as allies of this transition.

Finally, the clustering model or diamond model is presented. This model was created in economics and business studies addressing competitive advantages of nations and companies, both linked to innovation, since, according to Porter, "firms create competitive advantage by perceiving new and better ways to compete in an industry and bring them to market, which is ultimately an act of innovation."[74]

Clusters are geographic concentrations of interconnected companies and institutions in a given industry. "Once a cluster begins to form, a self-reinforcing cycle promotes its growth, especially when local institutions are supportive and local competition is vigorous. As the cluster expands, so does its influence with government and with public and private institutions."[75] The author concluded that clusters are crucial for nations' competitive advantage because the

[69] GEELS, F. W. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy, [Amsterdam], v. 31, n. 8-9, p. 1257-1274, Dec. 2002; GEELS, 2020; GEELS, F.; SCHOT, J. Typology of sociotechnical transition pathways. Research Policy, [Amsterdam], v. 36, n. 3, p. 399-417, Apr. 2007; SHOVE, E.; WALKER, G. CAUTION! Transitions ahead: politics, practice, and sustainable transition management. Environment and Planning A: Economy and Space, [London], v. 39, n. 4, p. 763-770, Apr. 2007.

[70] GEELS, 2002.

[71] NELSON, R. R.; WINTER, S. G. An evolutionary theory of economic change. Cambridge, MA: Harvard University Press, 1982.

[72] FAGERBERG, 2015.

[73] GEELS, 2020.

[74] PORTER, M. E. The competitive advantage of nations. New York: The Free Press, 1990, p. 45.

[75] PORTER, M. E. Clusters and the new economics of competition. Harvard Business Review, [Boston, MA], v, 76, n. 6, p. 77-90, Nov./Dec. 1998. p. 84.

determinants of competitiveness are interdependent, and this systemic nature links thriving industries through vertical and horizontal relationships[76].

> *Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs. Finally, many clusters include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations – that provide specialized training, education, information, research, and technical support*[77].

This description makes it possible to identify the points of contact between the models (Table 4). They commonly recognize the importance of interaction between different types of organizational actors. Despite the merit of the other three models, this research opted for the innovation system. The MLP is more commonly used in studies focused on the transition of the technological paradigm and on businesses. The model of helixes brings the notion of the entrepreneurial university as a leading actor for innovation. It reflects its origin in analyses of Silicon Valley and indicates its normative nature. Finally, clustering focuses on competitive advantages and relationships between companies. Thus, the innovation system is broader and more universal, suitable for research in the field of public administration, and better adaptable to the reality of different contexts. Moreover, no element is lost, as the innovation system can consider the three main actors of the triple helix model or the actors of a given cluster. Only their weights are not predetermined but will depend on each context.

Table 4: Models to promote innovation

	Innovation systems	Triple helix	MLP	Clusters
Innovation: How?	Systemic and evolutionary interaction among organizations and institutions	Evolutionary and dynamic interaction in a complex network system of relationships with the university, industry, and government	Entry of novelties into the system from the level of niches. The novelties become established when compatible with the above level, the technological regime, and the political-institutional support.	Geographical concentration of competition and collaboration between related companies and/or between support industries

Source: Elaborated by the authors based on Lavén[78]

[76] LAVÉN, F. Organizing innovation: how policies are translated into practice. 2008. Thesis (Doctoral of Business, Economics and Law) – Göteborg University, Göteborg, 2008; PORTER, 1990.

[77] PORTER, 1998, *op. cit.*, p. 78.

[78] LAVÉN, 2008, p. 77.

Having addressed the most used theoretical approaches to innovation policies, we inquire which objects or subtopics have been attracting research attention in this field and how the literature on the subject has developed. This study adopts the innovation systems approach, and the concept of innovation policies reflects this choice. It focuses on the systems, networks, and relationships among institutions involved in innovation. In addition, it is possible to cluster research dedicated to policy instruments[79], research that discusses the determinants of innovation processes[80], and research dedicated to the description and analysis of EU[81] innovation policy, of groups of countries[82], or case studies of specific countries[83].

One of the important sub-themes is innovation policy instruments since exemplifying these instruments helps clarify the understanding of the policies. The list of instruments synthesized in Table 5 may have additions due to the creativity of public policymakers, and it is not exhaustive.

In this sense, the most recurrent instruments identified in the literature can be divided into six categories: Public Innovation and Development (I&D); promotion of academia-industry collaboration; encouraging technology and knowledge transfer; direct support to private I&D; tax incentives; venture capital funds[84]. As direct instruments, one can identify public I&D, direct support to private I&D through public funding and public procurement or other demand-driven innovation policies. Indirect categories can be promoting academia-industry collaboration; encouraging technology and knowledge transfer; tax incentives; government-funded venture capital funds.

[79] EDQUIST *et al.*, 2015; MAZZUCATO, M. The Entrepreneurial State: debunking public *vs*. private sector myths. London: Anthem Press, 2014.

[80] BERGEK, A. *et al.* Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. Research Policy, [Amsterdam], v. 37, n. 3, p. 407-429, Apr. 2008; EDQUIST, C. (ed.). Systems of innovation: technologies, institutions and organizations. London: Routledge, 1997; EDQUIST, C. Systems of innovation: perspectives and challenges. *In*: FAGERBERG, J.; MOWERY, D.; NELSON, R. (ed.). The Oxford Handbook of Innovation. New York: Oxford University Press, 2005, p. 181-208; GALLI, R.; TEUBAL, M. Paradigmatic shifts in national innovation systems. *In*: EDQUIST, C. (ed.). Systems of innovation: growth, competitiveness and employment. London: Pinter, 1997, p. 342-364; MCKELVEY, M. Using evolutionary theory to define systems of innovation. *In*: EDQUIST, C. (ed.). Systems of innovation: growth, competitiveness and employment. London: Pinter, 1997, p. 200-222.

[81] CARAYANNIS, E. G.; KORRES, G. M. (ed.) The innovation Union in Europe: a socio-economic perspective on EU integration. Cheltenham, UK: Edward Elgar, 2013.

[82] EDQUIST; HOMMEN, 2008, p. 1-28; FAGERBERG, J. Innovation systems and policy: a tale of three countries. Stato e Mercato, [Bologna], n. 106, p. 13-40, Apr. 2016; MAKÓ; ILLÉSSY, 2015.

[83] HALL, P. A.; LÖFGREN, K. Innovation policy as performativity: the case of Sweden. International Journal of Public Administration, [London], v. 40, n. 4, p. 305-316, 2017; LAVÉN, 2008.

[84] Capital de risco, capital empreendedor, capital de investimento ou capital de ventura. Opta-se por utilizar os termos como sinônimos, todas possíveis traduções para *Venture Capital Funds*. EDQUIST *et al.*, 2015; FAGERBERG, 2015; MAZZUCATO, 2014.

Table 5 : Public policy instruments

Type of instrument	Direct	Indirect	Description
Public I&D	X		Universities, public research institutes
Academia-industry collaboration		X	Including policies for creating clusters with the participation of academia and industries; policies to encourage collaboration
Workers education/training		X	Policies for education and professional training
Technology and knowledge transfer		X	Including spin-off measures, entrepreneurship policies, consultancy, and technical services
Private I&D	X		Direct support to private I&D and business innovation
Tax incentives for I&D		X	Differentiated rates, non-incidence, exemptions, or tax deductions
Venture Capital Funds		X	Funded by the government
Demand-oriented innovation policies	X		Public procurement, innovation inducement prizes, and similar instruments

Source: Elaborated by the authors

Among the instruments above, the literature review showed that the latter has recently received more attention, referring to demand-driven innovation policies[85]. The terms used to refer to these instruments have not been consolidated yet. The terms are broad-based innovation policies, systemic innovation policies, a demand-pull view, demand-oriented policy instruments, public procurement for innovation, pre-commercial procurement and, even more broadly, holistic innovation policies[86].

In a holistic approach to innovation policies, each of the five main NIS processes should be complementary, as the delay of one can compromise or delay the entire system. Thus, knowledge only makes sense and can be used if there is demand, funding, skills, and institutions. The same logic applies to any of the other processes.

It turns out that, in general, research on innovation policy in the EU has been sparse, approaching various and discontinuous themes. Another feature is the significant influence of practice to direct research themes, and precisely because of this influence, studies on the so-called regional innovation system have been common recently.

Regional innovation policy studies can be seen as studies of innovation systems, which can turn to NIS or research and innovation strategies for smart specialization (RIS3). Some still consider regional studies as a mixture based on the systemic view but add the importance of proximity and interorganizational geographic relationship, brought from clustering and the triple helix, for innovation development[87].

In recent years, there have been more investigations on the evolution of innovation policies from a historical perspective, but the number of studies is still timid and does not represent a clear trend. According to González-López and Guntín-Araújo, "the majority of evolutionary research on innovation policies

[85] EDQUIST *et al.*, 2015; FAGERBERG, 2015: MAZZUCATO, 2014; MAZZUCATO, M. Economia de missão: um guia ousado e inovador para mudar o capitalismo. Lisboa: Bertrand, 2021.

[86] EDQUIST *et al.*, 2015; FAGERBERG, 2015.

[87] BOROWIK, I. M. Knowledge exchange mechanisms and innovation policy in post-industrial regions: approaches of the Basque Country and the West Midlands. Journal of the Knowledge Economy, [Berlin], v. 5, n. 1, p. 37-69, Mar. 2014.

starts from a normative and theoretical point of view, and in very few cases is based on empirical studies."[88] These research works took place at the European, national, or regional level of analysis and represented case studies of a specific country or region and comparative studies.

These studies point out replicable lessons about the evolutionary changes in the last decades of the innovation policy in a specific region, such as the Basque Country[89], Galicia[90], or Wales[91]. Research on the Basque Country was one of the first empirical studies to use path dependence analysis tools applied to the development of science, technology, and innovation policies in support of RIS3 policies. It pointed out the advantages and disadvantages of the previous experience of Basque innovation policies for the development of subsequent policies. In common, the three studies (Basque Country, Galicia, and Wales) used the literature on path dependence and the theoretical framework of historical institutionalism. As for differences observed in the studies, the first operationalized the analysis of continuity and change of innovation policies, the second used the coalition of interests, and the third presented regional studies and economic geography.

It was possible to identify the emergence of research adopting a historical and comparative perspective about Estonia, Latvia, and Lithuania between 1989 and 2010[92]. The analysis was extended to three countries, but the object was restricted to one specific sector of innovation policy, the scientific research funding policy. The analysis addressed how different national trajectories in this area emerge and differ over time. One of the contributions is to combine historical institutionalism with the phenomenon of institutional Europeanization.

The research by Karo and Looga on Slovenia and Estonia also stood out. The authors compared the two countries in their institutional changes of economic restructuring and their innovation policies[93]. The study contributed to emphasize the importance of the political-administrative context (or the institutional setting of the design) and the relevance of implementing the public policy and including frameworks of the new institutionalism (called discursive). Finland and the UK were the objects of a comparative study that combined transport and innovation policies, called "innovation system in transport." The study was based on the literature on the path dependency relationship (both at the institutional and at the public policy level) with technological expectations and images of the policy problem[94].

V. CONCLUSION

The Lisbon Strategy (2000-2010) and the Europe 2020 Strategy (2010-2020) are two EU economic and social development programs that stand out for promoting innovation and mark three distinct phases of the evolution of incentive policies. The last one of these phases is recognized by the focus on institutional interrelationship, incentives for non-technological innovation, the trend toward decentralization, and the effort toward greater coordination of innovation policies and collaboration between the actors involved.

On the side of state governance, initiatives to promote public procurement are reflected in the recent literature on the subject.

[88] GONZÁLEZ-LÓPEZ, M.; GUNTÍN-ARAÚJO, X. Evolution of the Galician innovación policy: from zero to smart specialization. Revista Galega de Economía, [Santiago de Compostela], v. 28, n. 2, p. 23-38, 12 Sept. 2019. p. 25.

[89] VALDALISO, J. M. *et al.* Path dependence in policies supporting smart specialisation strategies: insights from Basque case. European Journal of Innovation Management, [Bingley], v. 17, n. 4, p. 390-408, Oct. 2014.

[90] GONZÁLEZ-LÓPEZ; GUNTÍN-ARAÚJO, 2019.

[91] HENDERSON, D. Policy path dependency in a less developed region: the evolution of regional innovation policy in Wales (UK). Revista Galega de Economía, [Santiago de Compostela], v. 28, n. 2, p. 39-52, 12 Sept. 2019.

[92] TÕNISMANN, T. Paths of Baltic States public research funding 1989-2010: between institutional heritage and internationalisation. Science and Public Policy, [New York], v. 46, n. 3, p. 391-403, June 2019.

[93] KARO, E.; LOOGA, L. Understanding institutional changes in economic restructuring and innovation policies in Slovenia and Estonia. Journal of International Relations and Development, [London], v. 19, n. 4, p. 500-533, Oct. 2016.

[94] UPHAM, P.; KIVIMAA, P.; VIRKAMÄKI, V. Path dependence and technological expectations in transport policy: The case of Finland and the UK. Journal of Transport Geography, [Amsterdam], v. 32, p. 12-22, Oct. 2013.

The two main theoretical approaches for understanding innovation and policies that promote it originate from neoclassical economics and evolutionary or neo-Schumpeterian economics and inform, respectively, the linear and systemic views of the phenomenon of innovation, whose understanding is essential for policy design.

In public policy and its intersection with law, the most widespread interdisciplinary approach is evolutionary, which shares the theoretical framework of the new sociological and historical institutionalism. According to the evolutionary approach, innovation occurs within a national system, evolves throughout history, and shows characteristics of being path-dependent. Other institutionalist and evolutionary models were identified alongside the innovation systems model, such as the triple helix, multilevel perspective, and clustering models.

Research on innovation policy is dispersed, addressing varied and discontinuous topics. Another feature is the significant influence of practice to direct research themes, and precisely because of this, works on the so-called regional innovation system have been common recently. Although there have been more studies on the evolution of innovation policies from a historical perspective in recent years, they are not as many, so it is unclear if this perspective represents a trend.

Considering the frontier of research on innovation policy in the EU, there is recent research from historical and comparative perspectives. There is evidence of studies on specific regions, such as the region of the Basque country, Galicia, Wales, or studies on countries such as Estonia, Latvia, Lithuania, Slovenia, Finland, and the UK, more often comparative studies, with emphasis on the use of theoretical tools of historical institutionalism.

Studies on innovation policies benefit from the application of the literature on innovation systems. Such approaches should be expanded as a research agenda due to their explanatory power, requiring more interdisciplinary studies in the literature that combine this approach with legal analyses of regulation and the promotion of innovation.

The research limitation lies, on the one hand, in the decision to adopt bibliographic research that addressed neo-institutionalist frameworks of public policies to promote innovation; on the other hand, in the nature of the systematic and narrative review. In the first case, the knowledge extracted from the studies is subject to selection bias, even when trying to minimize arbitrariness. In the second, the choice of descriptors (words and phrases) may unintentionally exclude relevant literature. Future research could expand the selection to other theoretical strands and time frames.

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Social Communication and its Development in the Knowledge Society in Times of the Digital Age

Garrit Geneteau

University of Panama

SUMMARY

To speak of social communication means to refer to man himself. Its origin is as old as the human being. Hence, communication is based on signs and sounds. However, language is its main characteristic. An element that has evolved throughout the history of the individual.

Therefore, in the twentieth century, social communication takes on academic importance, after establishing itself as a discipline and emerging as a science. Not in vain the evolution of technology has made the communication channels used a few decades ago, are almost obsolete compared to broadband communication that allows to establish contact in real time with good image and sound quality.

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Therefore, in the twentieth century, social communication takes on academic importance, after establishing itself as a discipline and emerging as a science. Not in vain the evolution of technology has made the communication channels used a few decades ago, are almost obsolete compared to broadband communication that allows to establish contact in real time with good image and sound quality.

In the society of knowledge and technology, the development of society is closely linked to social communication, if we take into account that it is of utmost importance for human growth.

Although the digital age facilitates communication between humans, it brings as a consequence a challenge of equal magnitude: although mobile devices were invented so that man could communicate with other individuals, this has caused a large part of humanity to lose the tradition of talking to other people, while communicating, more and more, through the different digital platforms.

Keywords: communication, receptor emitter, technology & language.

Author: Professor of Journalism Faculty of Social Communication University of Panama.

I. INTRODUCTION

The present study entitled: Social communication and the development of society in times of the digital age, which aims to expose the importance of social communication in the development of the human being, presents a methodological design where the study of the problem is exposed.

The first part of the research development, Social communication, exposes the background of communication from the appearance of man, how it has evolved through history, until reaching our days, in the digital age.

Social communication in recent years has gained strong growth, especially in digital publications, together with the prominence and growing increase of social networks, which combined constitute a powerful media element and good support as long as they are used properly.

In the professional and scientific field, social communication has an ally in journalism, through which it is used to disseminate content and captivate public opinion. Therefore, the future of journalism is digital. An example of this are social networks that have become a hotbed of information, which in many cases end up being news.

Likewise, this study analyzes the challenges of social communication in a technological context compared to traditional communication, through radio, television and the press, conventional channels of dissemination of the message.

After the presentation of the first part of the research, the analysis is moved on to interpretation, which takes into account the evolution of technology that has caused some

communication channels to be outdated, in favor of digital communication.

In the second part of the investigation, Development in society, human development is weighted as a key factor in today's society, where social communication becomes important to achieve political, economic, educational goals, among others.

In the twentieth century, the concept of communication for development appeared, which addresses a series of communication strategies that are applied to the so-called Third World countries with the aim of improving their living conditions. This concept was based on the fact that the media had important effects that could lead to the economic development of nations and, as a consequence, bring about social change.

Not surprisingly, communication for development refers to the type of communication that must be intentionally directed and systematically planned to changes in society, institutions and individuals. Meanwhile, development communication is linked to the media, because they have the capacity to create a favorable public atmosphere for social change, an important factor for the modernization of societies.

The research also provides a graphic cake where the results of the study are exposed, and closes with an analysis of results and discussion, a conclusion and bibliographic references.

II. METHODOLOGICAL DESIGN OF THE STUDY

2.1 Problem Statement

In the digital age, social communication, as a key factor for social development, becomes important, but the debate also arises about what is the correct way to communicate: should communication continue to be expressed through its traditional channels such as speech or should it be virtual, giving way to technology?;

Is traditional communication compatible with technological communication?; Is virtual communication adequate for today's social development?

This research is focused on the study of this problem, which covers social communication from its dawn, with the appearance of man, to the present, in the digital age.

2.2 Justification

The importance of carrying out this research entitled: Social communication and the development of society in times of the digital age, lies in contributing to the clarification of how to communicate, regardless of the channel used: traditional or virtual, taking into account the impact on social development. In other words, social communication is of paramount importance for the knowledge and technology society.

2.3 Objectives

2.3.1 General objectives

Know the importance of social communication in human development.

2.3.2 Specific objectives

- Explain what traditional communication and virtual communication consist of.
- Describe the most important consequences of the use and abuse of virtual communication.
- Analyze social development in a context of virtual communication.

2.4 Scope of the Study

Through this research, Social communication and the development of society in times of the digital age, the scope of social communication is explored, from the traditional to its technological expression.

Consequently, this study is linked to the debate on the different forms of social communication that human beings have experienced throughout history.

2.5 Limitations

The scheduled period for the collection of information on the study topic is one month, from May 1 to 31, 2019. Also, the lack of research on the subject to establish a comparison and thus measure its consequences, is another factor that limits this research.

2.6 Methodology

To carry out this research, a survey was used as an instrument for searching and collecting information, with five (5) questions, formulated with the aim of inquiring about social communication and the development of society in the digital age.

In addition, to present the theoretical framework, books, articles on the Internet and publications of newspapers and magazines were consulted.

2.7 Social Communication

Social communication has existed since the appearance of man on earth. Despite this, several theories have been recorded about the origins of communication and how language has evolved throughout history.[1]

Since its inception, "communication has always been based on sounds and signs, but language is the most obvious characteristic that distinguishes man from other animals."[2]

There is no doubt that the development of written communication was in the invention of the printing press of the German Johannes Gutenberg (1440). It was thus that from the fifteenth century the knowledge was registered so that it reached the whole world massively. Meanwhile, communication as a science emerged

For the sophists what was important was the power of the word in society, while Plato suggested a rhetoric based on true knowledge and not on argumentative tricks, since he considered language as an imperfect means of expression, because it distorted reality. Aristotle, for his part, offered an alternative position: true knowledge as a product of analysis and reasoning.[4]

In the seventeenth century, the celebrated English philosopher Francis Bacon offered the framework for a "new science" based on inductive reasoning and empirical observations. Scientific studies of communication during this century initiated the speaker movement, which became the hotbed of communication study in America in the late 1800s.[5]

In the twentieth century, communication was established as a discipline and emerged as a science, product of the union of oratory and the field of language, also supported by rhetoric, which intensified his research.[6]

During the last half of the twentieth century and the beginning of the twenty- first century, communication studies have consolidated a debate in the scientific and professional field. The institutionalization of communication knowledge has important implications. For example, the evident transformations in terms of communicators in today's society; the integration of social communicators in work teams for very diverse areas beyond traditional mass media; the current debates and innovations

[1] Wright, A. Background to Communication. Antecedentes.org. Retrieved from: https://antecedentes.org/comunicacion/
[2] Wright, A. (1)
[3] Wright, A. (2)
[4] Villanueva, R. Theory of mass communication: stages of the development of human communication. Retrieved from:https://rociovillanuevamollo.wordpress.com/2009/01/26/el-desarrollo-historico-de-la-comunicacion-como-ciencia/
[5] Villanueva, R. (1)
[6] Villanueva, R. (2)

on communication regulations and policies in Latin America.[7]

In the 30s the first classical school dedicated exclusively to the study of social communication was created. Since then, the systems with which people communicate have evolved in recent decades with the development of technologies and the internet. An example of this is that, today, traditional media such as radio, television and the written press have joined instant messaging services such as the WhastsApp or video calls that allow people to connect from different locations on the planet, not only with voice, but also through the image at low cost.

Therefore, the evolution of technology has made some communication channels widely used a few decades ago, are outdated in favor of broadband communication that allows real-time contact with good image and sound quality, unthinkable just a few years ago. Not in vain human communication has been transformed throughout humanity in parallel with technological development.[8]

Although the digital age facilitates communication between humans, it brings as a consequence a challenge of equal magnitude: although mobile devices were invented so that man could communicate with other individuals, this has caused a large part of humanity to lose the tradition of talking to other people, while communicating, more and more, through the different digital platforms. [9]

The problem arises as a result of the amount and speed of information to which people are exposed today. Information saturation. Publications such as Forbes magazine warn that the excess of information leads to the "automation of our feelings, which causes us to lose sensitivity to people and what surrounds us. Today it is very common to see in any boardroom, in any company, people who do not communicate, and while everyone arrives and starts the meeting, the participants are immersed in their phones and nobody pays attention. "

On the other hand, the multiplication of the supply of new media leads to the fragmentation of audiences and new media consumers, who devote less time to television and more to the internet, for example.

Currently, one of the forms of social communication is through journalism. The Spanish newspaper El País, in its edition of April 20, 2016, mentions that "in a highly globalized world and subject to the changes that new technologies bring about, it is a reality that for some time journalism has been undergoing a strong reconversion. Digital journalism has been in the media landscape for just over a decade, but in a short time it has managed to overshadow its biggest competitor: the giant of the written press on paper, which enjoyed a considerable audience and dissemination.[10]

This is how social communication in recent years has gained strong growth, especially in digital publications, "together with the prominence and growing increase of social networks, which combined constitute a powerful media element and good support as long as we use them properly".[11]

2.8 Development in Cociety

Today, it is common to associate the idea of social development with that society that enjoys access to diverse goods and services, which is democratic and participatory, egalitarian and equitable. A society in which its inhabitants have

[7] Massoni, S. Communication as a scientific discipline. Trends21. Retrieved from: https://www.tendencias21.net/fluido/La-comunicacion-como-disciplina-cientifica_a183.html

[8] Herrera, M. (2017). Human communication in the digital age. Forbes. Mexico. Retrieved from: https://www.forbes.com.mx/la-comunicacion-humana-en-la-era-digital/

[9] Herrera, M. (1)

[10] Pérez Blanco, P. (2016). Journalism in the digital age. The Country. Spain. Retrieved from: https://elpais.com/elpais/2016/04/13/opinion/1460540302_620130.html

[11] Perez Blanco, P. (1)

equal opportunities and where there is a certain homogeneity in their living conditions. [12]

As for the knowledge society, development in society has come to occupy a central place in the current discussion of the social sciences, since it summarizes the social transformations that occur in modern society, while offering a vision of the future. Proof of this is Latin America, where significant efforts have been made to increase educational opportunities, which has led to coverage rates in primary education, on average, being very high, above 90%, similar to the level of the most economically developed countries, such as those that make up the Organization for Economic Cooperation and Development (OECD).[13]

One of the keys to social development is social communication, if one takes into account that it has a decisive importance in human growth. Thanks to rapid advances in technology and communication techniques, it can be said that, today, the world is in the era of telecommunications at the service of social development.[14]

Social communication, in a technological context, allows people belonging to different social groups within a community to exchange information and ideas in a positive and productive way. In this sense, social communication becomes more important when it is linked to the development of society.[15]

In the twentieth century, the concept of communication for development appeared, which addresses a series of communication strategies that are applied to the so-called Third World countries with the aim of improving their living conditions. This concept was based on the fact that the media had important effects that could lead to the economic development of nations and, as a consequence, bring about social change. [16]

From the 50s, the media began to be used systematically to promote social development. After the Second World War, new independent nations appeared that became targets of the expansionist policies of the world powers in the economic field. The countries of the Third World were the fundamental objectives of the development plans that began to be developed from international organizations such as the UN, the World Bank, UNICEF, UNESCO, UNDP, FAO, among others, where the key tool was the media.[17]

Not surprisingly, communication for development refers to the type of communication that must be intentionally directed and systematically planned to changes in society, institutions and individuals. Meanwhile, Bolivian journalist Luis Ramiro Beltrán believes that development communication is linked to the media, because they have the ability to create a favorable public atmosphere for social change, an important factor for the modernization of societies.

In Latin America there are three fundamental models of communication for social development, whose approach varies depending on the conception of development on which it is based and, of course, the role that the media should have in this process, which are: Liberal-Causal model, Marxist-Socialist model and Monistic emancipatory model. [18]

[12] Márquez Jiménez, A. (2017). Education and development in the knowledge society. Scielo. Mexico. Recovered from: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0185- 26982017000400003

[13] Marquez Jiménes, To. (1)

[14] Marquez Jiménes, To. (2)

[15] Marquez Jimenez, To. (3)

[16] Ferrer, A. (2002). Science journalism and development: A view from Latin America. Dissertation.

[17] Ferrer, To. (1)

[18] Sedano, V. (2007). Causes of citizen absenteeism in the municipal Participatory Budget from a communication for development approach. Bachelor Thesis. UAP. Lima, Peru.

The Liberal-Causal model establishes a cause-effect relationship between communication and development. That is, it argues that the introduction of technology and the issuance of certain messages would have an effect on economic growth, thus creating a motivation for change and innovation, leading to the transformation of traditional society to modern one. The proposal of this model points towards a westernized and capitalist society.[19]

Meanwhile, the Marxita-Socialist model maintains a direct relationship between communication and development, while differing from the previous model in the role given to the media in the process. Therefore, the media are considered key elements in the dissemination of ideology, being used for political propaganda and the mobilization of the masses.[20]

The emancipatory Monistic model demonstrates that social media and technology are necessary tools for social development, but not sufficient to bring about social change. This model focuses more on the specific needs of the target populations, encouraging their participation in the development projects themselves. On the other hand, in addition to favoring economic and political development, it aims towards autonomy and identity to nations, promoting their social and cultural development. [21]

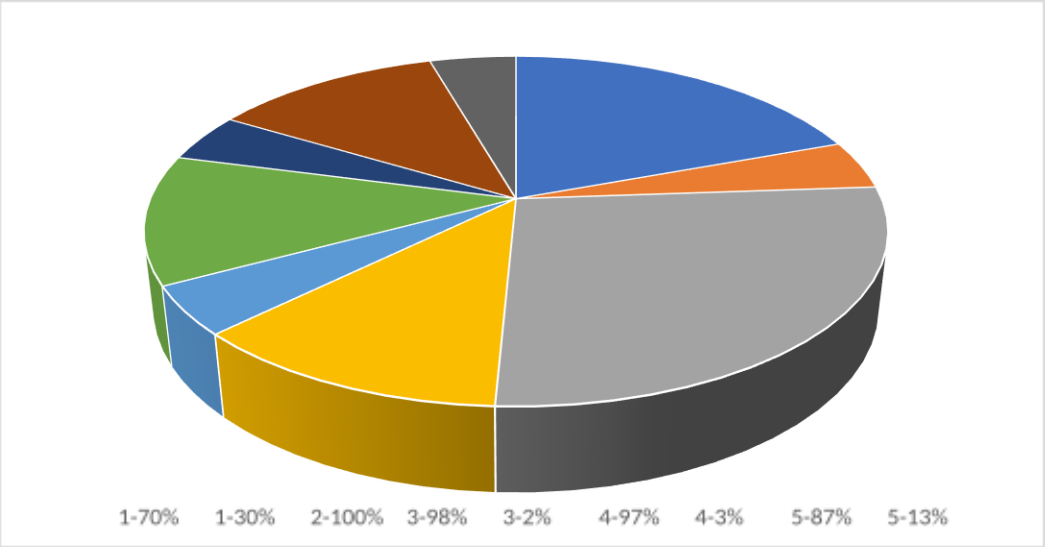
Rafael Obregón, professor of communication and social development at Ohio University, argues that "communication and development is a young discipline, but at the same time full of profound transformations in its definition and application. For those who begin to explore the relationship of communication with social development, it is essential to understand its background and conceptual evolution, to know the criticisms, successes and advances, as well as to explore the most recent trends and debates.

Obregón asserts that development is not an exclusive element of politics, economies or modernity. "Social development is proper to all the internal and external actions that humans undertake daily with the aim of achieving a standard of living that satisfies their ideals of existence."[22]

[19] Sedano, V. (1)
[20] Sedano, V. (2)
[21] Sedano, V. (3)

[22] Obregón, R. (2007). Communication, development and social change. Communication Portal. Retrieved from: http://www.portalcomunicacion.com/lecciones_det.asp?id=49

III. RESEARCH RESULTS SURVEY



1. Is social communication developed through journalism?

   Yes: 70% No: 30%

2. Is social communication essential for the development of society?

   Yes: 100%

3. Has social communication, in times of the digital age, evolved?

   Yes: 98% No: 2%

4. In times of the digital age, does social communication shorten distances, but isolate individuals?

   Yes: 97% No: 3%

5. Is it positive that while there is more communication in the digital age, real- time social contact is lost?

   Yes: 87% No: 13

IV. RESULTS AND DISCUSSION

After completing the research entitled: Social communication and the development of society in times of the digital age, We present the results and discussion based on the survey carried out among the students of the School of Journalism of the University of Panama.

As explained in the study, social communication is developed through journalism as one of its most widespread channels. 70% of the students said they agreed with this argument, while 30% said no.

On the other hand, social communication is essential for the development of society. Without social communication, human beings simply could not communicate. Faced with this approach, 100% of respondents said they agreed.

Undoubtedly, in times of the digital era, social communication has had a remarkable evolution, if we take into account that we currently talk about traditional communication and digital communication. 98% of respondents considered that social communication has indeed developed in recent decades, while 2% thought it has not.

In the context of digital communication, distances are shortened, however, individuals are isolated. 97% of respondents acknowledged that they did. Meanwhile, 3% said no.

After the presentation of the study, it has been made clear that it is not positive that while there is more communication in the technology society, social contact is lost in real time. 87% of students agreed with this position, while 13% said no.

V. CONCLUSION

Currently, in the XXI century, there are differences with classical communication: sender-receiver. One of the modifications that we can observe is that the channel as a means of communication has changed considerably.

Today, we communicate much more through social media than in person. This causes the communication between the sender and the receiver to be modified. With the use of technology, facial expressions, body expressions, intonation, silences or many other factors that influence communication cannot be observed. In that sense, is communication through social networks poorer?

Yes. However, through social media we feel much freer and less intimidated as we would be in front of someone. In this type of communication also enters the factor about what is true and what is not, since perhaps the receiver, who is behind a profile, is not who he claims to be in reality.

Undoubtedly, in the twenty-first century there is no longer talk of traditional social communication. In the digital age, the type of communication we face is indirect, informal. And, in some cases, it could become dangerous, if you take into account that, many times, we are not prepared for all the dangers that may occur in a social network.

New ways of communicating have a strong impact on the development of society. In this regard, whether we like it or not, social development today revolves around the digital age. New technologies are carrying out profound changes and transformations of a society that moves in a globalized world.

These changes represent a real revolution that we have to live, despite the fact that many people have not realized what we have on top. The digital age is here to stay. Meanwhile, social development is manifested through a technological revolution: internet, computers, devices, chat, forums, blogs, digital media, that is, the language, life, customs of many people have been transformed to give way to a digital culture.

After the technological flood, the social challenge is to assimilate the change in relation to knowledge, attitudes and skills. It is necessary to take advantage of the digital world, where education plays an important role.

In this context of communication, the receiver has mutated from using the media to living in it. What we used to do was sit and watch TV, turn on the radio or read the newspaper. But now using the media is like using an object. Therefore, much of our lives happen in the media, especially those that are mobile and intelligent.

We are permanently connected. It is no longer a discreet activity, but something that happens at all times, in all places. The digital world has become a third environment in people's lives.

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