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THE RESEARCH PROGRAM ON TEACHER ACTION, STUDENT ACTION AND THEIR CONNECTIONS (PROACTION): FUNDAMENTALS AND METHODOLOGICAL APPROACHES

O PROGRAMA DE PESQUISA SOBRE A AÇÃO DOCENTE, AÇÃO DISCENTE E SUAS CONEXÕES (PROAÇÃO): FUNDAMENTOS E ABORDAGENS METODOLÓGICAS

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Abstract
This article deals with the theoretical foundations and methodological approaches of a Research Program, which has been under development for ten years, that investigates the actions of teachers and students by direct observation in the classroom. The Program received the name: The Research Program on Teacher Action, Student Action and their Connections (PROACTION) and has two general research questions: a) Which teacher and student actions are observed in science and mathematics classes in basic and higher education, how can they be interpreted and in what ways do they connect with each other? b) What implications for teaching, learning and teacher education can be drawn from the results found? In the article we present three possibilities of theoretical foundations for the Program, based on the articulation with teacher education, with the social theories of action and with the Actor-Network Theory. We also explain three different investigative approaches to address these questions: the first focuses on the description of the actions, the second on the explanation, and the third on the connections between the actions. At the end, we comment on the Program's developments and some points to be explored in the future research.

Keywords: Teacher Action; Student Action; Connections.

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Resumo

Este artigo trata dos fundamentos teóricos e abordagens metodológicas de um Programa de Pesquisa, que tem estado em desenvolvimento há dez anos e que investiga as ações de professores e estudantes por observação direta em sala de aula. O Programa recebeu o nome de Programa de Pesquisa sobre a Ação Docente, Ação Discente e suas Conexões (PROAÇÃO) e possui duas questões gerais de pesquisa: a) Quais ações docentes e discentes são observadas em aulas de ciências e matemática no ensino básico e superior, como elas podem ser interpretadas e de quais formas elas se conectam entre si? b) Que implicações para o ensino, a aprendizagem e a formação de professores podem ser extraídas dos resultados encontrados? No artigo apresentamos três possibilidades de fundamentação teórica para o Programa, baseadas na articulação com a formação de professores, com as teorias sociais da ação e com a Teoria Ator-Rede. Também explicitamos três diferentes abordagens investigativas para tratar as questões levantadas: a primeira foca na descrição das ações, a segunda na explicação, e a terceira na conexão entre as ações. Ao final comentamos os desdobramentos do Programa e alguns pontos a serem futuramente explorados nas investigações.

Palavras-chave: Ação docente; Ação discente; Conexões.

Introduction

This article deals with the theoretical foundations and investigative approaches of a Research Program, which has been under development for ten years (ARRUDA; LIMA. PASSOS, 2011; ARRUDA; PASSOS, 2015; ARRUDA; PASSOS, 2017; ARRUDA; PASSOS; BROIETTI, 2019), that investigates the actions of teachers and students by direct observation in the classroom. The Program received the name: The Research Program on Teacher Action, Student Action and their Connections (PROACTION, or, PROAÇÃO in Portuguese) and has two general research questions:

> a) Which teacher and student actions are observed in science and mathematics classes in basic and higher education, how can they be interpreted and in what ways do they connect with each other?
> b) What implications for teaching, learning and teacher education can be drawn from the results found?

This theoretical article has two objectives: the first – to indicate guidelines for research works (dissertations, theses, articles etc.) which are in progress in our group[4]; the second – to provide responses to some recent criticisms that have been made to the PROAACTION Program by some researchers in the field, mainly evaluators of our articles.

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The first criticism questions the relevance and originality of the research: it is not clear to such researchers why the theme represents an original approach to face the various research problems which are still open, especially those related to teacher education; in addition, the results already found by the group are sometimes taken as irrelevant, since, supposedly, they would not add new knowledge to research in teaching.

The second criticism refers to the foundation: theoretical depth and a broader dialogue with the literature would be lacking in our research; the articles would be presenting excessive self-citations, which would indicate endogenous research.

The third criticism concerns the nature of the research and its methodology: the study would only be descriptive and not analytical or interpretive; the categories found would need better explanations and are not new in the field; the evaluators also questioned that in the articles few classes are analyzed (in general, two or three).

In the next two sections we present some theoretical options that can provide a basis for research related to the PROACTION Program and the different methodological approaches that could be used in the Group's research. In the Final Considerations, we will provide some answers to the criticisms mentioned, comment on the developments and some points to be further explored in the research.

This article is partially articulated with another article published in 2017, in this same journal, in which we outlined the general lines of the referred Program and dealt with three research instruments called the Teacher Matrix, the Student Matrix and the Knowledge Matrix, developed to investigate the relationship with knowledge in the classroom (ARRUDA; PASSOS, 2017).

Theoretical foundation

The purpose of this section is to present some theoretical options that researchers have at their disposal for their research work under the PROACTION Program. The first option seeks to relate teacher action to the field of teacher education and research on pedagogical practice; the second briefly presents the main theories that approach action from the point of view of sociology; and the third seeks to establish a dialogue between the theme addressed in this article and the Actor-Network Theory.

Teacher action and teacher education

The initial concerns about the issue of teacher action originated from the field of

teacher education and are related to a thesis, defended in 2001 (ARRUDA, 2001). In the aforementioned thesis, the author analyzed the contradictions detected between the speech and the actions of High School Physics teachers in an in-service teacher education project. It was observed that, while the participants assumed the objective of changing their teaching, the actions they developed contradicted their objectives. That is, they, in fact, did not demonstrate with their actions that they really wanted to change. This finding was called the teacher's inertia and is understood as a resistance to change the traditional teaching practice (lecture classes) and/or to introduce new content in their classes (ARRUDA, 2001, p. 67). At that time, the issue of teacher action (in addition to what the teacher reports about his/her pedagogical actions, what he/she does, in fact, in the classroom) began to emerge, as something to be investigated in the future.

Later, in another thesis defended in 2009 (PASSOS, 2009), the author drew attention to the predominance of a prescriptive discourse within the teacher education of teachers who taught Mathematics. The research, which analyzed 32 years of publications in journals in the field of Mathematics Education (1976 to 2007), concluded that the teacher and his/her education were the most researched themes in those three decades and that, in most of the investigated articles, the authors highlighted the "duties" of the teacher, such as, the teacher must: be an agent of transformation, be accessible, evaluate his/her actions, create an environment of freedom, be practical-reflective, etc. (PASSOS, 2009, p. 158, 160, 193, 236, 238, our translation).

Although, in the scope of our research, concerns about the teacher's action in the classroom were motivated by these two theses, Schön (1997) had already drawn attention to this point previously.

> We have to check what teachers do in direct and recorded observation that allows a detailed description of the behavior and a reconstruction of the intentions, strategy and assumptions. Confrontation with directly observable data often produces an educational shock, as teachers discover that they act according to different theories of action from those they profess (SCHÖN, 1997, p. 90, our translation).

Tardif and Lessard (2008), in later years, complemented the analysis with the recommendation presented below.

> It seems to us that the first step to be taken to analyze the work of

> teachers is to make a resolute critique of the normative and moralizing views of teaching, which are primarily interested in what teachers should or should not do, leaving aside what they really are and really do (TARDIF; LESSARD, 2008, p. 36, our translation).

In order to overcome the moralizing and normative points of view about teaching, these authors propose that teaching be analyzed as "any other human work, that is, describing and analyzing the material and the symbolic activities of the workers as they are carried out in their own workplaces" (TARDIF; LESSARD, 2008, p. 37, our translation). This theoretical perspective is opposed to that which seeks to understand teaching "from the top", which privileges the structures, the institutional system, great sociological variables; it is a question of starting "from the bottom", turning our attention to workplaces and "everyday practices, through which the work process of school actors is carried out and reproduced" (TARDIF; LESSARD, 2008, p. 38, our translation). The teachers' work involves giving meaning to action.

> If teachers were just agents of this institution called the school, it would be enough to analyze their determined functions and their legal *status* to understand their action. But [...] teachers are also actors who invest in their workplace, who think, who define and give meaning to their actions, and experience their role as being *personal*, building knowledge and a culture that is specific to the profession. In summary, teachers' work is not just about fulfilling and doing, but it is also the activity of people who cannot work without giving meaning to what they do, it is an interaction with other people: students, colleagues, parents, school leaders etc. (TARDIF; LESSARD, 2008, p. 38, our translation).

Although the expression "teacher action" is sometimes mentioned in the literature on teacher education, the most commonly found terms are teaching practice, pedagogical action, pedagogical practice, educational practice, etc., which, eventually, can be considered as concepts close to that of teacher action.

For Altet (2011), the notion of teaching practice is polysemic, multidimensional and refers to several definitions. In one of them, teaching practice is defined as a particular way of carrying out an activity.

> Teaching practice is generally defined as a person's unique way of doing things, his or her own way of performing a professional activity in an educational institution. Practice is not just a set of observable acts, actions and interactions linked to the multiple tasks of visible professional activity; it includes the procedures performed by the activity in a given situation, by a person interacting with others, with the reactions, interactions, options and decisions made (ALTET, 2011, p. 652, our translation).

The previous definition highlights the uniqueness, interaction and decisions involved in teaching practice.

When discussing the different conceptions of internship and the relationships with theory and practice, Pimenta and Lima (2004) also approach teacher action as a pedagogical action.

> In a broad sense, action designates human activity, the doing, effective doing or doing that is simply opposing a passive state. However, in a philosophical and sociological understanding, the notion of action is always referred to objectives, purposes and means, implying the subjects' awareness of these choices, assuming a certain knowledge. Thus, we call pedagogical action the activities that teachers carry out in the school collective assuming the development of certain oriented and structured material activities (PIMENTA; LIMA, 2004, p. 42, our translation)

Such observations lead us to the considerations of Gauthier and collaborators (2006) regarding the differences between pedagogy and didactics, linking the first to the actions practiced by the teacher and the second to the actions of the student.

> For theoretical and methodological reasons, we believe that, at the conceptual level, that is, at the analysis plane, it is more pertinent to conceive pedagogy as encompassing everything that concerns the teacher's behaviors in order to instruct and educate students and associate the term didactics to everything that depends on the student's behaviors in relation to his/her learning [...] We are all in agreement to say that pedagogy (or teaching) designates the set of actions practiced by the teacher in the scope of his/her instruction and teaching functions and the education of a group of students in the school context. (GAUTHIER et al, 2006, p.136, our translation).

The term pedagogical practice is also widely used in the literature, but in general without a specific definition. According to Tardif (2002), it is possible to identify three conceptions of educational practice: "The first, associates educational practice to an art; the second, to a technique guided by values; the third, to an interaction" (TARDIF, 2002, p. 154, our translation).

Education as art is found in ancient Greek ideas, mainly in the works of Plato and Aristotle, in which art (*téchne*) differs from action (*práxis*) and science (*epistéme*) (TARDIF, 2002).

> [...] the educator's action can be associated with the artisan's activity, that is, with the activity of: 1) someone who has an idea, a general

representation of the objective one wants to achieve; 2) someone who has acquired and concrete knowledge about the material with which one works; 3) someone who acts based on tradition and on recipes with a proven effect specific to one's art; 4) someone who acts relying also on personal ability; and, finally, 5) someone who acts guided by experience, source of good habits, that is, throught "ways-of-doing", "moves", "ways-of-proceeding" which are proven by time and successive successes (TARDIF, 2002, p. 159, our translation).

The conception of educational practice as a technique guided by values, present in modernity, is characterized by opposing objectivity (actions are guided by neutral axiological objectives) to subjectivity (actions are guided by norms and interests that depend only on agents) (TARDIF, 2002). Within this model of practice, the classroom teacher would be guided by two types of knowledge: scientific norms and theories.

In a classroom, the teacher is guided by two types of knowledge: 1) he/she must know the rules that guide his/her practice; these norms correspond to everything that is not an object or product of scientific thought, but interferes in education, such as values, rules, regulations or purposes; 2) he/she must also know the existing scientific theories regarding education, the nature of the child, laws regarding learning and the teaching process; in theory, these theories should guide the action, which will then be a technical-scientific action, that is, an action determined by the current state of scientific knowledge. In this conception, what distinguishes the classroom from a laboratory, the education from a science, and the pedagogy from a technology is only a difference in degree and not in nature (TARDIF, 2002, p. 164, our translation).

The third conception of educational practice is based on interactive action, which assumes that human action is not oriented towards the manipulation of objects, but rather through the actions of others. Educational action, therefore, is purely social.

In education, we don't deal with things or objects, not even animals like Skinner's famous pigeons: we deal with our fellow humans, with whom we interact. Teaching is entering a classroom and placing yourself in front of a group of students, striving to establish relationships and unleash with them a development process mediated by a wide variety of interactions. The interactive dimension of this situation lies, among other things, in the fact that, although we can keep students physically in a classroom, we cannot compel them to participate in a common action program guided by learning purposes: it is necessary that students associate themselves, in one way or another, with the ongoing pedagogical process so that it has some chance of success[5] (TARDIF, 2002, p. 167, our translation).

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[5] In our understanding, we would say that student actions would have to be connected to teacher actions and vice versa.

Considering that these three conceptions are still insufficient to account for educational action, Tardif (2002) proposes eight types of action in education, which we will mention here: traditional action, affective action, instrumental action, strategic action, normative action, dramaturgical action, expressive action and communicational action. As a consequence, Tardif (2002, p. 175, our translation) discusses that "the teacher's work does not correspond to a specific type of action", but, on the other hand, "constantly uses a great diversity of heterogeneous actions", which is compatible with the results that we have found in our research[6].

The social theories of action

In the previous section we sought to show how the theme of teacher action is articulated with some theoretical perspectives of the field of teacher education, especially with what is called teaching practice. In this section we raise the possibility of interpreting teacher action based on social theories.

In sociology, the concept of action has played a prominent role since the end of the 19th century (JOAS; BECKERT, 2001)[7]. In this field, the discussion of action "tends to focus primarily on rational choice theory on the one hand and normative theories of action on the other" (JOAS; BECKERT, 2001, p. 270).

Theories of action based on rational choice are related to Weber and Coleman. For Weber, sociology is the science that deals with the understanding of social action, its course and consequences.

> We shall speak of "action" insofar as the acting individual attaches a subjective meaning to his behavior be it overt or covert, omission or acquiescence. Action is "social" insofar as its subjective meaning takes account of the behavior of others and is thereby oriented in its course (WEBER, 1978, p. 4).

According to Weber, people act purposefully towards a goal. In this sense, the actions can be: *instrummentally rational*, that is, determined by expectations regarding the behavior of objects and human beings; *value-rational*, when determined by

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[6] This point will be explored in the future in another article.
[7] The concept also appears centrally in other fields such as economics, psychology and philosophy (JOAS; BECKERT, 2001).

conscious beliefs in value as an end in itself; *affectual*, when associated with affections and feelings; and *traditional*, that is, determined by habits (WEBER, 1978, p. 24-25).

For Coleman (1994), although the central problem of sociology is to explain the functioning of social systems, in most research, the observations are not made about the system as a whole, but focus on some part of it, in general on the individual; that is, empirical social research – which uses interviews, records of behavior or direct observation – is often concerned with explaining individual behavior (COLEMAN, 1994, p. 1).

Coleman uses an intentional theory of individual action, which, according to him, is the same theory used by Weber.

> The individual level theory of action I will use in this book is the same purposive theory of action used in Weber's study of Protestantism and capitalism. It is the theory of action used implicitly by most social theorists and by most people in the commonsense psychology that underlies their interpretation of their own and others' actions. It is ordinarily the dominant model of action we apply when we say we understand the action of another person: We say that we understand the "reasons" why the person acted in a certain way, implying that we understand the intended goal and how the actions were seen by the actor to contribute to that goal. (COLEMAN, 1994, p. 13).

However, Coleman needs a more precise notion of rationality and, for that purpose, he assumes the *utilitarian rational actor model* in economics, which, in summary, expresses that the actor, in a situation in which he/she has diferent bundles of goods, will choose the bundle that will maximize their utility (JOAS; BECKERT, 2001, p. 270-271).

> For some purpose in the theory of this book, nothing more than this commonsense notion of purposive action is necessary. For much of the theory, however, a more precise notion is required. For this I will use the conception of rationality employed in economics, the conception that forms the basis of the rational actor in economic theory. This conception is based on the notion of different actions (or, in some cases, different goods) having a particular utility for the actor and is accompanied by a principle of action which can be expressed by saying that the actor chooses the action which will maximize utility. (COLEMAN, 1994, p. 13-14).

For Bourdieu (1998), however, individuals do not always act rationally. As Aquino (2000, p. 23, our translation) states, "it would be extremely difficult to think carefully about what to do for each new situation". That is, in similar situations, people

tend to act similarly, due to the *habitus*. For Bourdieu (1998), *habitus* generate practices.

> *Habitus* are generative principles of distinct and distinctive practices [...] *habitus* are also classificatory schemes, principles of classification, principles of vision and division, different tastes. They make distinctions between what is good and what is bad, between whar is right and what is wrong, between what is distinguished and what is vulgar, and so forth, but the distinctions are not identical. (BOURDIEU, 1998, p. 8).
> The *habitus* is this kind of practical sense for what is to be done in a given situation (BOURDIEU, 1998, p. 25).

According to Perrenoud (2001, p. 163, our translation), "pedagogical action is constantly controlled by the *habitus*".

> Most of [the teacher's] actions emerge at the same time, in different proportions of rational thinking, guided by knowledge, and of reaction, guided by less conscious schemes, products of his/her life story, as well as his/her professional experience. (PERRENOUD, 2001, p. 170, our translation).

Finally, for Lahire (2002), the known theories of action are of two types: those that take into account the actor's past, his/her early childhood experiences (for example, the different psychological or neuropsychological theories, the psychoanalytic theory and the *habitus* theory) and, on the other hand, those which are not concerned with the past, analyzing the action in a given situation (theory of rational choice, methodological individualism, symbolic interactionism, ethnomethodology) (LAHIRE, 2002, p. 46). For him, human actions cannot be explained by just one of these theories. In the case of a tennis match, for example, it is understood, by the urgency of their actions, that players are unable to rationally consider the acts they have to perform. However, long-term actions (for example, sending a man to the moon), in general, require planning, calculations and careful preparation.

> The question of intentionality or unintentionality, of conscience or of unconsciousness, does not arise in a general or absolute way in the action, but always depends on the sequence of the considered action: being a short action or long action, a simple action or a complex action, an ordinary action or an extraordinary action (LAHIRE, 2002, p. 152, our translation).

The social theories of action addressed in this section could be summarized as follows: in Weber (1978) we find that action is determined by ends rationally calculated by the actor, by values as an end in itself, by affections and feelings, by traditions; for Coleman (1994), action is directed to maximize the utility (maximum of favorable results/minimum costs), being that almost all actions can be considered rational regarding their ends; Bourdieu (1998) emphasizes action as determined by the *habitus* (action schemes that guide the perception of the situation and the appropriate response); and for Lahire (2002), human actions are closer to a pure practical sense in routine situations and closer to rationality as to what is new.

Any of these authors can serve as a theoretical option to support the concept of teacher action.

Teacher action and Actor-Network Theory

The concept of teacher action can also be based on *Actor-Network Theory* (ANT). To discuss some points about ANT, we will rely mainly on the book *Reassembling the Social: An Introduction to Actor-Network-Theory* by Latour (2005).

Latour starts by opposing traditional sociology insofar as it postulates the existence of a specific type of phenomenon called society, social dimension or social structure.

> [...] this version of social theory has become the default position of our mental software that takes into consideration the following: there exists a social 'context' in which non-social activities take place; it is a specific domain of reality; it can be used as a specific type of causality to account for the residual aspects that other domains (psychology, law, economics, etc.) cannot completely deal with [...] (LATOUR, 2005, p. 3-4).

For Latour, however, "there is no social dimension of any sort, no 'social context', no distinct domain of reality to which the label 'social' or 'society' could be attributed" (LATOUR, 2005, p. 4).

> Since in both cases the word retains the same origin – from the Latin root *socius* – it is possible to remain faithful to the original intuitions of the social sciences by redefining sociology not as the 'science of the social', but as the tracing of associations. In this meaning of the adjective, social does not designate a thing among other things, like a black sheep among other white sheep, but a type of connection between things that are not themselves social. (LATOUR, 2005, p. 5).

Latour calls this new sociology the sociology of associations. From this basis, the author begins to address several controversial points in sociology. Two of them have a strong connection with our studies on teacher action: the question of what action is and the possibility of attributing action to non-humans.

Firstly, the issue regarding action: what does it mean to act? Why do we do what we do? Why is our action always connected to the action of another? Or: "When we act, who else is acting? How come I never do what I want?" (LATOUR, 2005, p. 43).

As we saw in the previous sub-sections, there is a tendency to think of action as rationally based, explained through conscious reasons and motivations. But, from Bourdieu and Lahire we can understand that there are conscious, planned actions and automatic actions, moved by the *habitus*. "Psychoanalysis goes even further by stating that what constitutes the individual is not the conscious, but the unconscious thinking" (ARRUDA, 2001, p. 152).

Therefore, there are no clear answers to questions about the origins of a subject's action. Thus, we agree with Latour that there is a fundamental uncertainty about the action, according to the quotations below.

> Action is not done under the full control of consciousness; action should rather be felt as a node, a knot, and a conglomerate of many surprising sets of agencies that have to be slowly disentangled. It is this venerable source of uncertainty that we wish to render vivid again in the odd expression of actor-network. (LATOUR, 2005, p. 44).

> An actor is what is made to act by many others. An 'actor' in the hyphenated expression actor-network is not the source of an action but the moving target of a vast array of entities swarming toward it. [...] To use the word 'actor' means that it's never clear who and what is acting when we act since an actor on stage is never alone in acting. (LATOUR, 2005, p. 46).

> By definition, action is dislocated [dislocal]. If an actor is said to be an actor-network, it is first of all to underline that it represents the major source of uncertainty about the origin of action (LATOUR, 2005, p. 46).

Obviously, such statements can be translated into the classroom: why does the teacher do what he/she does? What or who is involved in the teacher's action? How does teacher action connect to student action?

As the motto of ANT is "follow the connections, follow the actors themselves" (LATOUR, 2005, p. 179), this theory caught our attention exactly on this point: the emphasis on the connections between actions.

> [...] we have to lay continuous connections leading from one local interaction to the other places, times, and agencies through which a local site[8] is *made to do something* [...] If we do this, we will render visible the long chains of actors linking sites to one another without missing a single step (LATOUR, 2005, p. 173).

The second point where ANT has implications for teaching and learning is the idea that objects also act.

> After all, there is hardly any doubt that kettles 'boil' water, knifes 'cut' meat, baskets 'hold' provisions, hammers 'hit' nails on the head, rails 'keep' kids from falling, locks 'close' rooms against uninvited visitors, soap 'takes' the dirt away, schedules 'list' class sessions, prize tags 'help' people calculating, and so on (LATOUR, 2005, p. 71).

It is evident that objects interfere with the course of our actions. We are going to make a bank transfer and the system is down; we are going to make food and the gas is out; we are going to take the elevator and there was a blackout in the electrical system; we are going to the beach and there was a landslide. It is obvious that the same goes for daily actions of teaching: we are going to teach a remote lecture and the wi-fi is slow or the signal drops frequently; we are going to perform a Physics experiment and the equipment is not working; we are going to present a seminar and the projector does not connect to the laptop; we are going to plan a class and we can't find the textbook; we are going to teach a subject, but there is no syllabus or program. Objects, both in everyday actions and in didactic actions, participate in the course of our actions. When they work normally they are practically invisible; but when they present problems we realize how much they participate in our actions.

It is not trivial to include a non-human in the course of an action, since implicitly we always use a theory of intentional action, as already mentioned. However, if we start from the controversies about actors and acts, we can agree with Latour that "any thing that does modify a state of affairs by making a difference is an actor – or, if it has no figuration yet, an actant" (LATOUR, 2005, p. 71). In other words, to find out if something is an agent, we have to investigate whether it makes a difference in the course of another agent's action and whether we can prove that difference.

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[8] It is also interesting how Latour uses the term local site, that is, a position in space, in this text, since for some years now we have used the metaphor of the *teacher as a place* when analyzing the relationship between teacher, interns and students (ARRUDA; BACCON; 2007). It is a point to be further explored.

To end these brief comments on ANT, we have included an excerpt from the entry on *Actor-Network Theory* of the Encyclopedia of Social Theory (*Sage Publications*).

> Taking seriously the agency of nonhumans (machines, animals, texts, and hybrids, among others), the ANT network is conceived as a heterogeneous amalgamation of textual, conceptual, social, and technical actors. The "volitional actor" for ANT, termed *actant*, is any agent, collective or individual, that can associate or disassociate with other agents. Actants enter into networked associations, which in turn define them, name them, and provide them with substance, action, intention, and subjectivity. In other words, actants are considered foundationally indeterminate, with no *a priori* substance or essence, and it is via the networks in which they associate that actants derive their nature. Furthermore, actants themselves develop as networks. Actors are combinations of symbolically invested "things", "identities", relations, and inscriptions, networks capable of nesting within other diverse networks (RITZER, 2005, p. 1).

In summary, ANT can also be used as a theoretical basis for investigations related to the PROACTION Program.

Methodological approaches

We are now in a position to explain three different methodological approaches to address the issues raised by the theme of teacher action, student action and their connections: the first focuses on the *description* of the actions, the second on the *explanation* and the third on the *connection* between actions.

Although different, the approaches can be used simultaneously in research works[9]. In other words, the researcher can treat the topic through different approaches at the same time, which has been occurring in some studies. Such a possibility is represented in Figure 1.

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[9] We are not considering, at this moment, any theoretical inconsistencies that may exist between the different approaches. We will leave this problem, if it exists, to be resolved in the future.

Figure 1 – Investigative approaches of PROACTION
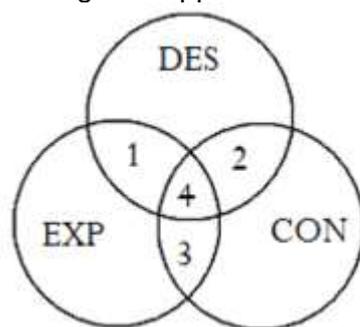
Source: the authors

In the representation of Figure 1, DES, EXP and CON refer, respectively, to the descriptive, explanatory and connective approaches. The numbers represent the sectors in which the approaches are used simultaneously in research: DES + EXP (1); DES + CON (2); EXP + CON (3); and DES + EXP + CON (4).

Regardless of the approaches adopted, the Research Program on Teacher Action, Student Action and their Connections (PROACTION) is based on qualitative research. (LÜDKE; ANDRÉ, 1986; BOGDAN; BIKLEN, 1994; DENZIN; LINCOLN, 2005; COHEN; MANION; MORRISON, 2007; FLICK, 2009) and, in particular, considerations of textual analyses – Content Analysis (BARDIN, 2011) – and, Discursive Textual Analysis (MORAES; GALIAZZI, 2011). The data are collected in the classroom, through video and/or audio recordings, in order to capture the teacher's actions, the students' actions and their speeches. Direct recording is often not possible, so observation (participant or not), reports and field diaries have also been used. Sometimes the data collected directly in the classroom are supplemented with interviews, which are usually semi-structured, as well as/or autoscopies.

The descriptive approach

In general, we can say that the perspective "from the bottom" to analyze teachers' work, adopted by Tardif and Lessard and commented on in the second section of this article, inspired us in the first approach adopted by the group in research which deals with teacher and student action. In other words, we try to focus on the "daily practices" of teachers (TARDIF; LESSARD, 2008, p. 38, our translation). For these authors, this perspective "from the bottom" could lead to the construction of *inductive models of teaching work*, that is, "models of interpretation and understanding based on the study of concrete action systems in which teachers work" (TARDIF;

LESSARD, 2008, p. 39, our translation).

In the absence of a more precise definition of the concept of teacher action, in our initial research, of the descriptive type, we consider, provisionally, that teacher action is the action that the teacher performs in the classroom, with aims at teaching and learning (ANDRADE; ARRUDA; PASSOS, 2018, p. 350, our translation), or a "way of proceeding, behavior" (HOUAISS; VILLAR; FRANCO, 2009, our translation).

Considering the centrality of the didactic pedagogical triangle in the group's research since 2010 (ARRUDA; LIMA; PASSOS, 2011; ARRUDA; PASSOS, 2017), the extension of the research to investigate students' actions was immediate. We highlight that this triangle is the usual model of a standard classroom, being represented by Figure 2:

Figure 2 – Didactic pedagogical triangle
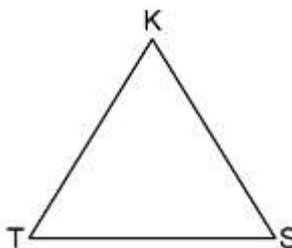
Source: adapted from Arruda and Passos (2017, p. 100)

By our interpretations of the triangle in Figure 2, T (the teacher), S (the student) and K (the knowledge) are three actors in the full sense of the term. Therefore, we assumed from the beginning that research on action in the classroom could focus on each of the vertices of the triangle: the teacher and his/her actions (teacher actions), students and their actions (student actions), and knowledge and its actions (knowledge actions) (ARRUDA; PASSOS, 2017).

There is still an important consideration to be made about the vertices of the triangle. They can be interpreted in two ways. Through the relationship with knowledge (CHARLOT, 2000), that is, as relationships between T, K and S. In this case, they would represent the relationship of the teacher and the student with knowledge, which we previously interpreted as *teacher learning* and *student learning* (ARRUDA; PASSOS, 2017, p. 100). But the vertices can also be seen, through ANT, as connections between the actants T, S and K. We will discuss a little more about this later. In any case, this justifies why the Research Program received the title of Teacher

Action, Student Action and their Connections.

The descriptive approach, which is still ongoing in the group, has been adopted in several research works since 2016, many have already been published, such as: Andrade, 2016; Andrade and Arruda, 2017; Dias, Arruda, Oliveira and Passos, 2017; Passos, Passos and Arruda, 2017; Andrade, Arruda and Passos, 2018; Carvalho, Arruda and Passos, 2018; Benicio, 2018; Dias, 2018; Vicentin, Passos and Arruda, 2018; Arruda, Zapparoli and Passos, 2019; Benicio, Arruda and Passos, 2019; Filgueira, 2019; Assai, 2019; Santos, 2019; Benicio, Arruda and Passos, 2020a; Benicio, Arruda and Passos, 2020b; Borges, 2020; Carvalho, Stanzani, Passos, Lorencini Jr., 2020; Dias, Arruda and Passos, 2020; Maulana and Arruda, 2020; Turke, 2020; Vicentin, Passos and Arruda, 2020a; Vicentin, Passos and Arruda, 2020b. Some of these studies were also concerned with connections and, therefore, also appear in the connective approach.

The explanatory approach

The explanatory approach seeks inspiration and foundation in themes of teacher education, in social theories of action and in works on intentionality.

Explaining the action of another is a crucial psychological issue for human beings, interpreted in general in terms of goals, desires, beliefs, motives, etc. Seeking to understand and interpret what others are thinking and feeling is an activity that we practice daily. From early childhood, children learn to differentiate entities that have intentionality from those that do not: infants, for example, "have different expectations about the focus or location of future actions when they perceive an entity to be goal directed" (NRC , 2007, p. 63-64). In short, since early childhood, children have learned to differentiate the social world from the physical world, through a spontaneous psychology based on the intentionality of common sense. In addition, people can act on others from a distance.

> A facial expression, a comment, or a gesture can cause another agent to spring into action in ways that are directly related to that first event, even though it may be spatially quite distinct. (NRC, 2007, p. 63).

In education, for example, getting involved and believing in the beliefs, values and knowledge of other people, particularly the teacher, can be decisive for learning: "Establishing mutual trust between the teacher and the student" can be crucial for

engaging in learning (ARRUDA, 2001, p. 138, our translation), which is called the "transferential pedagogical relationship" (VILLANI, 1999, p. 10, our translation).

In philosophy, however, the meaning of the word 'intentionality' is different from the common meaning of the word 'intention', being part of contemporary discussions about the mind and mental states.

> Contemporary discussions of the nature of intentionality are an integral part of discussions of the nature of minds: what are minds and what is it to have a mind? They arise in the context of ontological and metaphysical questions about the fundamental nature of mental states: states such as perceiving, remembering, believing, desiring, hoping, knowing, intending, feeling, experiencing, and so on (JACOB, 2019).

One of the contemporary authors who studies intentionality is Michel Tomasello.

> Human beings are the world's experts at mind reading. As compared with other species, humans are much more skillful at discerning what others are perceiving, intending, desiring, knowing, and believing. (TOMASELLO *et al.*, 2005, p. 675).

According to Tomasello, great apes can also perceive each other as intentional agents. But humans go further.

> [...] humans not only understand others as intentional agents but also put their heads together with others in acts of shared intentionality, including everything from concrete acts of collaborative problem solving to complex cultural institutions. (TOMASELLO, 2014, p. x).

In general, we agree with Tomasello's *hypothesis of shared intentionality* (2014, p. 31):

> The *shared intentionality hypothesis* is that this story comprises a two-step evolutionary sequence: joint intentionality followed by collective intentionality. At both of these transitions the overall process was, at a very general level, the same: a change of ecology led to some new forms of collaboration, which required for their coordination some new forms of cooperative communication, and then together these created the possibility that, during ontogeny, individuals could construct through their social interactions with others some new forms of cognitive representation, inference, and selfmonitoring for use in their thinking.

But intentionality and purpose must be considered as different concepts.

> [...] an intention is a plan of action the organism chooses and commits

> itself to in pursuit of a goal. An intention thus includes both a means (action plan) as well as a goal [...] (TOMASELLO *et al.*, 2005, p. 676).

That is, the same action, observed externally, may have different intentions. In research data on the actions of teachers and students this appears frequently. Consider, for example, the action category "to wait". It has been found in several research projects, both for teachers and students. The action to wait[10] can have several different goals. In the case of teacher action, waiting could have as objectives: to wait for the students to enter the room, to copy, to be quiet, to organize their materials, etc.; in the case of student action, waiting could have as objectives: to wait for the teacher to arrive, to wait for the teacher to return to the classroom, to wait for the teacher to start the explanation, etc. (BENICIO; ARRUDA; PASSOS, 2020a).

Some authors, such as Franco (2016), establish differences between the pedagogically constructed teaching practice and the mechanical teaching practice, which puts excessive value on technique.

> Teaching practice is configured as a pedagogical practice when it is inserted in the intentionality foreseen for its action. Thus, a teacher who knows the meaning of his/her class in face of the student's education, who knows how the class integrates and expands the education of this student, who is aware of the meaning of his/her action, has a different pedagogical performance: he/she dialogues with the student's needs, insists on their learning, monitors their interest, makes a point of building learning, believing that this will be important for the student (FRANCO, 2016, p. 541, our translation).

The quotation highlights the intentionality and the sense of pedagogical practice, which Tardif (2002) calls action models of educational practice, which are representations that serve to define this practice, such as objectives and purposes.

In our group, for the time being, we have little research that has been dedicated to explaining teacher/student action. We can cite: Piratelo, 2018; Piratelo, Arruda, Costa and Passos, 2020.

The Connective Approach

The hypothesis that there would be a connection between teacher action and student action is already old in the group, although it has only recently been made

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[10] It is important to highlight that the action to wait meant that the teacher did not perform any other action, besides waiting. The same goes for the student action to wait. See Benicio, Arruda and Passos (2020a).

explicit. The side T-S itself in the triangle of Figure 2 brings out this idea. This led us to question Charlot's statement that what matters for learning "is the student's practice, not the teacher's practice" (CHARLOT, 2005, p. 96, our translation). That is, if the teacher and student actions are connected, it is reasonable to assume that the teacher's practice may be positively or negatively correlated with the student's practice. As of 2017, the question: "In what ways are the students' actions connected with that of the teachers?" was included in the Research Program (ARRUDA; PASSOS, 2017) and then made explicit.

Some more descriptive studies on the connections have already been carried out. One idea that seems to be promising is the Pedagogical Efficiency Indicator or PEI, defined as "the time student actions remained connected to teacher actions for a specified period" (BENICIO; ARRUDA; PASSOS, 2020a, p. 468, our translation).

After the studies on Latour's texts, we realized that the Actor-Network Theory could provide a basis for the idea of connection between actions. This word (connection) appears several times in the book *Reassembling the Social* (LATOUR, 2005, p. 5, 8, 75, 107, 108, 176, 180, 220, 221, 239, etc.). In continuity, we present moments when they appear in the referred text, where the pages are indicated by brackets.

> [...] the adjective, social does not designate a thing among other things... but a *type of connection* between things that are not themselves social [5]. [...] Social is *nowhere* in particular as a thing among other things but may circulate *everywhere* as a movement connecting non-social things [107]. [...] social connections – an expression that, as we know, does not mean 'connections made of social', but new associations[11] between non-social elements [239] (LATOUR, 2005).

Things are not "social" because the social, in Latour's sense, is an association and not an explanation of traditional sociology.

The idea of connection is central to ANT. As Latour says: "the hyphenated 'network' is not there as a surreptitious presence of the Context[12], but as what connects the actors" (LATOUR, 2005, p. 180).

> [...] networks are structures that allow to visualize in an orderly way how their elements (actors and connections) are related, allowing the user to extract meaning from the information [...]. Nodes (actors) and

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[11] The word connection is confused in the text of Latour with the word association.
[12] Understood as social context.

edges (ties or bonds) have different properties and attributes. Ties are the ones that prevent the net from fraying. Thus, if the tie of a node is removed, the network disappears. On the contrary, if the bonds are increased, the network is strengthened (FRANCO, 2014, p. 4, our translation).

From the idea of network and connections, we can expand the understanding of the classroom model in Figure 2. It will no longer be a "didactic system", immersed in increasingly larger social contexts called "teaching systems" and a "noosphere" , as we have done previously (ARRUDA; LIMA; PASSOS, 2011, p. 146), but an immense network – a didactic-pedagogical network – in which T, S and K are three actors connected to many other actors, as represented in Figure 3.

Figure 3 – Didactic-pedagogical network
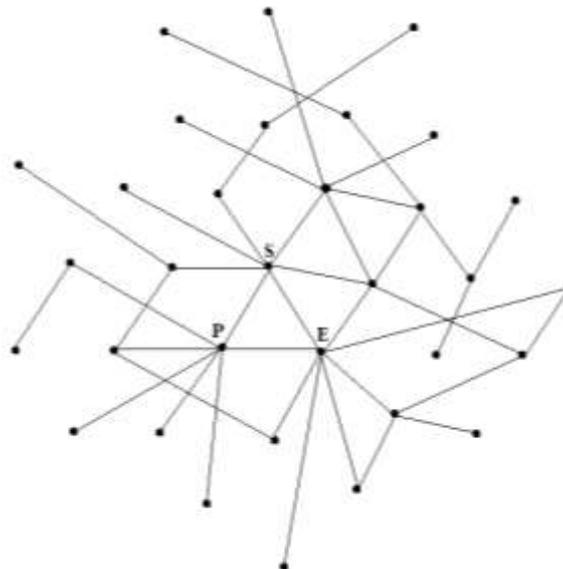
Source: the authors

In Figure 3, which would represent a *didactic-pedagogical network* built from the triangle of Figure 2, we consider that the points are actors in the sense of ANT (actants) and the lines are the connections between them. But it is good to remember that social connections are rarely just between human beings.

> [...] the continuity of any course of action will rarely consist of human-to-human connections [...] or of object-object connections, but will probably zigzag from one to the other (LATOUR, 2005, p. 75).

That is, the points correspond to human and non-human beings. We also remember that what we call the *connections between teacher and student actions* is

an inference, that is, it cannot be observed directly.

The exploration of this research approach in the group is also in its beginnings. We can cite the following works related to this: Corrêa (2021), Corrêa, Arruda, Passos and Fiorucci (2021); and Marrone Jr, Arruda and Passos (2021).

Next, we set out the objectives of PROACTION.

Objectives of PROACTION

Based on the considerations made in this section and in the previous ones, we present here the objectives established by the PROACTION Program:

1) Describe and/or categorize the teaching actions (teacher actions) and/or learning actions (student actions) carried out by teachers, students and/or other human and/or non-human actors that are part of the network, in any area of knowledge, especially in Science and Mathematics, by direct observation of the classroom and/or in any physical and/or virtual environment.

2) Infer, based on the actions of teachers, students and/or other actors involved, human, non-human or hybrids[13], the possible existing connections between them.

3) Determine the central teacher actions in a lesson by means of a temporal comparison among the actions.

4) Investigate whether and how the actions of teachers and students differ depending on the methodology used by the teacher and/or the content of the discipline.

5) Interpret the intentions and objectives of the teacher and/or student actions carried out during classes, possibly in joint conversations with teachers and students.

6) Describe the connections between the actors in order to explain the structure of the network that supports them.

7) Investigate the connections between teacher and student actions through the Pedagogical Efficiency Indicator (PEI).

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[13] A hybrid can be thought of as a mix between a human and a non-human: "Actors are mostly hybrids. An automobile is an actor, a car/driver hybrid, a mechanical apparatus under some human control that also produces and constrains particular human actions and mobilities, even identifications" (FENWICK; EDWARDS, 2010, p. 152).

8) Investigate the participation of non-humans in the course of teacher and student actions and the action of hybrids.

9) Investigate teacher and student learning as an effect of the connections and participation in the network.

10) Develop models and instruments for the analysis of descriptions, explanations and connections between teacher and student actions.

Final considerations

In this article we presented some theoretical and methodological options that the researcher can adopt to conduct investigations under the PROACTION Program. The deliberate use of the word *option* reflects the way we understand research on teaching and learning.

From a general point of view, our research conception considers that the data and theoretical references must *adapt* to each other, as already proposed for the theory-experiment relationship in Physics education.

> In this work, based on a discussion about the different possibilities of understanding the relationship between theory and experiment, we propose, based on Thomas Kuhn's ideas, complemented by van Fraassen's thinking, a new orientation for the Physics laboratory, conceiving it, not as a confirmation or disproof of hypotheses, but as a process of adaptation between theory and experiment (ARRUDA; SILVA; LABURÚ, 2001, p. 47, our translation).

This provides us with two general guidelines for conducting an investigation: (i) we can start from a theoretical framework, with clear research questions and well-defined models, which lay the foundations for large *a priori* categories, with which the collected data are articulated; (ii) or, we can go directly to the data collection and, as the analyzes are carried out, *a posteriori* categories emerge, which will then be adjusted to the theoretical framworks[14]. As we have emphasized in the EDUCIM Group meetings, whatever the adopted guideline, the final product of the investigation (the thesis or dissertation) must take the form of a text that harmoniously articulates the data with the theoretical references, so that the final product has at least the following qualities: originality, clarity, coherence, conciseness and cohesion[15].

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[14] We can see similarities between our research perspective and the top-down or bottom-up approaches, mentioned by Tardif and Lessard (2008), commented on in the 2nd section of this article.

[15] We thank Professor João Paulo Camargo de Lima for reminding us of this list of attributes that a research work should have, emphasized in EDUCIM meetings several times.

Next, we present responses to the criticisms commented on in the Introduction. The first criticism questions the relevance and originality of some investigations conducted in the group. As for relevance, it must have become clear that analyzing what the teacher does, in fact, in the classroom, is an old concern in the field of teacher education, as we saw in the quotations by Schön (1997) and Tardif and Lessard (2008), corroborated by other research works (ARRUDA, 2001; PASSOS, 2009).

Regarding originality, the research carried out in the group shows a new perspective of classroom research, without similarities with other research on teaching, learning and/or teacher education, with the exception of what Tardif and Lessard present in chapter 7 of the book Teachers' Work (TARDIF; LESSARD, 2008, p. 235-248). However, these authors are more concerned with interactivity in concrete classroom situations and are more focused on the teacher and his/her objectives than on the connections between teacher and student actions and their implications for the learning and education of these two actors.

The second criticism concerns the theoretical part of our work and the excess of self-citations. It is likely that, in some of them, the conversations with the literature in the field, especially teacher education, was not evident or insufficient. In the present article we try to present three different possibilities for the foundation of the research. In teacher education, there is an obvious relationship with research on teaching practice. However, social theories of action also offer an excellent theoretical anchor. We particularly appreciate Lahire's ideas, which seem to unite intentional and unintentional views on action. As a third option we have ANT, which understands action from another perspective, which is very promising for our research.

Regarding the excess of self-citations, this occurs, evidently because we are not aware of other bibliographic productions equivalent to those published by our group.

The third criticism concerns the nature of the research and its methodology, which would be only descriptive and not analytical or interpretive. Although in the initial research the focus was more on description, as explained in the previous section, the Research Program is not only descriptive, but also explanatory and connective.

In fact, regarding description, Latour asks: what is it that is wrong with descriptions?

The simple act of recording anything on paper is already an immense

> transformation that requires as much skill and just as much artifice as painting a landscape or setting up some elaborate biochemical reaction. No scholar should find humiliating the task of sticking to description. This is, on the contrary, the highest and rarest achievement. [...] the opposition between description and explanation is another of these false dichotomies that should be put to rest [...]. If a description remains in need of an explanation, it means that it is a bad description. (LATOUR, 2005, p. 136-137).

Still on methodological issues, it needs to be clear that the categories, obtained after the descriptive analysis of the classes, are emergent, that is, they do not need explanation, which is not the case with *a priori* categories. Regarding the complaint that in the articles few classes are analyzed (in general, two or three), it is necessary to clarify that the recording of the timing of each action and the subsequent codification of the units of analysis in just one class is immense. In other words, the data provided by a few classes is sufficient to produce a good experimental basis[16].

Finally, we will mention some possible developments of the PROACTION Program. Looking at the Program as a whole, it is possible to see that it is a sequence of long-term research works, whose initial focus was mainly on the descriptive approach. As a result, the results of the explanatory and connective approaches are still incipient. We think that a large part of the dissertations and theses should include these approaches, in the coming years.

Another point to be explored concerns the concept of connection, which must be deepened both theoretically and experimentally. We emphasize here the connection between teacher and student actions in the formal education system, represented by the didactic triangle. We suppose that learning should be more efficient when actions are connected.

However, from a theoretical point of view, we believe that the concept of connection goes beyond the formal teaching context and can be applied to learning in general. The fundamental hypothesis is that learning, in the broad sense, that is, regardless of whether education is formal or informal, is directly related to the possible connections between the actions of the learner and the actions of other actors, whether they are human or non-human. Connections in general produce learning and development. To Make connections is to understand a little more about the education

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[16] See, for example, Dias (2018), Appendix A (p. 91); Benicio (2018), Appendix C (p. 240) and Appendix D (p. 281); Assai (2019), Appendix B (p. 175).

of a teacher or the learning of a student[17]. This position, in a way, echoes what Tomasello says.

> Thinking would seem to be a completely solitary activity. And so it is for other animal species. But for humans, thinking is like a jazz musician improvising a novel riff in the privacy of his own room. It is a solitary activity all right, but on an instrument made by others for that general purpose, after years of playing with and learning from other practitioners, in a musical genre with a rich history of legendary riffs, for an imagined audience of jazz aficionados. Human thinking is individual improvisation enmeshed in a sociocultural matrix. (TOMASELLO, 2014, p. 1).

The connection is also historical, as Tomasello's quotation shows. The connection is not only spatial, but also temporal. To learn Physics, Astronomy, Chemistry, Mathematics etc., is to connect with concepts, theories, models, examples (in the sense of Thomas Kuhn), which are part of the history of scientific development. The study of connections opens, therefore, a perspective for the History and Philosophy of Science or for the works of Latour and the Actor-Network Theory.

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[17] See Latour (2012), p. 180, in particular footnote 234.

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