

# MATHEMATICS EDUCATION AND AFFIRMATIVE ACTIONS: POSSIBILITIES AND CHALLENGES IN HIGHER EDUCATION TEACHING<sup>1</sup>

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## ABSTRACT

*The aim of this paper is to reflect on conceptions of STEM program faculty members concerning the implementation and maintenance of affirmative actions in higher education. Data were produced through interviews with faculty and managers in mathematics and engineering courses, and were organized and analyzed using content analysis from the theoretical perspective of critical inquiry. Results can be summarized in four themes: beyond the culture of dependency; affirmative action students' singularities, particularities and academic achievement; the permanence issue; and the valuing of teachers involved in practices aimed at promoting the permanence of affirmative action students.*

AFFIRMATIVE ACTION • EQUITY AND EDUCATION • TEACHING •  
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**A**FFIRMATIVE ACTION POLICIES ARE ASSOCIATED TO THE DEVELOPMENT OF PRINCIPLES for fighting discrimination by creating norms and differentiated criteria to provide access to certain goods or services to individuals belonging to specific, mostly vulnerable groups, implying an ideal of equity of access, regardless of individuals' ethnic, racial, social or gender origin. In Brazilian higher education, a few public universities have affirmative actions in place since 2003 by means of place reservation programs or mechanisms to increase candidate grades in selection processes. In subsequent years, the number of institutions that fomented some kind of affirmative action progressively increased. This led both supporters and opposers of such policies into intense discussions, which divided the society (GOLDEMBERG; DURHAM, 2007; MAGGIE; FRY, 2002; SEIFFERT; HAGE, 2008). In 2012, the Federal Supreme Court denied several lawsuits filed against the use of affirmative actions in higher education. The justices found that in the context of higher education, they are constitutionally legal. In the same year, the federal government had a bill enacted which became known across the country as the "law of quotas", establishing that all federal higher education and vocational institutions shall reserve at least half of all places in all courses for students who graduate from public schools, respecting the social and racial aspects (BRASIL, 2012).

Since the fomenting of affirmative actions in our country, many studies have discussed questions related to their justice, equity and validity in the context of higher education (CAMPOS; FERES JUNIOR;

DAFLON, 2013; CARVALHO, 2003; CATANI; HEY, 2007; GOLDEMBERG; DURHAM, 2007; SCHWARTZMAN, 2008; SEIFFERT; HAGE, 2008). Others have focused on aspects related to comparisons between the performance of affirmative and non-affirmative action students (BEZERRA, 2011; CAVALCANTI, 2015; MATTOS; MACEDO; MATTOS, 2013; PINHEIRO, 2014; QUEIROZ; SANTOS, 2010), academic, social and racial experiences of affirmative action students who entered courses (BROSTOLIN; CRUZ, 2010; CARVALHO, 2010; DAL'BÓ, 2011; WELLER; SILVEIRA, 2008), questions linked to stereotyping, social representation and coexistence between students, and questions concerning society's opinions on the use of those policies (CICALO, 2012; GUARNIERI; MELO-SILVA, 2010; LIMA; NEVES; SILVA, 2014; MENIN et al., 2008; SILVA; SILVA, 2012). However, diverging opinions about affirmative actions still circulate in universities, among faculty, managers and students, particularly in STEM courses. Therefore, the present article aims to reflect on conceptions of STEM faculty members regarding the implementation and maintenance of affirmative action policies in the context of higher education. Today, this area has demanded new possibilities and encountered new challenges, such as thinking about differentiated forms of research on the entrance of groups who were thus far out of higher education, and discussing, somehow, questions that already seemed challenging to higher education even before that inclusion, mainly concerning the high failure and dropout rates in mathematics-related disciplines. Thus, the article seeks to expand the discussions about affirmative actions in the context of Brazilian higher education, in which students from under-represented groups, of different cultures, with varied backgrounds, and often the first in their families to attend higher education, are overcoming the barrier to access and entering sought-after courses at prestigious public and private universities, particularly after the fomenting of affirmative policies.

This article discusses results of a qualitative study. Data were produced through interviews with faculty and managers in mathematics and engineering courses at two federal universities in the Southeast region of Brazil (UFA and UFB, fictitious names). We chose these institutions as our field of research because they have important characteristics regarding affirmative action policies, such as: they use affirmative actions since 2007, thus preceding the legal provisions that made affirmative actions mandatory; they have specific sectors to deal with matters related to affirmative actions, e.g., the offer of psycho-social and psycho-pedagogical services, as well as higher education introduction courses; they foment funding for socioeconomically vulnerable students; and one of them implemented a special selection process for indigenous and refugee students in Brazil. In this work, our

reflections were conducted from interviews with six faculty members: Ana, Amanda, Marcos, Paulo, Henrique and Reginaldo (fictitious names). Instead of rigid questionnaires, the interviews sought to allow for open dialogues with the teachers. Thus, they were conducted individually, audio-recorded and later transcribed with the participants' consent. In addition, whenever analytical perceptions emerged during the talks, we recorded them in a field notebook. Moreover, according to the initial impressions we formed from our interaction with the participants, we made short summaries after the end of each interview. Those summaries were initially included in the field notebook and later developed and increased. To complement the interviews, we also explored official documents of both institutions.

To organize and analyze data, we used content analysis, from the theoretical perspective of critical inquiry (CROTTY, 1998). Once all data (transcribed interviews, field notebook notes, summaries and official documents) were organized, we conducted an in-depth reading of and an immersion in all of them. This process allowed assigning codes and constructing categories and themes, which were compared as more analyses were conducted, with changes made as necessary. The results of this process allowed important reflections, which were discussed in the light of a wide range of theoretical sources, about aspects of affirmative action policies that are part of teachers' everyday practice. These results may be summarized in four themes: beyond the culture of dependency; singularities, particularities and academic achievement of affirmative action students; the permanence issue; and the valuing of teachers involved in practices aimed at promoting affirmative action students' permanence.

## **BEYOND THE CULTURE OF DEPENDENCY**

Among the STEM faculty members who participated in the research, we found a discourse that affirmative action policies are more than a mere form of culture of dependency and that they are important to lessen the existing inequalities in Brazilian higher education. Brazil's social inequality, the search for equal opportunity, the benefits of diversity, the possibility of upward mobility and the ideal of a fairer society were present in their arguments. Below we present excerpts of the interviews with Ana and Paulo which exemplify this stance, which was repeated in other talks. Ana has been teaching at the UFA for almost ten years. She conducts research and works with disciplines in the area of mathematics education. In turn, Paulo is in the area of pure mathematics; he has been teaching at the UFB for about eight years, and teaches disciplines in several courses in the field of mathematics and engineering.

Paulo: *The idea of discussing policy of quotas is to discuss a social question, it's about social and educational policy. In this perspective, the goal of these policies would be for you to put into the system, in those deliberative positions that have decision power, people who were excluded, who represent excluded sectors. Then you have a better chance to change the course of things. It's a mechanism that comes with defects, brings complications, but it has that role of changing the order of things. If we don't change the order of things, nothing is going to change at all.*

Ana: *We're talking about a society that was slave-based, that had a military dictatorship in its history, a society that, in the beginning of its education, it was totally religious, with the Jesuits, with that non-professional thing, the teacher is that person who must have a vocation and who doesn't need a wage. All this is in the imagery of society. Brazilian society still hasn't got used to thinking that we can and must indeed have anybody actually anywhere. This "any" involves people with special needs, black people, indigenous, etc., anybody, anywhere. To me, though it may be a little radical, Brazilian society will really show that it is democratic, when we have proportionally blacks, indigenous, with special needs, whites, being representatives, governors, deans, cleaning staff, teachers, at restaurants. That's what democracy is to me, to have people in any place, whether good and bad. Today, we still don't have that. If we walk into a classroom now, we won't have census' proportion in the classroom, since preschool. I have to walk into the hospital and see that proportion in the number of doctors. We still don't have that. The Brazilian society doesn't even think it can walk into a hospital and see an indigenous doctor, or rather ten indigenous doctors. The day that happens will be like 'God, am I seeing right?!' To me, I still expect to see that. In every place, to see people circulating, blacks, indigenous, whites, etc.*

In Brazil, the question revolving around access to higher education through some affirmative action is still an obstacle, particularly in an education system that is historically related to meritocracy. One of the goals of affirmative action policies in higher education, as Paulo pointed out, is "to change the course of things". According to Ghiraldelli Jr. (2013), these policies may be thought of as an opportunity to expand coexistence, thus becoming a form of decreasing people's preconception and, consequently, their prejudice. It is the idea of "in every place, to see people circulating", as Ana pointed out. Even with this stance among the teachers interviewed, Park and Denson (2009) argue that STEM faculty are less likely to support diversity in the campus when compared to

other areas. Based on a study involving 40,000 faculty members at 411 colleges and universities in the United States, the researchers found that STEM students were the least favorable to such diversity. The authors believe that this is possibly owing to the small number of black students and ethnic/racial minorities in those courses. In addition, they highlighted that there are few theoretical connections with diversity in STEM courses, in contrast with humanities, arts and social sciences. This cannot be generalized to the Brazilian case, however, the work of the American researchers raises a question that is pertinent to the matter. And the teachers who participated in the present study are apparently in the opposite direction to that of the findings of Park and Denson (2009).

In Brazil, factors like income and race have historically determined who attends higher education or not (RISTOFF, 2014). Therefore, would it not be the responsibility of the university, as an institution maintained by the society, to have as one of its goals to develop mechanisms that can fight this inequality? In line with Ronald Dworkin (2011), the answer should be yes. According to this author, the university should try to build a faculty which, as a whole, can bring greater contributions to the goals defined by the institution. Dworkin does not expect all universities to have the same aims and goals, and he points out that, obviously, each institution has its freedom, within certain limits, to outline its own scope. However, they have public responsibilities that are not simply a matter of pursuing technological and scientific advance. To Dworkin (2011), the goals should be chosen with the purpose of benefiting the community in a broader way, rather than just focusing on the institution's students and teachers. Thus, it would be impossible to think that the university is ultimately focused solely on producing knowledge. There are other factors involved to which it may and should contribute. If fighting inequality in society is within its reach, then it makes every sense to use mechanisms to obtain a faculty with individuals of all sectors of society and of all races. The purpose is for such contributions to reach the community, thus collaborating to make it fairer and more harmonious. As Dworkin (2011, p. 572) points out, "we expect educational institutions to contribute to our physical and economic health, and we should expect them to do what they can for our social and moral health as well". The results of our study provide evidence that the positions of the teachers converged in that direction. Many showed concern with the country's social inequality and the way higher education often contributes to perpetuate these inequalities: *[the] Brazilian society doesn't even think it can walk into a hospital and see an indigenous doctor, or rather ten indigenous doctors. The day that happens will be like "God, am I seeing right?!"*

Many who advocate affirmative action policies claim that they are a form of compensating for the damages that certain groups suffered

in the past and which somehow affect the life of their descendants (SANDEL, 2014). This stance was present during the interviews. Ana, for example, was very emphatic in affirming that it is impossible to take a position for or against racial-based affirmative action policies if people do not learn about the history of black people in Brazilian society. Such discrimination, according to the teacher, has reflected on the everyday life of black students, from basic school to formal jobs. However, racial differences are still very big. In a country in which 53% of the population are self-declared black (BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS – IBGE, 2013), their representativeness in the higher education context is still much smaller than that of white students. According to data from the National Household Sample Survey – Pnad – and the Higher Education Census, in 2012, black individuals aged 25 years or over who had a higher education degree represented 13.3% of the total, 10% less compared to white students in the same conditions. The social contrast is also very evident in these figures, showing that individuals aged 18-24 years who were enrolled or graduating in Brazil and were part of the 20% of the population with lowest income represented, in 2012, only 4.2% of the total number of students. As for those belonging to the 20% of the population with highest income, they represented 47.1% of the total.

One of the teachers interviewed, Henrique, underlined that the “law of quotas” tends to collaborate to include both the black and the poor populations into the sphere of higher education. He said he was already noticing a few differences in his routine at the university. Henrique had been teaching disciplines in engineering courses for more than eight years at the UFB, particularly in the area of materials engineering, and was also a manager for the office of the dean when we interviewed him. His account shows a scenario that formed in the institution since the fomenting of affirmative actions.

*Henrique: At this year's enrollments, I saw far more poor people circulating in the enrollment sector, but not necessarily black people. I saw really poor people coming for enrollment, that mother saying, "my son was accepted in college". That really got my attention and made me really happy.*

As previously underlined, affirmative action policies in higher education are not an unanimity. In the society in general, there is still much resistance in relation to its use, which ends up reflecting on faculty. All the interviewees affirmed that they noticed, often in an implicit, subtle way, some opposition of department colleagues concerning students admitted through affirmative actions. The following excerpt

of the interview with Ana shows this feeling, which is present in her work environment:

Ana: *We have faculty members who think in terms of a culture of dependency. How do they think? "I feel sorry for them". When you think like that, "I feel sorry for that student who got here through the back door", that's already a problem. "It's the poor fellow who's not going to finish the semester. So, I'm not going to do much for him, because he's just a poor fellow anyway, soon he'll be quitting the course and I won't have to worry about that anymore. It won't be my problem anymore". So that student is considered a poor fellow, who tried and was frustrated. That is a vision that I've noticed in the university as a whole. You have that in school too. "I feel sorry for him, because his family is problematic, etc." It's what I call a culture of dependency. You have that kind of concept. The government gave these poor fellows the opportunity and they don't know how to use it, they have no knowledge. So, they don't need to stay around here. How do I notice that in the university, this vision of thinking about affirmative actions as a culture of dependency? [...] Here we still notice colleagues who see indigenous or any other group as a group who really doesn't know anything, they don't know the concept of anything, so you'd better not even invest much in them. I don't know what to call that group of teachers, but we have that here. Obviously, all this certainly exists in other places too. So I ask you: we have to deal with this, but how?*

At this point, we should highlight a few questions. With regard to black and indigenous students, many could understand affirmative action policies as a form of compensating for mistakes of the past, particularly regarding slavery. With regard to socioeconomically vulnerable students, many could consider affirmative actions a “good deed” or some kind of “charity” for these individuals. Further, many could “feel sorry” for the students who do not have the “traditional profile” that predominates in more selective institutions, like having attended good schools, coming from financially sound families, or having significant technical skills in mathematics. Various interpretations are possible. However, affirmative action policies in higher education should be seen as something different, which transcends any one of those ideas. In Silva e Skovsmose (2016), affirmative actions are discussed in a broader framework which is related to social justice matters. The exclusion that many groups have suffered in our society is a particular case of what we call *structural violence*, which is deep-rooted in sociopolitical and economic structures. That violence is exercised through routines, traditions, regulations and many other practices, and



it is represented by a power structure. Moreover, structural violence has characteristics that can be easily identified. First, there is not one well-defined person or institution which exercises that violence. It can also be turned into forms of discrimination that often concern access to food, health care, well-being and, of course, education. Ana brought a good example of that discrimination: *It's the poor fellow who is not going beyond the first semester*. Further, structural violence is accompanied by legitimizing discourses that make discrimination seem natural and unquestionable. “Most black people commit crimes” or “engineering is not for just anyone” are typical examples of that naturalization.

Many groups of people have been suffering that kind of violence throughout their lives. In this perspective, we discuss structural violence in the Brazilian society, particularly regarding the educational system. Black and poor students have been marginalized from the higher education system over the years in Brazil. This has strongly affected the standards of living in our society. We debate the necessity for individuals belonging to these groups, which have suffered various forms of structural violence over time, to have *special rights*. Thus, we interpret affirmative action policies as an expression of such rights, which goes far beyond a mere form of compensation or culture of dependency (SILVA; SKOVSMOSE, 2016).

## **AFFIRMATIVE ACTION STUDENTS' SINGULARITIES, PARTICULARITIES AND ACADEMIC ACHIEVEMENT**

Like any policy, affirmative actions can also present limitations. Even though Brazil is considered a “multicultural” country, faculty have always been mostly formed by white students from socioeconomically sound families. Recent data have proved this (IBGE, 2013). In the federal education system, affirmative actions have been seeking to fight such inequalities. But how has this process been conducted? According to Ana, the university has not been concerned with the particularities and singularities of underrepresented groups. Her account shows concern regarding the customs, cultures and knowledge that these groups bring to the institution, evidencing some resistance by the corpus of the university to accept and value such knowledge:

*Ana: These groups try to stay in the university, but you can see we're not willing to make conceptual changes. I'm talking about us, the university, so we bring the groups over, but we don't ask these groups, we don't care what their form of knowledge is. The university seems in a rush put the student through graduation, and then post-graduation, so, it's not concerned with these groups' singularity.*

How much knowledge could an indigenous student from a tribe in Brazil's central region bring to discussions in disciplines? How much knowledge could a student from a Landless Workers Movement's settlement bring to mathematics classes? The wood cube method used in Landless Workers Movement's settlements, which is discussed by Knijnik (2009), could provide an excellent discussion in the disciplines of calculus, for example. When Ana stresses that *we don't care what* [these groups'] *form of knowledge is*, she is emphasizing the importance for academic mathematics to approximate the mathematics of the various groups entering the university via affirmative actions. Amanda, who teaches at the UFA, provided an example of such an action. Together with two other teachers, Amanda developed an extension project that aimed to discuss with indigenous students academic knowledge of mathematics and physics, approximating it to students' everyday tasks. She stressed that the students usually entered the courses with serious difficulties related to basic education and not fully mastering Portuguese language. The action conducted by Amanda and her colleagues aimed to contribute to mitigate these difficulties. However, the teacher emphasized that participating in the course contributed to the students in other ways:

*Amanda: Then we realized that, in fact, what was really helping those students was less the mathematics and physics concepts we taught than the fact of valuing them [indigenous students] as persons in the university. Their feeling welcomed, their feeling that their culture is also important, because the discussion is: "why what is in the academy is important and the knowledge I have in my village is not?" So, when they realized that knowledge from their ethnicity is also important and that our talk had the same level of importance, that really brought positive results, you know? Because it makes them not to quit the course. They have many difficulties, but they end up dedicating themselves more, because they have a more positive vision of the university. I think this was the group's main outcome.*

During the production of data in the study discussed in this article, we made several visits to both the UFA and UFB, in addition to consulting various official documents of the institutions. In analyzing data, we found the existence of few actions like the one conducted by Amanda. Many of the teachers said they were concerned with the permanence of affirmative action students in the STEM courses, but there were few actions in this respect. Ana's concern with valuing groups' singularities apparently has not been a stance adopted by mathematics departments and institutes, let alone by universities and colleges.

During the interviews, teachers underlined everyday difficulties related to disciplines such as differential and integral calculus. According to them, this is not a problem solely caused by affirmative actions, as students in general have not been coming “ready” for the level of mathematics required by the institution. According to Paulo, for example, over time, most new entrant students, whether benefited by affirmative actions or not, have entered the courses with many academic difficulties related to mathematics contents. According to the teacher, this has contributed to a high failure rate in courses’ initial disciplines. Of course, this is a much broader question which involves the whole Brazilian basic education system and escapes the scope of this paper. However, it reflects an attitude that many of the teachers interviewed share: both affirmative and non-affirmative action students present major difficulties in mathematics disciplines, particularly in the initial period of courses.

The question of academic achievement among affirmative and non-affirmative action students was not the focus of the study discussed here. Therefore, we do not present data on students’ performance. In this respect, a few studies diverge. For example, Queiroz and Santos (2010) showed that, in the Universidade Federal da Bahia – UFBA –, the first class of students who had entered the institution via affirmative actions presented equal or higher performance coefficients than their non-affirmative action peers in over 60% of the most sought-after courses. On the other hand, using similar data collection procedures, Mendes Junior (2014) showed a different situation in the Universidade do Estado do Rio de Janeiro – UERJ –, where the average performance coefficients for the first class of affirmative action students was below that of non-affirmative action students, and that difference did not decrease over time.

The question of affirmative and non-affirmative action students’ academic achievement is, indeed, a delicate subject, and one cannot jump to hasty conclusions. For example, William Bowen and Derek Bok (2004), in their book *The Shape of the River*, conducted a major study on affirmative action policies and their effects on American higher education. The authors used a vast database with admission records and academic histories of over 90,000 higher education students at tens of institutions and raised significant questions about affirmative action policies, one of which may contribute to the discussion, particularly concerning students’ performance. According to Bowen and Bok (2004, p. 131), the average rank of affirmative action black students in the universities studied was lower than that of white students within the same SAT (Scholastic Assessment Test) interval, i.e., “black students with the same SAT scores as whites tend to earn lower grades”. But why did that happen? According to the authors, several factors can contribute to this “underperformance” effect. One of them is that,

usually, affirmative action students need to spend energy on various non-academic matters, facing situations that their peers in other groups usually do not. Other works also corroborate this fact (FOLTZ; GANNON; KIRSCHMANN, 2014; FRIES-BRITT; YOUNGER; HALL, 2010; HASKINS; KIRK-SANCHEZ, 2006; MUSEUS; LIVERMAN, 2010; TEREZINI et al., 1994). In the Brazilian context, the study of Felicetti (2011), for example, showed that, among other questions, affirmative action students<sup>2</sup> had to work to help support their families. Often, the students supported their households by themselves. Thus, those students ended up developing what Felicetti called a *double burden*, i.e., harmonizing job and academic life. Hrabowski *et al.* (2002) also highlight that black students in predominantly white campi are more likely to suffer from some kind of social and academic isolation. This is even more evident in STEM courses. Seymour and Hewitt (2000) say that this isolation makes students have doubts about their belonging in the campus, to wonder if “others” deem them incompetent, to become reluctant to look for any kind of help or make questions during classes, and to have no group of colleagues to share their experiences with.

In this perspective, what could studies on the performance of affirmative and non-affirmative action students tell us? In our view, nothing. Despite the difficulties, the studies conducted in the UFBA, in the UERJ and also the work of Bowen e Bok showed that most of these students persevered and completed their courses at high graduation rates. And it is in this direction that the discussion raised in this article can be considered important. Thus, we should not worry about making comparisons. We need to think of how to ensure the permanence of, and a better use of academic experiences by a group of students that might not have such an opportunity without affirmative action policies. Bowen e Bok (2004) showed that the benefits that come to groups which are underrepresented in the university, when a greater number of their members participate in all professions, exceed economic factors to return as benefits to the group itself as a whole. Thus, the discussion about affirmative policies should revolve around developing forms of contributing to the permanence and progress of students, particularly in the area of exact sciences, which is traditionally marked by high dropout rates, rather than focusing on comparing the performance of one student group or other.

## THE PERMANENCE ISSUE

Both in the American and the Brazilian scenario, the issue of affirmative action students' permanence in university is always debated. According to Bowen and Bok (2004) and Bowen, Kurzweil and Tobin (2006), these students are more likely to remain successfully in more selective

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In the study cited,  
the students were full  
scholarship holders at  
a private university.

institutions. Somebody could point out that this question is obviously related to these students' academic merit, as even though they used some affirmative action, they had high grades to enter a highly selective institution. However, in the research of Bowen e Bok (2004), students within the same admission grade interval at less selective universities showed a greater tendency to leave the course. One of the possible factors indicated by the researchers is the greater amount of funds that highly selective institutions have, showing that the financial question is key for students' permanence.

The results of the research discussed here show that this concern was also recurrent among the teachers who participated in the study. Henrique, for example, said he was aware that the financial side significantly affects students' everyday life and favors their permanence in the course. He highlighted that funds to subsidize the academic life of socioeconomically vulnerable students have been fundamental in his university, as they help in various aspects, from board and accommodation to the acquisition of equipment, such as laptops and graphing calculators. Nevertheless, one might question whether financial support alone suffices in collaborating to affirmative action students' permanence. Bowen and Bok (2004) showed that, in the more selective American universities, in addition to funds for board, accommodation and transport, there were also resources in terms of pedagogical support and academic guidance for those students. According to the authors, this set of measures can be responsible for the high graduation rates of students from underrepresented groups in those institutions. The teachers who participated in our study presented concerns in this respect. They said that other demands should also be present in university management discussions, particularly in the mathematics departments.

Moreover, the results of our study evidence a recurrent concern among teachers regarding the lack of previous knowledge in both affirmative and non-affirmative action students. Thus, one of the primary motivations to create possible pedagogical strategies for the permanence of students comes from what they call a "lack of previous knowledge" in newly entrants to STEM courses. In this perspective, the teachers highlight that the mathematics that is taught during secondary education has been emphasizing the memorization and training aspects, which causes new entrants to face academic difficulties in reflecting on and understanding the concepts that are taught during higher education. This concern was, therefore, one of the main motives for thinking about pedagogical strategies of permanence for students in STEM courses. In addition, the high failure rate in the disciplines of differential and integral calculus, particularly in early stages of the course, was unanimously referred to by the teachers.

From an institutional perspective, both the UFA and UFB adopted a few pedagogical measures to help students in this respect. Among those, it is worth mentioning the “levelling courses”. Based on a document survey and on e-mail exchanging with mathematics course coordinators and teachers at various federal universities in Brazil, we found this practice to be commonplace. Normally, such courses are offered by mathematics departments at the beginning of courses, often in connection with the office of the dean for extension. Faculty, graduate students and undergraduates in late college years administer the classes. A few courses changed their curriculum grid by reorganizing and adding compulsory subjects such as “foundations of mathematics” or “mathematics bases”, which work as prerequisites for the disciplines of differential and integral calculus and analytical geometry, among others. This was done in all STEM courses at the UFB and in the mathematics course at the UFA.

The question of “leveling courses” raises a pertinent question to mathematics education. During the interviews, various teachers questioned this practice. Ana, for example, asks the following question: *leveling to whom?* Most of the teachers interviewed said the actions should be designed to serve all students, as practice has shown that both affirmative and non-affirmative action students were facing many difficulties related to mathematics at those institutions. Paulo, for example, affirmed that *the problem is much more serious than changing calculus for pre-calculus. It's a structural thing that's even more complicated still. The university is not being able to manage this contingent. It's not about putting extra activities here [in the university].* Thus, leveling courses and “pre-calculus-type” subjects are usually attended by most students, regardless of how they entered college and what secondary education they attended.

Moreover, the teachers considered that, in general, students who entered via affirmative actions ended up having difficulties at the beginning of the subjects, since many of them did not study the necessary contents for the disciplines of the course. As for the students who entered through broad competition, normally coming from private schools, they had already dealt with such contents, though in a mechanical way, solely aiming to be approved in the university's admission test. Therefore, a deadlock emerges: should the university be concerned with this question and try to “remedy” aspects of secondary education in higher education? Many teachers said this is not part of the university's role. Reginaldo, for example, said that an introductory subject is not going to solve this question. Reginaldo has been teaching at the UFA in the area of mathematics for four years, and for over ten years in higher education. In the excerpt below, the teacher exposes his concern regarding the permanence of students, particularly those who entered through affirmative actions:

Reginaldo: *You've spent eleven years in school and it's not now, in six months, that you're going to learn what you didn't in eleven years. I think that's a totally mistaken way of dealing with this delicate matter which is the inequality because of the culture these people experience and, when they get in college, they find another culture. So, there's this culture shock, and that, in a way, it hasn't been treated in a more balanced way, so to speak. What you have is: there's a possibility of putting into university some people who never thought they might be there. Period, which is the quotas issue. The moment they get here at the university, there's no specific treatment of any kind for these people who get here, unlike those who had another form of basic education. So, the university works from a homogenizing perspective in which you can see no concern with discussing the permanence of students here. You could say: "well, you have the dining hall, then there's the permanence scholarship. etc." So, there are financial resources, albeit scarce, but it's not just financial resources that are going to make these people stay here. Obviously, it's going to depend a lot on each person's effort to try and fit into the system. Efforts do exist. I can see there are some people [...] who manage to go beyond themselves and they'll go straight on, but at quite heavy costs, both materially speaking but not just that. They can survive that, but there is a "capital", so to speak. A cultural capital that is really far from the cultural capital the university requires you to have to remain here.*

There are many factors that influence the permanence of students from underrepresented groups in the university, both from the material and the symbolic point of view.<sup>3</sup> As Reginaldo stressed, these students need to "fit into" the system by making efforts in various aspects of academic life, from studying basic education contents to acquiring materials. As mentioned earlier, it is believed that offering a contents leveling course could be enough. However, Hrabowski *et al.* (2002), for example, point out that such "remedial" actions are usually more harmful than useful. According to the authors, a more interesting strategy would be to challenge students from underrepresented groups to reach higher standards in university. Hrabowski and Maton (2009) highlight that, besides improving the course completion rate for students from underrepresented groups, the institution should ensure that they stand out in the course, gain substantial research experience and continue their studies via post-graduation. Based on various studies, Hrabowski *et al.* (2002) discuss a few facts that can collaborate in this respect. According to the authors, academic and social integration is key to the progress of these students in STEM courses. For example, in

<sup>3</sup>

See, for example, the discussion in Santos (2009, p. 71-79).

these courses, black students tend to suffer more from academic and social isolation than their peers. Thus, the contact with faculty out of the classroom environment, as well as developing guidance relations, tend to mitigate that isolation and can also bring positive outcomes for the student. Other works corroborate this fact (FOLTZ; GANNON; KIRSCHMANN, 2014; MUSEUS; LIVERMAN, 2010; SEYMOUR; HEWITT, 2000). The action conducted by Amanda was such an example, as discussed earlier. As she pointed out, the indigenous students felt welcomed and valued at the institution, which brought significant contributions for those students to remain in the course.

Hrabowski *et al.* (2002) also point out that developing the necessary skills and knowledge for exact disciplines is obviously an important measure to the success of students from underrepresented groups. In this perspective, the involvement in study groups proved positive in enhancing the skills required by STEM disciplines. However, according to the authors, factors such as guidance on study habits, time management, developing problem-solving strategies and the use of the university resources available are associated to positive academic results for these students. Further, the authors point out that support and motivation are linked to high success rates among them, and also that experiences in research projects, a positive expectation by faculty, mentoring and emotional support in times of pressure and difficulty proved significant with regard to the motivation for these students to remain in the courses. Similar results were found in other works (FOLTZ; GANNON; KIRSCHMANN, 2014; HASKINS; KIRK-SANCHEZ, 2006; HURTADO *et al.*, 2007, 2010; MUSEUS; LIVERMAN, 2010).

As we can see, it is necessary to consider a set of measures that transcends the creation of a single “remedy” discipline. The analysis of data of the study discussed here indicates that the teachers presented stances which converged in this respect. However, few actions were undertaken to that end, whether by teachers or the departments of the universities that formed our research field. This points us to two important questions, which concern the valuing of the teachers who engage in this type of activity and where these actions should come from.

## **VALUING OF TEACHERS ENGAGED IN PRACTICES AIMED THE STUDENTS RETENTION**

The results of our study evidence the existence of a recurrent subject among teachers, which concerns the valuing of the teacher who engages in actions aimed at contributing to students’ permanence. This is an important subject which deserves extensive reflection on the part of the academic community. The teachers who participated in



the research were then involved, or had once been involved, in some action dedicated to the academic development of students benefited by affirmative actions or from underrepresented groups who had entered the university before those policies came into existence. The actions varied, and were often open for all students, regardless of how they had entered. Among them, it is worth highlighting: leveling courses; specialist courses on key notions of differential and integral calculus, which were discussed with a historical approach; the planning of the disciplines of mathematics bases or foundations of mathematics for inclusion in the curriculum; mathematics tuition for indigenous students; advisory and mentoring for affirmative action students, particularly in the beginning of the academic semester; creation of and participation in study groups with black and indigenous students; and undergraduate research mentorship exclusively for affirmative action students.

Most times, the teachers conducted those actions in an isolated way, and many actions were not continued. The interviews bring evidence that the low value of the teachers who were involved in these actions before the university may have been one of the reasons for this discontinuity. According to the participants in the study, often, that valuing was small or the institution simply ignored the actions. They said that when activities are not connected to research, there is no recognition on the part of the university, whether in terms of career progression or of professional growth within the department. Below is an excerpt of the interview with teacher Marcos which summarizes the feeling of teachers who engaged in some of those actions over their career. Marcos is in the area of pure mathematics and has been working for almost 30 years at the UFA, where he teaches disciplines in engineering and mathematics courses.

*Marcos: Our life here is complicated, we're doing a lot of things at once, so focusing on just one thing is really difficult. It ought to be something more structured, I mean, somehow, people have to be recognized for that work. And that's the problem. You're recognized for your research and the number of classes you give, the number of students you advise. So, you're not recognized for spending the afternoon teaching people with serious difficulties to begin to understand the basic principles of mathematics. If that were possible, if you gave a class and, at the same time, that parallel work were valued, then there'd be no problem. The university doesn't value that kind of work. The valuing I'm talking about isn't financial. That's not the point. It's valuing in the sense of recognition, really, of an important community to help.*

In Brazil, the Constitution of 1988, in article 207, refers to the inseparable relationship between teaching, research and extension in Brazilian universities (BRASIL, 1988). However, practice has shown that the more qualified a faculty member, the further he goes from teaching and extension, as there is an extreme valuing of research in the academic environment. Because actions dedicated to developing permanence strategies for students (whether affirmative or non-affirmative action new entrants) are usually planned via those two dimensions, faculty members who do not link them to some research project end up wasting their energy in actions of “little weight” for their career. This situation was mentioned in practically all interviews conducted.

Research indicates that students often identify with and seek support from teachers who also belong to underrepresented groups or who show themselves more “open” for interacting with those students (FOLTZ; GANNON; KIRSCHMANN, 2014; HRABOWSKI; MATON, 2009; HRABOWSKI et al., 2002; MUSEUS; LIVERMAN, 2010). Most times, these teachers become the only persons the students can turn to, particularly when questions emerge that transcend classroom contents. During one interview, Ana called this advisory a *fourth element* in the activities of faculty members – besides teaching, research and extension –, which does not appear in the “career progression forms” nor contributes to teachers’ ascension within the institution. Ana reported a case in her trajectory at the university involving indigenous students who had entered via affirmative actions. The students were not being “accepted” by their peers in the student residence. Knowing about her engagement in affirmative action matters, a student took them to Ana’s office and she intervened in the situation. She also reported other cases where students came to her for guidance, particularly in questions related to racial and gender microaggressions<sup>4</sup> they had suffered at the university. In the following excerpt, Ana reports her discomfort about the non-valuing of teachers who engage in that type of advisory:

*Ana: The university tells you about teaching, research and extension. The university's flagship is research. So, you work and do things, and, as I said, this fourth element, this fourth arm, the students already know which teachers they can count on, so you're here [at the office] trying to write an article, then a student walks in and he's all in tears and he reports a case like the ones I told you. Then you stop everything you're doing to help and advise that student. It's something invisible. There's no way I can put this in my Lattes CV. There's no way I can write an article about it, because it's not my research focus [...], so it remains an invisible thing, but one that's a lot of work. So, we don't have, we who work with these questions, we don't have a place where you can talk about it.*

## 4

Microaggressions are verbal or non-verbal insults against individuals for questions strongly related to race, gender, ethnicity, religion, dialect or sexual option, and its main characteristic is the subtlety and haziness of the offenses. Often, microaggressions are unconsciously practiced by the aggressor, but they can cause serious harm to the life of the persons aggressed. For a more detailed discussion on the subject, see Silva and Powell (2016).

Valuing the teacher who engages in questions related to creating and developing teaching and advisory actions for students who enter through affirmative actions is very important. This work cannot be done as some kind of “community work”; on the contrary, it must be part of a university policy. Without due valuing, the teachers who engage in such questions gradually end up worrying about other matters and leave their engagement aside. One way of contributing to value teachers may be to institutionalize those actions. Still, without attributing the due “weight” to their involvement, the participation of teachers tends to stop.

Students from underrepresented groups who enter higher education face many challenges, particularly in the area of exact sciences, many of which have a major influence on their academic development. In addition to giving classes and helping these students, there are other ways in which teachers could collaborate, such as developing advisory actions, tutorships, courses, etc. Therefore, in order for students from underrepresented groups to remain and progress in courses, it is fundamental that the teacher’s engagement in this kind of activity represent a positive status in his department (FOLTZ; GANNON; KIRSCHMANN, 2014; MUSEUS; LIVERMAN, 2010). In this perspective, the valuing of the career of teachers involved in these actions must go beyond mere personal fulfillment to become part of a university policy related to affirmative actions, since student permanence has many aspects, one of the main being teachers’ engagement.

## FINAL CONSIDERATIONS

Affirmative action policies are usually part of a conflictive arena. Still today, it is possible to find strong arguments opposing the adoption of such measures in the context of higher education. In this scenario, the present work sought to discuss the conceptions of teachers in the area of exact sciences at two federal universities in the Southeast region of Brazil who had already been working with affirmative policies since 2007, thus anticipating the law that made them mandatory. Both institutions had characteristics we considered important, such as specific sections to deal with these policies. By analyzing the data produced in the research, we constructed four themes that proved relevant to the debate around affirmative policies in that they contributed to the emergence of significant reflections about various dimensions of affirmative action policies related with higher education teaching in mathematics education. The first subject evidences that affirmative actions should be considered as more than a mere ‘culture of dependence’ policy. Results of this study indicate that teachers in the area of exact sciences view such actions as important in fighting our society’s inequalities. In

this perspective, the present article argues that affirmative action policies should be treated in a broader way, as they transcend any culture of dependence policy or charity discourse. In Silva and Skovsmose (2016), we discussed the extent of structural violence in Brazilian society, particularly concerning the educational system. That violence has caused a significant impact on the life of many groups of students. Thus, affirmative action policies are an expression of *special rights*.

A second theme is related with pedagogical concerns regarding the singularities, particularities and academic achievement of students who entered college via affirmative actions. Teachers showed a special attention towards the particularities that many of these students bring to the university. However, apparently the university, particularly in STEM courses, is hardly concerned to explore and value the knowledge that many groups are bringing to the institution. Actions like the one developed by the teacher Amanda seem very rare in the academic environment. In addition, many studies on affirmative action policies prefer to focus on questions related to the performance of affirmative and non-affirmative action students. These comparisons can make sense for managers to discuss managerial actions, but they are still much too controversial. In the present, the focus of research should be turned to other questions, such as a better understanding of aspects that collaborate to the social and academic integration of students who enter higher education via affirmative actions, as these factors can affect their permanence and academic progress (SILVA, 2016).

Moreover, the findings of this study indicate that teachers who teach in STEM courses understand that ensuring access is not enough to fight inequalities in Brazilian higher education. It is necessary to discuss actions that ensure student permanence in the university. The teachers who participated in the study even reported the necessity and relevance of the financial support provided to students from underrepresented groups. As highlighted in the article, this position is corroborated by research that points to that necessity. However, in the case of STEM courses, there are other questions that should be debated. One of the main subjects approached was the possible lack of previous knowledge on the part of new entrants, whether affirmative or non-affirmative action students, particularly in differential and integral calculus. This fact has motivated most of the pedagogical actions which are carried out via teachers' initiatives or even via the institutions. This leads us to question what else could be done to contribute in this respect. Thus, it is important for research in mathematics education to work on this area of inquiry, which can produce reflections to collaborate to the emergence of new possibilities of pedagogical practice.

Still, another theme discussed in this study highlights a tension found in the development of pedagogical actions dedicated

to student permanence. The analysis of data indicates that one of the most commonly used permanence strategies to mitigate everyday difficulties in mathematics disciplines was to create remedy actions, such as the “levelling courses”, which are often embedded in courses’ curriculums. However, this has generated some tension among teachers in mathematics departments. There are those who disagree with that practice, as they do not believe that a simple discipline (or a course) can promote a major change. In their view, it is not possible to change study habits, motivate or “remedy” the knowledge of students by trying to fit them into higher education mathematics, using just one or a set of disciplines. Finally, findings of our study indicate a great discomfort on the part of STEM teachers relating to a possible lack of recognition of teachers’ engagement in pedagogical actions for the permanence of students from underrepresented groups. As Ana pointed out, engaging in questions related to affirmative action policies within her department often became a “fourth element” among teachers’ roles. The measures indicated by many researchers, as well as the ones conducted by some of the teachers interviewed, require, among others, a considerable degree of engagement. And that always faces an obstacle – the question of the recognition of such activities. The teachers highlighted that research is privileged among the university’s attributions and it ends up receiving a greater deal of effort from the collegiate that forms the institution’s department. This is a great challenge to the university, as teachers’ involvement in actions dedicated to education is key to the permanence of affirmative action students in the university, and it cannot be left aside.

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