Epistemology and Educational Sciences: Classic Epistemological Concepts in the Construction of Dissertations

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ABSTRACT

This paper aims to address a training experience in the area of education related to classic epistemological concepts, that is, related to the production and legitimation of scientific knowledge. It refers to the extracurricular discipline "Logic and Methodology of Social Sciences" taught in the Postgraduate Program in Education of Unochapecó at the beginning of 2020. Most of the participants were master's students in the Stricto Sensu Postgraduate Program in Education of Unochapecó, but there were also participants from other stricto sensu graduate programs of the institution, such as Health Sciences, as well as students from other universities in the region. The course was intended to be original in the sense that instead of focusing on theoretical aspects and typical discussions of epistemology, it directed attention to the practical applications of these ideas in the construction of a master's thesis. This paper describes that experience, exposes the pedagogical strategy used to achieve the objective of the course and evaluates its results. Thus, the article will begin with a description of its theoretical-methodological framework, then it will present the selected epistemological concepts with a focus on their usefulness for the construction of the thesis and in the partial evaluations carried out by the students and, finally, the definitive results will be presented.

KEYWORDS

Epistemological conceptions. Scientific knowledge. Human sciences. Research. Education.

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Epistemologia e Ciências da Educação: Conceitos Epistemológicos Clássicos na Construção de Dissertações

RESUMO

O presente artigo tem como objetivo abordar uma experiência de formação na área da educação referente às concepções epistemológicas clássicas, ou seja, relacionadas à produção e legitimação do conhecimento científico. Faz referência ao curso de extensão "Lógica e Metodologia das Ciências Sociais" ministrado no Programa de Pós-Graduação em Educação da Unochapecó o início de 2020. A maioria dos participantes era de mestrandos do Programa de Pós-Graduação *Stricto Sensu* em Educação da Unochapecó, mas também havia participantes de outros cursos de pós-graduação *stricto sensu* da instituição, a exemplo de Ciências da Saúde, além de estudantes de outras universidades da região. O curso pretendeu ser original no sentido de que ao invés de focar nos aspectos teóricos e discussões típicas da epistemologia, direcionou a atenção para as aplicações práticas dessas ideias na construção de uma dissertação de mestrado. Este artigo descreve essa experiência, expõe a estratégia pedagógica utilizada para atingir o objetivo do curso e avalia seus resultados. Assim, o artigo iniciará com uma descrição do seu referencial teórico-metodológico, em seguida apresentará os conceitos epistemológicos selecionados com foco na sua utilidade para a construção da tese e nas avaliações parciais realizadas pelos alunos e, por fim, serão apresentados os resultados gerais.

PALAVRAS-CHAVE

Concepções epistemológicas. Conhecimento científico. Ciências humanas. Pesquisa. Educação.

Epistemología y Ciencias de la Educación: Conceptos Epistemológicos Clásicos en la Construcción de Disertaciones

RESUMEN

Este artículo tiene como objetivo abordar una experiencia de formación en el área de la educación relacionada con los conceptos epistemológicos clásicos, es decir, relacionados con la producción y legitimación del conocimiento científico. Se refiere al curso de extensión "Lógica y Metodología de las Ciencias Sociales" impartido en el Programa de Postgrado en Educación de Unochapecó a principios de 2020. La mayoría de los participantes eran estudiantes de maestría en el Programa de Postgrado Stricto Sensu en Educación de Unochapecó, pero también hubo participantes de otros posgrados stricto sensu de la institución, como Ciencias de la Salud, así como estudiantes de otras universidades de la región. El curso pretendía ser original en el sentido de que, en lugar de centrarse en aspectos teóricos y discusiones típicas de la epistemología, dirigió la atención a las aplicaciones prácticas de estas ideas en la construcción de una tesis de maestría. Este artículo describe esa experiencia, expone la estrategia pedagógica utilizada para lograr el objetivo del curso y evalúa sus resultados. Así, el artículo comenzará con una descripción de su marco teórico-metodológico, luego presentará los conceptos epistemológicos seleccionados con un enfoque en su utilidad para la construcción de la tesis y en las evaluaciones parciales realizadas por los estudiantes y, finalmente, se presentarán los resultados generales.

PALABRAS CLAVE

Concepciones epistemológicas. El conocimiento científico. Ciencias humanas. Buscar. Educación.

Introduction

The purpose of this paper is to address a training experience of master's students in education related to epistemological conceptions, i.e., related to the production and legitimization of scientific knowledge.

At the beginning of the year 2020, an elective course entitled "Logic and Methodology of Social Sciences" was taught in the Postgraduate Program in Education at Unochapecó for master's students in education in extension mode and therefore open to other postgraduate programs of related subjects. Most of the enrollees were from the education area of the Unochapecó program, but there were also enrollees from other study houses in the region and, what was remarkably interesting, a group of enrollees from the master's program in Health Sciences. This diversity gave the course an interesting nuance because the professionals specializing in health sciences came from disciplines linked to the natural sciences and even hard sciences such as pharmaceuticals. This initially unforeseen presence and the approach of the course that we will present below gave the possibility of comparing in the classroom the different epistemological approaches of social sciences such as education on the one hand, and natural sciences such as biology or hard sciences such as chemistry on the other.

The focus of the course was intended to be original in the sense that, rather than focusing on the typical theoretical aspects and discussions of social science epistemology (SERNA DIMAS, 2012), attention was directed towards the practical applications of these ideas when constructing a master's dissertation. Epistemology is a meta-scientific discipline (GAETA; ROBLES, 1990), that is, the object of study on which it reflects is scientific knowledge. It is a philosophical discipline in which conceptual discussions prevail, such as: what is the difference between scientific and non-scientific knowledge, what differentiates social sciences from natural sciences and the latter from formal sciences such as mathematics and logic, what is the correct method for producing scientific knowledge and whether this method is the same or not in the different areas of knowledge. These topics are relevant for those who begin their studies in any scientific area, so there is usually always some discipline related to epistemology that addresses these issues both in undergraduate and graduate courses in most areas of knowledge.

However, a problem that we identified in our contact with master's students was that it was not easy for them to link these concepts and discussions, sometimes subtle and extremely complex, with the construction of their research and with their master's dissertation. In practice the construction of the dissertation is learned with the advisors, and it was not easy to connect this practice with the epistemological conceptions they saw in their courses.

This motivated us to conduct a brief, but intense course focused on explaining the usefulness of some of the classical concepts of epistemology, linking them and putting them into practice in the students' own research that participated in the course. That is, linking

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theory and practice in a know-how (FARIAS, 2009). This article describes this experience, exposes the pedagogical strategy used to achieve the objective of the course and evaluates its results.

Therefore, the article will begin with a description of the theoretical and methodological framework of the course, then it will present the selected epistemological concepts focusing on their usefulness for the construction of the thesis and the partial evaluations made by the students, and finally the results will be presented, and conclusions will be drawn.

Methodology and Theoretical Framework

The methodological strategy adopted to develop the experience was as follows: Four central epistemological concepts were defined around which the science methodology course was developed. They were selected based on what we identified as useful concepts and of application in a master's level research. Their usefulness lies in the fact that they allow a conceptual understanding of scientific activity, but also serve to organize the work, understand the stages of research, how to carry them out and the relationship between them.

These concepts were: 1) the master's dissertation as the construction of a complex reasoning; 2) the problem-hypothesis-test sequence as a scheme for the construction of an investigation; 3) the idea of empirical basis[1] as the set of propositions used by a scientific community to refer to the reality it intends to address; 4) the idea of fragmentation of schools and the variety of theoretical frameworks in the social sciences, as well as the difficulty in defining them.

In the course, students were asked to think about their research papers based on the proposed concepts and the authors addressed: reasoning (COPI; COHEN, 2013); problem, hypothesis, test (HEMPEL, 1983); empirical basis (POPPER, 1980); diversity of theoretical frameworks (KUHN, 2004), in order to assess whether they already had these aspects addressed and well defined in their research or whether they could improve any of them or even reformulate them. In the last meeting, a space was given for individual exposition and analysis of the students' research in terms of the concepts studied.

After a reasonable time had elapsed for the concepts to decant in the research, a semi-structured interview (VARGAS JIMÉNEZ, 2012) was conducted with the students who concluded the course, so that they could evaluate the impact of the course and the concepts studied in their own research. This consisted of an evaluation of the impact on each student's research of each of the topics addressed with the methodology proposed in the course, four levels or degrees of influence were determined: 1) No significant influence 2) General

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[1] Term adopted by Popper (1980) to refer to the way in which the basic statements with which the scientific community refers to observable reality and with which scientific hypotheses and theories are contrasted are justified.

influence due to greater understanding of the scientific methodology 3) Specific influence because it implied the partial re-elaboration of some aspect of the project 4) Specific influence because it implied the complete re-elaboration of some aspect of the project. Finally, a space was left for the interviewees to make any comments they considered necessary after each evaluation.

To show the results of the research, the four concepts addressed in the course and the students' evaluation of their impact and usefulness in their research will be presented separately. Finally, an overall evaluation of the impact of the course will be made.

Construct a Dissertation as a Complex Reasoning or Argument

One of the important concepts for the classical philosophy of science is that of reasoning. The epistemological discussions initiated during the early twentieth century in the Vienna Circle gave a relevant role to logic and the analysis of the different types of reasoning when conceptualizing the procedure of science to obtain and justify knowledge.

The aim of the course, however, was not to address these discussions in detail, but to present the concept of reasoning in its most general and accepted meaning to analyze its usefulness in the construction of a thesis in human and social sciences in general and educational sciences. Next, we will briefly present the presentation of the concept made in the course, and then focus on the impact or influence it had on the students' work.

Gianella (2002) tells us that a reasoning is a set of propositions or statements in which one of them, called conclusion, is intended to be founded on or inferred from others called premises.

"Reasoning" is usually understood as a synonym for "argument", thus Copi points out that:

> an argument is a group of propositions of which it is said that one of them follows from the others, considered as the basis or foundation of the truth of this one (...) For it to be said that an argument exists, there must be a structure in that set of propositions, a structure that captures or shows some inference. This structure is described using the words premises and conclusion. The conclusion of an argument is a proposition that is asserted based on other propositions in the argument. These other propositions, which are asserted (or assumed) to be supports of the conclusion, are the premises of the argument (COPI; COHEN, 2013, p. 7).

What is the usefulness of this concept for the construction of a thesis or dissertation? The contribution of this idea is significant if we understand that the elaboration of a thesis or dissertation consists of constructing a complex reasoning or argument. Every thesis or dissertation includes at least one conclusion, usually explicitly, since the last chapter is usually precisely that of the conclusions or final considerations. The chapters of the thesis are premises in the sense that their function is to support, sustain or prove the conclusion that, in general, appears in the final chapter. When evaluating a thesis, the analysis of internal

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coherence is crucial; the first reading corroborates the logical coherence between what is proposed in the introduction and the result stated in the conclusion, as well as the consistency of the result with what has been developed in the previous chapters.

Given the scope and length of a graduate thesis, it is important to understand that it is not just a simple reasoning, but one composed of several intermediate reasonings. In general, each chapter of a thesis implies a reasoning with a partial conclusion that will later serve as an argument to support the conclusion; this concatenation gives internal coherence to a work.

However, in the field of human and social sciences, another complexity must be added: reasoning is usually based on different methodologies that need to be explained in the thesis itself, for example, analytical, hermeneutic, dialectic, phenomenological, discourse analysis, etc. methodology. This adds complexity in terms of the "logic" of each methodology, which does not necessarily and strictly correspond to the correctness of the so-called "formal logic" or to the strictly deductive analysis of reasoning. This does not invalidate the assertion that, with these methodologies, complex arguments or reasoning are constructed to prove what will be the conclusion of the thesis. A different question is the standard with which we evaluate these arguments, whether we do so based on a strict formal logic or based on a broader and less strict criterion (MIRÓ QUESADA, 1988). In this sense, the idea of reasoning that we presented in the course was defined in a broad sense: there must be a relationship of justification, that is, of foundation, between what is developed in the thesis and the conclusions reached.

And what happens in practice? research is not usually presented as orderly as we postulate, many times we sense the conclusion first and then we look for the evidence, or on the contrary, some premises appear first and then a conclusion, or first the problem and then other relevant aspects, or the other way around. In short, the process of research and thesis construction does not seem to be so linear and orderly. Research in practice does not seem to happen with the coherence that a well-constructed argument has.

True, the actual process of a research is often more chaotic and less linear and organized than its final product: the well-constructed and articulated argument that constitutes a master's dissertation or a PhD thesis. But that is common to all arguments, Copi points out:

> When psychologists examine the reasoning process, they find it to be overly complex, highly emotional, and consisting of clumsy trial-and-error procedures illuminated by sudden sparks of understanding that are sometimes seemingly unconnected. They are of the utmost importance to psychology. But these obscure paths by which the mind arrives at its conclusions during the actual processes of reasoning are not at all the concern of the logician. He is only interested in the correctness of the process once it is finished. His problem is always the following: does the conclusion he has reached derive from the premises used or asserted? (COPI, 1992, p. 5).

Similarly, to paraphrase the quote, the actual research process, and the work of the master or doctoral student can be highly complex, highly emotional, with trial-and-error procedures and sparks of understanding sometimes seemingly unconnected. However, now of authoring the thesis, it will have to take the form of an understandable and well-structured argument that supports the conclusion reached. It is the moment to give an order to that process that was more systematic and unconnected with respect to its result.

Knowing this logic of the research and knowledge construction process in the social sciences, as well as the uncertainties and discontinuities of the real and creative process of knowledge creation, is useful for those who are starting out in research.
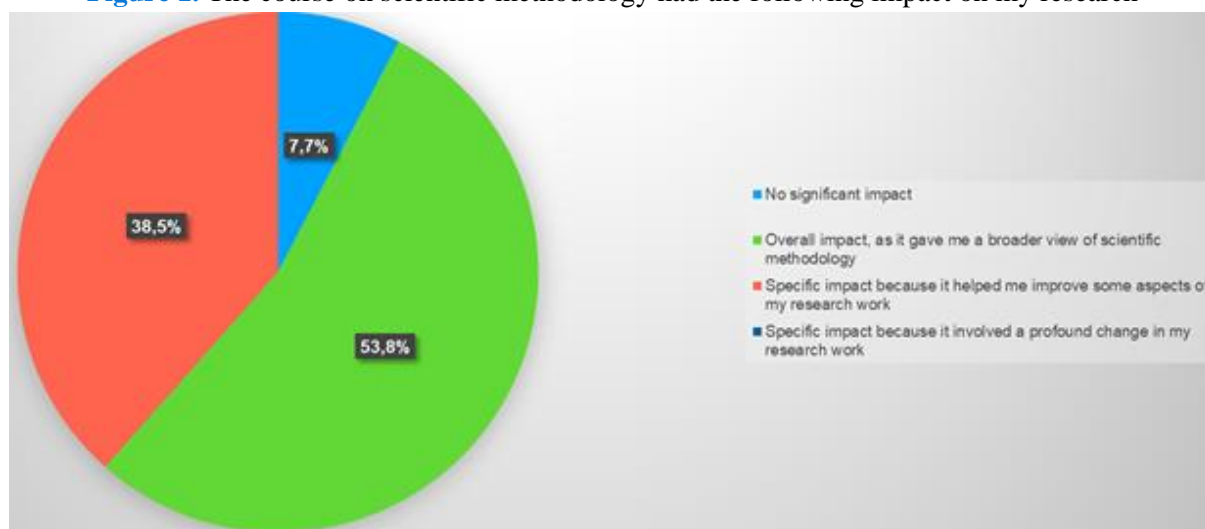
Evaluation Results

In Figure 1 we present a graph showing the results of the students' evaluations. The overall evaluation shows a moderate perception of impact, since ten of the thirteen students who completed the interview chose to affirm that the contribution of the topic developed in the course allowed them to better understand the logical order of a master's dissertation. On the other hand, a smaller group acknowledged that they perceived a specific influence because they improved the logical order in some aspects of their research.

These data allow us to infer that the approach of the course was partially achieved in this point, since the general understanding of the topic corresponds to the traditional approach of epistemology courses that deal with relevant discussions and general concepts about science.

Our objective was to have specific influence and at this point this specific usefulness is registered in a smaller percentage of cases.

Figure 1. The course on scientific methodology had the following impact on my research

No significant impact

Overall impact, as it gave me a broader view of scientific methodology

Specific impact because it helped me improve some aspects of my research work

Specific impact because it involved a profound change in my research work

Source: Research data

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With respect to the comments of the interviewees those who indicated specific influence clarified:

> I was able to improve the presentation of the analysis of the research data, so that they could better explain the investigated phenomena. (Interview 8)

> Could organize and think of new steps in organizing the elements of the dissertation. (Interview 10)

Among those who indicated general influence:

> It improved my theoretical understanding of complex thinking, in a very didactic and simple way. (Interview 4)

> A more general view of how to organize research. (Interview 6)

On the other hand, it is not expected that each concept seen will necessarily produce a concrete improvement in each paper. Students are guided by professors who are experts in their area of research who, whether they know in detail the epistemological discussions, know methodologically how to guide a good dissertation, so the margin of influence and concrete improvement on the papers is not necessarily large.

Defining a Research Problem and Hypothesis

The second topic that we presented in the course was the classic outline of a scientific investigation: definition of the problem to be investigated and the formulation of at least one conjecture or hypothesis (answer to the problem) that will be explored during the development of the investigation.

We owe the classic epistemological analysis of this scheme to Carl Hempel, a member of the Vienna circle. Another of his classic formulations is that of Karl Popper, who in some aspects agrees with Hempel's approach, but rejects it and polemics on important points such as the role of induction in the confirmation of scientific knowledge.

Hempel, in addition to being an epistemologist, was a physicist and therefore paid special attention to the natural sciences. However, his proposals include and are interesting for the social sciences and the humanities. This interest lies on the one hand in the intrinsic value of the postulated procedure but also has a pragmatic interest. The conception of implicit science evidenced by the state scientific agencies that finance and regulate scientific research corresponds in general terms with the ideas of Hemper and Popper regarding the importance of defining problems and formulating hypotheses. In order to apply for a master's or doctoral thesis and, moreover, to obtain scholarships or other types of funding, the applicant is asked to specify the problem to be addressed, the main hypothesis that will guide the research and the methodology with which the conjecture will be explored and the results of this will be evaluated.

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The idea that science is exercised from the proof or refutation of hypotheses understood as possible answers to scientific problems, is the most common and generalized conception of understanding the procedure used by scientific researchers (KLIMOVSKY, 1997). Consequently, it corresponds to the requirements requested by the state agencies that finance and regulate these activities at the time of presenting a research project.

In keeping with the purpose of the course, we present Hempel's ideas, focusing on their usefulness for research in social sciences and especially in the field of education.

> But it is possible that what we are required to do in that first phase of scientific research is to gather all the relevant facts, but relevant to what? But relevant to what? (...) let us suppose that the research refers to a specific problem. Wouldn't we start, in that case, by gathering all the facts... or, better, all the available data that are relevant to that problem? (...) the specific type of data to be collected is not determined by the problem under study, but by the attempted answer that the researcher tries to give it in the form of a conjecture or hypothesis (...) hypotheses, as attempted answers, are necessary to guide scientific research. These hypotheses determine, among other things, the type of data to be collected at a given moment in a scientific investigation (HEMPEL, 1983, p. 28-29).

The quotation presents the idea that scientific research starts from a well posed problem, but the problem alone is not enough, it is necessary to attempt an answer that we call hypothesis or conjecture. This hypothesis guides the research as it allows the selection of relevant data to evaluate whether it is an adequate answer to the problem.

The construction and definition of the problem is a fundamental step for any research in any area. However, the presence of the hypothesis as an answer to the problem and its function of guiding the research is not always so clear or evident in our field. Many times, at the beginning of a research we only have a problem, this is quite frequent in social sciences and in education. We have a problem based on certain data or concepts, but not necessarily a hypothesis. Although this situation is more frequent, it is not exclusive to the social sciences. Hempel points out that whenever an attempt is made to solve a problem or answer a question, there must implicitly be some general hypothesis that establishes the parameters of the solution.

For example, the objective of this article can be stated as the following problem: Are there concepts from classical epistemology that are pragmatically useful for educational science research? If yes, which ones? In our answer, the hypothesis that there are pragmatically useful concepts is evident, and we state some of the ones we consider most interesting. That is, we work under the general hypothesis that there are at least four interesting concepts. Our argument is constructed by stating the problem or objective of the article, giving a positive answer to it through this implicit hypothesis and trying to demonstrate the usefulness of these concepts. Having a well-formulated problem, asking good questions about the chosen topic, and trying to answer them always implies implicit hypotheses, even if they are not fully and clearly formulated at the beginning of the research.

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It is also interesting to understand that the emergence of the hypothesis is not a mechanical process; on the contrary, it is the product of the researcher's creativity and imagination (HEMPEL, 1983).

In the course we emphasize this aspect: to stimulate creativity, imagination in order to stimulate the emergence of new perspectives. Scientific knowledge in general is associated with systematicity, rigorousness or proof, which are important virtues but must be combined with the creative contribution of researchers.

Another relevant point, related to the justification of the postulated hypotheses, has to do with the pretended objectivity of scientific knowledge. For although hypotheses require creativity and imagination, the mere fact of having a creative idea does not mean that scientific knowledge has been produced. Here Hempel emphasizes the justification of conjectures, the author proposes a scheme of empirical-inductive type of proof, Popper for his part formulates his falsifications theses. Klimovsky (1995) rightly states that the inductive-statistical method is widely used and accepted for the natural sciences. But how valid and useful is this for the human and social disciplines?

With the words human and social sciences, we cover an exceptionally large variety of disciplines, there are some in which experimental verification of hypotheses or conjectures is usual and relevant. In economics and sociology, the use of inductive-statistical methods is widespread. Likewise, data collection through interviews and/or focus groups or other qualitative methods is equally important in areas such as education and psychology. However, there are disciplines belonging to the humanities, such as philosophy in its various branches, in which the use of empirical-statistical data to justify their theses or conjectures is unusual. Or the disciplines linked to the legal sciences, which work with what "should be" rather than with what actually "is". In general, these are disciplines that use conceptual and argumentative methodologies of a theoretical nature, propose concepts and argumentative strategies to prove, justify and convince of the correctness of their positions. There are references to practice, experience, or empirical data, but of an interpretative or hermeneutical nature. We do not find what we properly call 'experimental proof'.

Note that this article has an epistemological approach, a theoretical hypothesis and a partial but relevant empirical contrast. That is, discussions, theoretical and conceptual proofs, or refutations, as well as empirical surveys and contrasts through interviews. In the course there was a variety of research, most of them resorted of empirical contrasting, qualitative, since they were focused on the educational system of the region, but all of them had some degree of theoretical or conceptual argumentation. In the following sections we will discuss these characteristics of human and social research in more detail.

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Evaluation Results

The graph in Figure 2 shows a good degree of impact on this point, with seven students stating that the influence was of a general nature, but almost half of them reported that there was a specific influence on their work and two students also indicated a very pronounced influence.

The evaluation shows that the proposed objective was met in an appreciable percentage since six students noted a clear impact on their research in that they improved the argumentative sequence of their thesis. Among them, two students profoundly reorganized a substantial aspect: the argumentative order and structure.

Figure 2 – The idea of building a thesis on how complex reasoning is constructed had the following impact on my research.
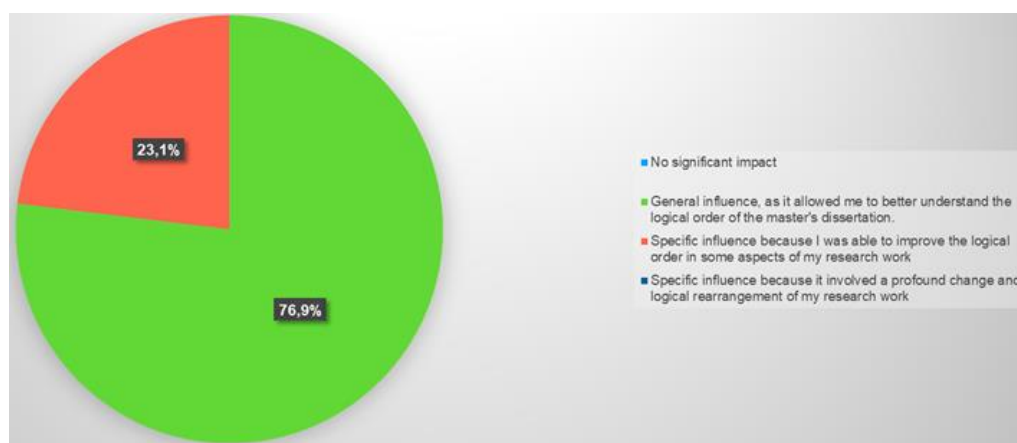
Source: Research data

On the other hand, the seven students interviewed perceived an improvement in their understanding with respect to the typical argumentative sequence of dissertations or scientific research, but no specific and appreciable influence on their work. That is, the general and classic objective of epistemology courses. Regarding the comments of the students among those who chose the option with the greatest impact:

> [it allowed me to have a] more defined sequence of the construction of the dissertation. (Student 9)

Students who perceived specific influence:

> It allowed me to improve my arguments. (Student 5)
> It [allowed] me to focus on the object of research. (Student 6)

Students who indicated general influence:

> It briefly systematized my thinking. I would like the course to develop this aspect more. (Student 4)
> It clarified some doubts in a significant way in the scientific argumentation process. (Student 7)

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The comments provide relevant information regarding the students' choices. At this point it is interesting to note that the attendees were at different stages of their master's degree, so it is likely that the greatest impact was on the less advanced students, while the effect of general understanding was on the more advanced students, some of whom had almost completed their work. The latter, guided by their advisors, have surely gone through the stages mentioned above, so that the theoretical review with a focus on practical usefulness helps to a greater understanding of the task already performed and of the experience of scientific research. The selected testimonies illustrate this situation well.

The Idea of an Empirical Basis as a set of Technical Propositions Used by a Scientific Community

The problem of the empirical basis, i.e., the set of facts or, rather, of basic statements about the facts against which theories are contrasted, has been classically formulated by Karl Popper. His approach problematizes the naive conception of experience proposed by the Vienna circle, which assumes a uniform perception of facts:

> it is not possible to propose a scientific statement that does not transcend what we can know with certainty "based on our immediate experience" (a fact to which we will refer with the expression "the inherent transcendence of any description" -that is, of any descriptive statement-): every descriptive statement uses universal names (or symbols, or ideas), and has the character of a theory, of a hypothesis (POPPER, 1980, p. 90).

In simpler words, Popper postulates that there is no experience that is uniform and independent of the theories we hold, because to describe it, our statements, even the most basic ones, use words and concepts whose meaning depends on a certain theoretical framework. Although the basic statements with which science describes experience have a close connection with the perception of facts, they are also theoretically charged: we describe and interpret perceptions according to the theories we hold. Popper postulates that the form and language in which empirical facts are described are determined by a tacit agreement among the members of a scientific community who implicitly accept a set of theoretical terms present in their descriptions of empirical reality.

What is the usefulness of the idea of empirical basis proposed by Popper in the construction of a dissertation in education? The interest is related to the need to build a solid theoretical framework in each dissertation, especially around social sciences, and humanities.

In the course there was an interesting fact, there were two health science students trained in disciplines linked to the natural sciences. This allowed us to exemplify and concretely compare the different approaches that exist between the social and natural disciplines. One of the master's students was a pharmacist and claimed that in the disciplines in which he was a specialist there was a homogeneous theoretical framework, for example, in

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chemistry he did not need to define what a chemical element was, nor as a pharmacist what he understood by medicine or treatment. The theoretical framework is homogeneous, i.e., widely accepted in the pharmaceutical community as unproblematic. This does not mean that it is indisputable or unquestionable; it merely points to the fact that it is not necessary to define or clarify it in each investigation.

For their part, the students in the field of education were faced with different situations. The theoretical framework is not homogeneous; the very conception of education has important theoretical nuances according to the authors and theories selected. There were approaches based on Foucault, others on Paulo Freire, on authors of classical Marxist orientation, and some even argued with neoliberal-oriented conceptions, for example. The definition and discussion about what the term "education" itself means is problematic and needs to be addressed and resolved in each research. In this sense, the theoretical-conceptual work in social sciences and in particular education is much more intense than around natural sciences, for example.

This diversity of theoretical frameworks and lack of homogeneity with respect to the object of study and even research methodologies are often perceived as a disadvantage of the social sciences with respect to the natural sciences, as we shall see in the following section. However, an interesting circumstance occurred in the course that relativizes this statement.

The student pharmacist's research revolved around optimizing therapy with an extremely specific drug for patients with one type of disease. He was working as a pharmacist in charge in a public care unit where patients from the poorest sectors are treated. The treatment has specific and strict dosing schedules, which generates complications, because if one of the stages is suspended, all the previous treatment is lost and must be restarted. I found it particularly difficult to convey this need to not skip any stage and for patients to understand the need to be strict in their compliance. I was building an application that would allow simple and direct communication between patient and professional and give alerts of the times to comply with the dosages. This idea that the way of describing the experience depends on the theoretical background and on belonging to a scientific community, helped him to understand the difficulties of communication between professional and patient. It allowed him to think of the need for a strategy of what in education we call "pedagogical transposition", i.e., a translation of the technical or scientific language into terms understandable to the receiver of the message with the least possible loss of information.

In this practical application of epistemological concepts and the pedagogical approach of her research, she made an important contribution to the problem she had posed. Likewise, the students in education were able to understand both the usefulness and the need to build their theoretical framework and some difficulties related to it, which we will discuss in the following point.

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Evaluation Results

In this axis, the students' perception of the influence on their work, although it was relevant with an important percentage of specific and very specific influence, was somewhat lower than the previous point, five students stated that it helped them to improve the expression in terms of scientific language of their work, and among these, one student indicated that it rewrote their work in more precise terms and improved the technical or scientific expression of the same. On the other hand, a significant percentage indicated a general influence, since it allowed a better understanding of the difference between scientific language and everyday language, a classic objective of any basic epistemology course. However, those who chose the option of general influence pointed out in their comments specific contributions and modifications to their work, which may be small, but are relevant to evaluate the results of the course.

Figure 3 – The idea of building a thesis on how complex reasoning is constructed had the following impact on my research
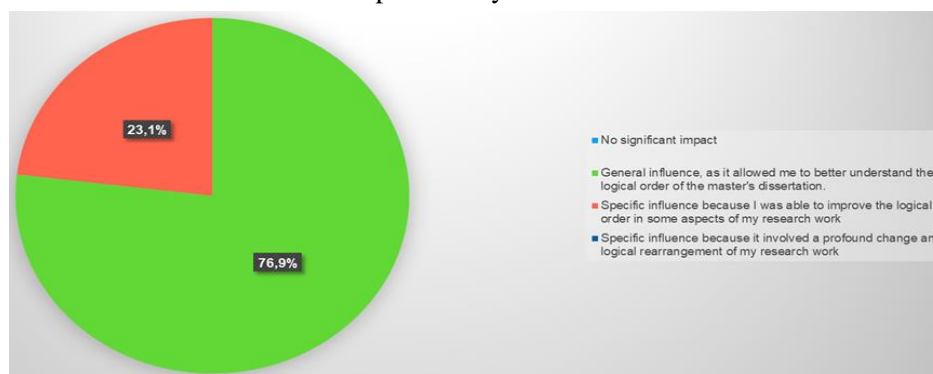
Source: Research data

Regarding the comments of the interviewees, who chose the maximum influence said:

> It was important to think and re-evaluate the writing, thus seeking other looks. (Student 6))

Among those who chose specific influence because they modified some important aspect:

> [allow me to] To write precise statements to communicate with a specific community. (Student 3)
> It directly helped in authoring my research, but I was also able to understand the difference between scientific and everyday language (Student 8)
>
> It has improved my scientific writing (Student 10)
>
> I find it quite difficult to write in a scientific language and methods, as my professional background allowed and extensive writing and production, but without much scientific care. Understanding the need and purpose of scientific language helps to think now of writing, to improve and have that careful look. (Student 11)

In turn, students 10 and 11 chose the general influence option and note that the comments indicate a considerable impact on their work.

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The Construction of the Theoretical and Methodological Framework

The topic we will introduce at this point is one of the most relevant for students in education and will be of similar interest for those who are beginning research in other human and social sciences: the construction of the theoretical framework. In a dissertation in our area, the work on the theoretical framework is intense, necessary, and complex, and implies a relevant difference with respect to research in the natural sciences, for example.

To address this topic, we turn to one of the most notable figures of epistemology in the 1970s, a representative of what was called the New Philosophy of Science and who has already become a classic author of the discipline: Thomas Kuhn.

In 1958 Kuhn was invited to participate in the Center for Advanced Studies in the Behavioral Science, at Stanford. There he shared his stay with social scientists, which allowed him to observe a notable contrast between the behavior of the community of social scientists and those of natural scientists where he had been trained (GAETA, GENTILE, 2004). Especially with respect to the type and subject of discussions and disagreements:

> I was astonished at the number and extent of patent disagreements among social scientists about the nature of accepted scientific problems and methods (...) the practice of astronomy, physics, chemistry, or biology does not normally evoke the controversies about fundamentals that nowadays often seem endemic, for example, among psychologists or sociologists (KUHN, 2004, p. 13). (KUHN, 2004, p. 13).

The author argues that in the communities of natural scientists there is debate on specific topics of their disciplines and that discussion on the theoretical bases of the sciences is infrequent. In other words, there is no disagreement on the foundations of the discipline, or, in other words, there is broad consensus on the theoretical and methodological framework: on the way of posing a problem, the theories that make it possible to conceptualize it and the methodologies available to solve it. This difference is crucial for understanding one of the major differences between the work of the social scientist and that of the natural scientist. The former will have to dedicate an especially important part of his time to establish and/or build a theoretical framework in which his problem makes sense, as well as a methodology to answer it. The latter will not have to do so.

It is well known that in this divergence between social and natural sciences lies one of the germs of the idea of paragidm[2] that will make the American author famous. He argues that the natural sciences reached a period of maturity by establishing a paradigm, which

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[2] The term Paradigm was introduced in epistemological and academic debates in the now classic book The Structure of Scientific Revolutions, by Thomas Kuhn, whose first edition was published in 1962. Veiga-Neto emphasizes that "[...] the word comes from the Latin form paradigma, atis, which in turn comes from the Greek paradeigma, acts, with the meanings of 'model' and 'example', from the verb paradeíknumi ('to put in relation', 'in parallel', 'to show'). This verb is formed by combining the prefix para ('together with') with the verb deiknunai (to show)" (VEIGA-NETO, 2007, p. 38-39). The author warns that the etymological exercise does not intend to determine the original meaning, "[...] to understand the older uses of paradigm and to perceive "[...] the semantic shifts that occurred along the 'stream of thought and life'" (VEIGA-NETO, 2007, p. 39).

implies a unified vision in a scientific community of the foundations of their science: object of study, theoretical and methodological framework.

The situation of the social sciences is different; it postulates that they have not yet reached their "maturity" and, therefore, there is frequent fragmentation and competition between schools that sometimes have radically different conceptions of the object of the discipline, as well as of the theories and methods for approaching it. This situation is notorious in the social and human disciplines, particularly in philosophical research, this diversity is even seen as a positive feature.

Beyond the value judgment implied in pointing out the "maturity" or not of a set of disciplines, it is certain that arduous theoretical and methodological discussions will have to be addressed in all social or human research. One of the theoretical frameworks in dispute will have to be selected or one's own will have to be constructed in general as a variant or combination of some previous ones, and the object of study itself will even have to be defined, since not everyone understands it in the same way. For example, in the course there was a student trained in psychology who approached pedagogical issues from her discipline, it will not be the same to approach them from the behaviorist, cognitive or psychoanalytic school, since they present notorious differences not only with respect to the definition of the object of study but also to the methods. Similar divergences can be found in each of the social and human disciplines. Therefore, the social scientist will eventually have to address the discussions that Kuhn observed with some surprise during the period he was in the Stanford community of social scientists.

Focusing now on the specific objective of this paper we must ask ourselves what is the usefulness of the exposed idea for students who are starting out in research? The researcher who is beginning his or her thesis or dissertation is not always aware of the degree of divergence and controversy that exists around the discipline he or she is addressing. He will have to devote a good deal of time and energy to address these discussions to orient himself and position himself with respect to them, that is to say: he will have to construct his theoretical and methodological framework. This is an extremely thorny issue that the researcher in the natural sciences does not need to face, he will not have to position himself on the very foundations of his discipline, discuss and clarify his fundamental concepts and the specific meaning he will give to them. It is not necessary for a physicist to clarify in what sense he understands the concept of "mass" or "velocity"; in general, the biologist does not need to clarify what he understands by "evolution" or what is the most adequate definition of "cell". But it is extremely common for a thesis in education to define what is meant by "education" in each theoretical framework and to differentiate it from other possible meanings or meanings, or for a thesis in the field of cultural studies to define the meaning given to the word "culture". The space devoted to these definitions is not minor; there are even complete theses that only discuss these concepts.

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The beginning social researcher must address, even partially, some of the most complex and fundamental questions of his or her discipline. Being aware of this challenge and the complexity of this task, of the need to go through these discussions and to orient oneself is a fundamental step in social research. This awareness reduces the feeling of disorientation, focuses the task, the effort and allows us to understand that even the best founded and argued position will always be open to objections and criticisms.

Finally, we dedicate a short paragraph to vindicate the usefulness of the social and human sciences, which have been labeled as immature. Paradoxically, Kuhn is popular among social scientists, firstly, because he proposes a demystifying vision with respect to hard sciences such as physics or astronomy in which he was trained, raising serious doubts about the accuracy, perfection, and objectivity of his methods. But also, because it uses concepts from the social sciences, constructs a theoretical framework different from that used by previous epistemological schools and generates a great polemic discussing the very foundations of current epistemology. In trying to answer what scientific knowledge is, it resorts to the typical procedure of the human and social sciences, claiming in fact the potential of our disciplines.

Axis Evaluation

The graph shows that this point had the greatest impact on the students' work, since eight of them chose to indicate a specific influence and among these three indicated a profound influence with respect to the construction of their own theoretical framework. On the other hand, six students perceived a general impact as far as this point allowed them to better understand the need to define the theoretical framework of their work.

Figure 4. The idea of the empirical basis as the set of technical propositions (statements) used by the scientific community to describe the empirical reality had the following impact on my research.
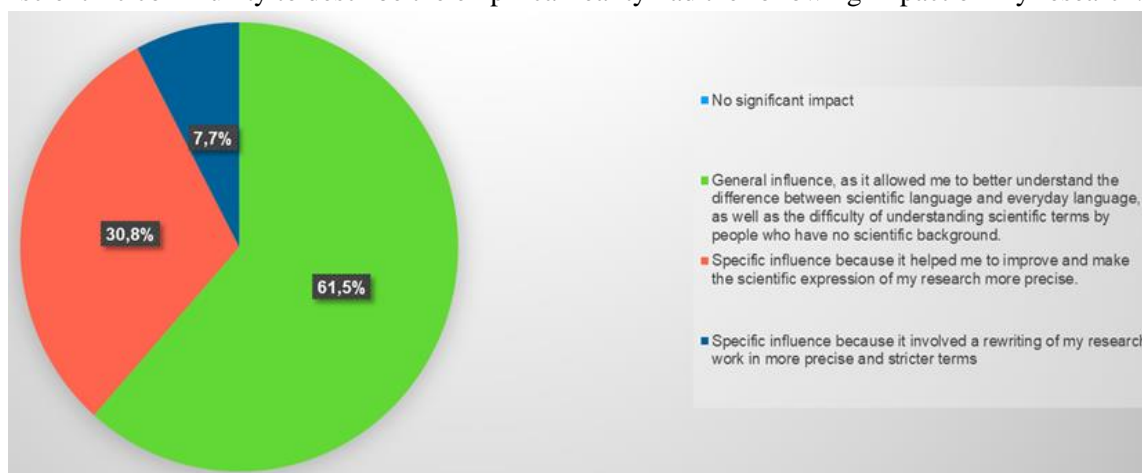
Source: Research data

Regarding the comments we can point out among those who chose the more specific influence option:

> It allowed me to reflect and reassess the set of references to be used in the final stage of my dissertation. (Student 8)
>
> I was able to understand that the theoretical framework situates the research within a current or proposal, and that by knowing the theoretical current and its trajectory we speak of a "place" that needs to be understood first. This can both affirm and change the researcher's own theme/idea. (Student 11)

Regarding those who chose specific peer influence:

> [served me to] The definition of my theoretical framework for my discussions to be well supported (Student 3)
>
> [helped me to] Determine some theoretical frameworks (Student 10)

Those who opted for a general influence:

> Elucidated the nuances of defining the theoretical framework (Student 7)

It is interesting to note that the presence of two health professionals trained in professions with a strong emphasis on hard sciences, especially chemistry and pharmacology, made it possible to contrast in practice and with comparisons of concrete research work these differences presented at the theoretical level. This practical and concrete understanding of the point may be one of the reasons why the perception of impact was greater. Another reason was surely the experience of students in education and related social disciplines in the arduous task of constructing and consolidating a theoretical and methodological framework for their work.

Overall Course Evaluation

In this section we present the general evaluation of the course. In the interview conducted the question about the impact of the course on each student's research (Figure 5) was in first place, then we went on to inquire about each specific point.

It is interesting to note that there is no exact correspondence between this first answer and the subsequent ones, i.e., between the perception of the overall impact of the course and the specific questions on the impact of the topics covered. In particular, five students indicate that there was a specific influence because it implied the reformulation of some part of their thesis, and if we look at the subsequent answers, nine students indicate specific influences of different degrees. One of the students indicated that it did not imply a significant contribution, however in the specific questions no student chose this option.

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Figure 5. The idea of fragmentation among schools and variety of theoretical frameworks in the social sciences, as well as the difficulty of defining the theoretical framework social research, had the following impact on my research.
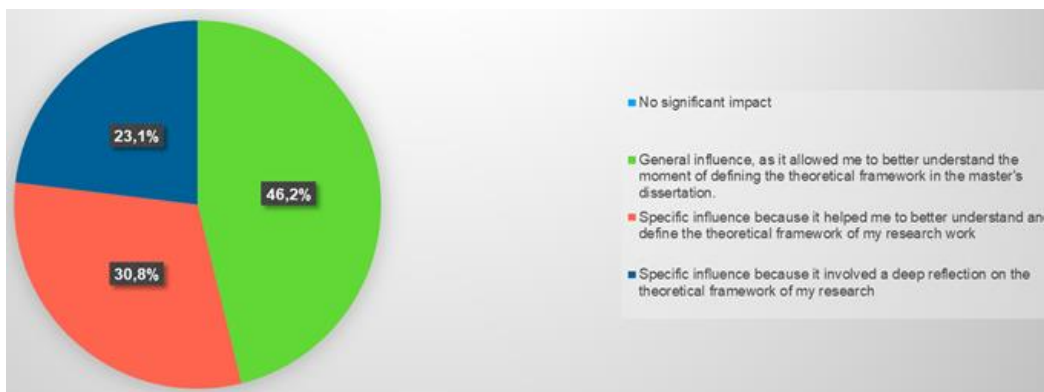
Source: Research data

One hypothesis to explain this divergence is that the perception of impact is different when asking general and broad questions about the "whole" than when asking specific questions about each of the parts. Possibly the real impact of the course lies somewhere in between these two types of response. A table of specific responses is presented below to graphically show this divergence.

Figure 6 - Course impact level

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13
P1	🟩	🟧	🟩	🟩	🟩	🟩	🟩	🟧	🟩	🟧	🟩	🟩	🟩
P2	🟩	🟩	🟩	🟩	🟧	🟧	🟩	🟧	🟩	🟦	🟦	🟩	🟩
P3	🟩	🟩	🟧	🟩	🟩	🟦	🟩	🟧	🟧	🟩	🟩	🟧	🟩
P4	🟩	🟩	🟧	🟩	🟧	🟩	🟦	🟦	🟩	🟧	🟦	🟦	🟧

Figure 6 - Source: research data

Figure 6 allows us to observe graphically for each student (E) the level of impact of the course on each of the axes consulted (P), with red color being a general impact, yellow specific and green specific or profound. Ten out of thirteen indicated that the course had a specific influence as far as it implied a modification or at least partial improvement of some aspect of their thesis related to the methodological topics addressed. Five of them stated that the improvement of some aspect of their work was total or very profound. Only three indicated that the influence of the course was general in that it increased their understanding of methodological and epistemological issues.

The convergence of these last two figures allows us to argue that the objectives of the course with respect to its usefulness and practical effects on the participants' research work have been achieved. We will address this issue in detail in the conclusions.

Conclusions

The most interesting conclusion of this work is that we reached a partial confirmation of the hypothesis that the course on logical methodology of the social sciences focused on the practical usefulness of classical epistemological concepts in the construction of theses in education, allows improving, in addition to the general understanding of these concepts, specific aspects of master's research related to the concepts studied.

Ten out of thirteen students who completed the course, i.e., almost 77%, improved some specific aspect of their dissertation and almost 40% profoundly reformulated some aspect of their work linked to the concepts studied. When questioned on specific points, 23% said that they had only improved their general understanding of the issues studied, which meant a non-specific contribution to the improvement of their research work.

Although the practical training of a novice researcher oversees the counselor, we believe that the proposed approach helps the theoretical-practical understanding of the scientific activity, facilitating the task of the counselor and concretely improving the work of the participants in the courses that adopt this approach.

We therefore believe that this proposal is original and novel, and we hope that in the courses related to science methodology, in addition to the review and theoretical exposition of the concepts, critical reflections on the practice itself, common expositions, comments on the students' own research projects and their relationship with the concepts studied will be included.

This approach allows for a deeper understanding of the concepts as it shows how they operate in practice and at the same time allows for a conceptual and methodological improvement of the students' work, contributing synergistically to the already hard work of the guiding professors.

Stricto Sensu graduate programs can move in the direction of training their future researchers in the proposed epistemological perspective, offering courses that, in addition to the theoretical content, work in a practical way and for each student's research, the way in which the concepts studied are applied and become useful. This will place the students and their own research in the scientific debates, necessary for the challenge of doing science in the field of education and for research training in this area.

The act of research, lived as a social and historical process, as a rigorous and deep work, makes it possible to problematize what seems given, immutable, and natural. It is a movement that involves curiosity, inquiry, analysis, discovery, ethics, aesthetics and understanding of social complexity and the unique challenge of producing reflections and articulation of different knowledge, contributing to the discovery of the limits of knowledge that sometimes appear as fragmented and sometimes as totalizing.

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Appendix A - Questionnaire answered by students

This questionnaire on the course Logic and Methodologies of Science given during early 2020 is intended to evaluate the impact of the course on the research of the master's students who participated in it:

1) The course on methodology of science had the following impact on my research:

1. No significant impact.

2. Overall impact in that it gave me a broader view of scientific methodology.

3. Specific impact because it helped me to improve some aspects of my research work.

4. Specific impact because it implied a profound change in my research work.

Briefly explain the reason for the chosen option:

2) The idea of thesis construction as the construction of complex reasoning had the following impact on my research:
1. no significant influence.

2. General influence in that it allowed me to better understand the logical order of a master's dissertation.

3. Specific influence because I was able to improve the logical order in some aspects of my research work.

4. Specific influence because it involved a profound change and logical reordering of my research work.

Briefly explain the reason for the chosen option:

3) The concept of constructing a thesis according to the problem-hypothesis-test sequence had the following impact on my research:
1. no significant influence.

2. General influence in that it allowed me to better understand the argumentative sequence (problem-hypothesis-proof) of a scientific dissertation.

3. Specific influence because it helped me to improve the argumentative sequence of my research paper.

4. Specific influence because it involved a re-elaboration of the problem and/or hypothesis and/or hypothesis testing of my research paper.

Briefly explain the reason for the chosen option:

4) The idea of the empirical base as the set of statements used by the scientific community to describe empirical reality had the following impact on my research:

1. no significant influence.

2. General influence in that it allowed me to better understand the difference between scientific language and everyday language as well as the difficulty of understanding scientific terms by people who do not have a scientific background.

3. Specific influence because it helped me to improve and make more precise the scientific expression of my research work.

4. Specific influence because it involved a rewriting of my research paper in more precise and strict terms.

Briefly explain the reason for the chosen option:

5) The idea of fragmentation among schools and variety of theoretical framework in the social sciences, as well as the difficulty of defining the theoretical framework in social research, had the following impact on my research:
1. no significant influence.

2. General influence in that it allowed me to better understand the moment of defining the theoretical framework in a master's dissertation.

3. Specific influence because it helped me to better understand and define the theoretical framework of my research work.

4. Specific influence because it implied a deep rethinking of the theoretical framework of my research.

Briefly explain the reason for the chosen option: