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Chapter 4

SELF-EFFICACY BELIEFS OF TEACHERS: AN ANALYSIS OF BRAZILIAN HIGH SCHOOL PHYSICS TEACHERS

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ABSTRACT

In this chapter we investigated the association between levels of personal efficacy beliefs and levels of general efficacy beliefs with academic education of physics teachers. Our study is based on Bandura's (1986) conceptualizations about self-efficacy beliefs. The data were collected on a Likert questionnaire applied to a group of 136 Brazilian physics teachers. The analysis consisted of correlation tests and analysis of variance, provided by the statistical package SPSS ® for Windows version 13 (Norusis, 2003). The analysis showed statistically significant results only for the personal efficacy beliefs of physics teachers. For the academic training, we observed that the graduate teachers in physics have mean rank levels of personal efficacy beliefs (78.73) compared with teachers trained in other courses in the area of exact sciences (55.40) and those trained in courses in the area of biological sciences (37.79). We highlight the association between higher levels of self-efficacy beliefs of teachers with academic training in physics, which indicates the importance of offering adequate training to physics teachers in our country. Then we performed an exploratory factor analysis in an attempt to elucidate the factors that most influence these beliefs in the context of physics teaching.

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INTRODUCTION

Recent studies in science education have revealed a multiplicity of theoretical and methodological approaches concerning the understanding of the learning process of pupils in the classroom. To some extent, all these works respond to criticisms made of the model of conceptual change that found favor in the decade of the 80s and which adopted as an implicit presupposition the idea of molding the pupil in the image of the teacher.

These criticisms appear among several researchers in the area of science teaching (Baird and Mitchell, 1986; Baird, Fensham, Gunstone, and White, 1991; Cobern, 1996; Confrey, 1990; Duit and Treagust, 2003; Duval, 2004; Gunstone, 1992; Mortimer, 1995, 1998; Pintrich, Marx, and Boyle, 1993; Solomon, 1989; Strike and Posner, 1992), as they search for inspiration in other areas of knowledge, such as psychology, sociology, philosophy of language and psychoanalysis, in the attempt to move forward in the ability to explain and interpret the processes of teaching and learning, and increase understanding of the praxis of teaching at different levels of schooling.

We may affirm that the objective proposed by the researchers in conceptual change was to encourage and provoke the modification of concepts, ideas, and representations held by the pupils, into concepts, ideas, or representations legitimized by the scientific community. Thus, the aspect considered principal for these works is the cognitive.

Among the investigations which aim at an exhaustion of the presupposition of conceptual changes we would draw attention to those that raise the question of the need to consider something which, at first sight, appears to have nothing to do with the domain of cognition: the motivational, subjective, and affective aspects.

There are authors (Fillou, 1984; Pajak, 1981) who understand that such aspects are correlated with the emotions that permeate the relationships that are established in class between teacher and pupils. In this way, the specific discipline is relegated to a second level, or sometimes, may even disappear when faced with attempts to improve the affective climate of a class. Other authors, such as Strike and Posner (1992) recognized the need to take into account aspects of the teaching-learning relationship which up till then had been barely considered, such as objectives, values and goals of the students in the process of conceptual change. In this way, the relationships of the students with their teachers, with their peers, and with the school context, begin, then, to be considered factors capable of influencing the level of involvement in school tasks and the effort applied in undertaking them.

Pintrich et al. (1993) highlight, on the one hand, the importance of the investment of research into the search for explanations and ways of treatment of learning problems, principally those related to knowledge of physics, through models of conceptual change. But, on the other hand, when they elaborate a revision of the characteristics of such models, grounded in the cognitive domain, they identify that this theoretical framework leaves two aspects wide open: the influence of factors related to the motivational beliefs of the pupils in their own learning and the possibilities of sustaining the conceptual change as deriving from the roles assumed by the individuals in the classroom.

Generally, the models merely give prominence to the cognitive domain, avoiding the inclusion of individual goals, intentions, aims, expectations, or needs.

That is to say, the motivational aspects are not taken into consideration in the investigation of the cognitive competencies for which, to some extent, the pupil should be

being prepared. These approaches are constituted as attempts to respond to the revisions of studies in the area of science education, which indicate that it is necessary to consider and include socio-psychological dimensions and environmental factors (Confrey, 1990).

In this way, the most recent studies and results in the area of science teaching introduce the need to understand in what way motivational factors can influence learning, in particular, self-efficacy beliefs. The inclusion of motivational aspects in the process of conceptual change brings new questions to be investigated concerning the teaching-learning relationship and, at the same time, puts us in touch with the complexity of this relationship.

THEORETICAL FOUNDATION

According to Bandura (1986) self-efficacy beliefs are psychological components that are related to the personal perceptions of competence to execute specific courses of action. They are founded upon information from four sources: *mastery experiences, vicarious experiences, verbal persuasion* and *physiological states. Mastery experiences* refers to situations in which the individual is faced with a difficult situation and managed to confront it successfully, which proved encouragement to confront other similar situations.

Vicarious experiences relates to situations in which the observation of the execution of a similar task influences the confidence of the individual. When we see one of our peers succeeding in the execution of an activity, we believe ourselves capable of doing the same. This factor is particularly interesting in the school environment, where the activities are shared by many people. Thus, for example, the observation of the actions of more experienced peers by less experienced pupils proves to be of great importance.

Verbal persuasion refers to the situations in which communication between the peers influences the self-efficacy of the individuals. This is an important factor in the school situation, in which the teaching staff of an institution may share the particular discourse, which may either increase motivation or reduce it.

Physiological factors refers to the reactions of the individual when confronted by threatening situations. Symptoms such as stress, sweating, abdominal pain, dizziness are common in these situations. The way in which the individual is aware of and relates to the functioning of his or her body is vital to the level of self-efficacy.

The level of self-efficacy of a particular person, in this light, is seen as resulting from the interaction of three principal factors: the people, the environments and the behavior. For Bandura (1986) this interaction is characterized in a triadic manner, in which the personal factors (the individual's beliefs, attitudes, and knowledge) interact with the environment (the social and material resources) and with the behavior that reflects the actions of the individuals.

The relationship between these factors (personal, environmental and behavioral) is understood as dynamic and interdependent. The constitution of the level of self-efficacy is fairly sensitive to changes in the configuration of these factors. In this sense, the influence of environmental and personal factors is explicit in the behavior and in the self-efficacy of the individual, as well as the implications of the behavioral aspects in the environmental and personal conditions.

According to Bandura (2005), self-efficacy beliefs act as a fundamental element in the self-regulation of motivation. Individuals motivate themselves and orient their actions in anticipation through the exercise of premeditation, forming beliefs about what they can or cannot do.

They predict probable results of success or failure of possible actions, they set objectives and goals for themselves, and plan modes of action aimed at having consciousness of a posited future. Premeditation, in this sense, is translated into incentives and appropriate actions through self-regulatory mechanisms.

We should distinguish three different types of cognitive motivators, through which the self-efficacy beliefs operate: *causal attributions, expectations of results,* and *recognized objectives*.

In *causal attributions* the self-efficacy beliefs influence the mechanisms of cause and effect. Those who consider themselves to be highly effective attribute their failings to a lack of effort; those who consider themselves to be ineffective attribute their failings to low ability. Causal attributions affect the motivation, performance, and affective reactions principally through the self-efficacy beliefs.

In the *expectations of results*, the motivation is governed by the expectation that the behavior will produce certain results and the value of those results. From the point of view of expectations the question that occurs is: *can I carry out such a task?* As for the results component, a reply is sought to: *why should I carry out such a task?* But people act on their beliefs about what they can do, as well as on the probable results of their performance. In this way, the potential for motivation of the expectation of results is partially governed by the self-beliefs of ability. Countless options exist which people do not pursue because they simply judge that they do not have the ability to carry them out.

Finally, in the *recognized objectives* the capability of exercising self-influence through a personal challenge and the evaluative reaction for one's own achievements provides a greater cognitive mechanism of motivation. The behavior is motivated and guided by the recognized objectives acting in the here-and-now instead of projected into some future situation. Recognized objectives act broadly through processes of self-influence instead of regulating the motivation and the action directly. The motivation based on a set of recognized objectives involves a process of cognitive comparison. When they generate some self-satisfaction in the goals adopted, people direct their behavior and create incentives for persisting in their efforts until they attain their objectives. They search for self-satisfaction based on the fulfillment of evaluated objectives and are impelled to intensify their efforts through discontent with poor performances.

In synthesis, self-efficacy beliefs are decisive in the establishment of objectives and goals that people set for themselves, how much effort they invest in the tasks and challenges, how much they persist in the face of difficulties and failures in their personal and professional path, and the manner in which they react to the occasional failures of experience. When beset by obstacles and failures, people who feed their doubts about their capabilities decrease their efforts or quickly give up.

Those who have a strong belief in their capabilities exercise a greater effort when they fail to master a challenge. Strong perseverance generally has an effect on the performance of tasks carried out.

RESEARCH INTO THE SELF-EFFICACY BELIEFS OF TEACHERS

In the school context, the self-efficacy beliefs of both teachers and pupils rank among those most studied by the theoreticians of motivation, and are part of a set of many other beliefs that decisively influence what and how an individual perceives, understands, learns, and performs (Kagan, 1992; Pajares, 1992, 1996). The concern of the researchers has gravitated towards the processes that occur in the classroom, with a valorization of self-regulation in the learning process and the identification of the differences in teachers in relation to their knowledge of the subject and their beliefs about teaching and learning. As is outlined in this chapter, many of the beliefs of teachers during the development of their lessons are important in the creation or the maintenance of pupil motivation; some of these beliefs are conscious; others, however, have to do with routines teachers developed within their teaching praxis.

It is a common experience among teachers that, even when gifted with all the pedagogical competence required and the knowledge pertinent to their subjects, they suffer frequent assaults on their motivation to continue expending efforts in the direction of educational goals which they seek to attain with their classes. In general, these teachers complain of the difficulties in maintaining discipline in their classes and of the scant or non-existent involvement of their pupils in learning. They often attribute the causes of school failure to the incompetence of their pupils, to poor working conditions, and their increasing loss of authority. We also find, at the other extreme, those teachers who are held up by their colleagues, pupils, and school management team as exemplars of a good teacher. They are able to capture their pupils, involving them actively in the activities proposed in the classroom, even so-called "problem-pupils." Often, such pupils respect these types of teachers as true authorities. For their part, these same teachers make a tremendous effort to overcome the school failure of their pupils, being considered by the members of the institution as committed, perspicacious, and innovative. They like their pupils, and act in a receptive and respectful manner, which can be evidenced by the treatment they receive in return from the pupils.

How can we explain these different behaviors of teachers who, often, are immersed in the same school conditions? How can the performance of teachers affect their pupils and their motivation for learning? To respond to these questions, a concept is used which was developed in the last two decades in the field of psychology and which has proven to be of high explicative power regarding the successes and failures in the school context. This concerns the concept of self-efficacy beliefs, which is the perception, or the expectation that a person has of him or herself. These beliefs consist of a judgment or conceptualization of the individual's own abilities to execute a task, as well as how many courses of action are required to attain a certain degree of performance (Bandura 2005; Zusho, Pintrich, and Coppola, 2003).

Ashton and her collaborators (1984, 1985) are considered to be the first in the decade of the eighties to research the self-efficacy of teachers. They used a methodology which included the application of a questionnaire based on earlier research by the *Rand Corporation.* Ashton (1984) defined teacher self-efficacy as the degree to which the teacher believes s/he has the capacity to influence the performance of the pupils. Contextual variables were then considered as factors that make it difficult for teachers to maintain a high sense of

efficacy, such as isolation and lack of support from the school administration and colleagues. In initial research with 48 high school teachers, the authors used the same two items of the pioneering Rand Corporation studies in addition to teacher interviews. In a tentative interpretation related to Bandura's theory (1977), Ashton and her collaborators identified the first item of the Rand Corporation test (''...a teacher cannot do much...'') as representative of a construct that they went on to call general efficacy of teaching, equivalent to the construct that Bandura had called expectation of result. The second item (''... I feel I can...'') is the item they called personal efficacy in teaching and would correspond to Bandura's self-efficacy expectation. In this way, as the results indicated, it may occur that a teacher's efficacy beliefs do not attain the same degree in both aspects, since these are independent measurements. For example, a particular teacher (in this case, male) may believe that teachers in general can attain positive results even when family situations create obstacles to the pupil's learning; although, he does not believe this to be so in his own case. Although his efficacy beliefs in teaching are elevated, the same does not occur with the personal efficacy in relation to his teaching in particular, that is to say, he has low personal efficacy beliefs in teaching.

Gibson and Dembo (1984) investigated teachers' beliefs with respect to their relationship with challenging pupils using a 30-item Likert scale and factorial analysis. They found that teachers with a high level of self-efficacy beliefs believed they were capable of teaching even the most challenging pupils using greater effort and with the support of family members. Teachers with a low sense of personal efficacy believed they could achieve very little with these pupils, given the social and school reality of these pupils.

In summary, high self-efficacy beliefs of teachers appear to be related to: (a) better performance of the pupils in a variety of disciplines examined; (b) increments of the self-efficacy beliefs of the pupils themselves, considered as a decisive variable in their motivation; and (c) the adoption of more suitable strategies for dealing with pupils, especially those with difficulties. Inversely, teachers with lower perceptions of self-efficacy are characterized by a tendency to avoid new activities or even plan them, when they consider them to exceed their capabilities; were less persistent in dealing with pupils who present difficulties, and proved to be less inclined to innovations (Schunk, 1991). In the light of these discoveries, Woolfolk (1993), among others, concluded emphatically that the efficacy beliefs of teachers is one of the few personal characteristics that, in a consistent manner, has appeared to relate to the performance of pupils.

In the same sense, social interactions between teachers exert a powerful effect on their efficacy beliefs. The general climate of the school has a considerable impact on these beliefs, with increases in the self-efficacy beliefs of teachers being noted when their schools were perceived to have high levels of collaboration between teachers and their supervisors (Chester and Beaudin, 1996; Imants and Brabander, 1996; Ross, 1995). The younger and least experienced teachers, with initially low self-efficacy beliefs, reported an increase in their self-efficacy beliefs when they worked cooperatively with teachers who were more experienced and who had higher self-efficacy beliefs (Chester and Beaudin, 1996). Thus, the interactions with colleagues who provide confirmatory feedback for the didactic procedures employed by the teacher contribute to the personal efficacy beliefs, while a negative feedback can reduce these beliefs (Smylie, 1988; Ross, 1995).

Research into teacher training has shown, in general, that these pre-professionals enter training programs with personal beliefs with respect to teaching, with images of the good teacher, images of themselves as future teachers, and the memory of their good teachers and

of themselves when they were pupils. In addition to this, these personal beliefs and images generally remain unaltered throughout the training programs and accompany the teachers during their teaching practice (Kagan, 1992) and, we could say, throughout their professional life.

The climate of a classroom, with its consequences of pupil motivation and performance, is determined to a large extent by the self-efficacy beliefs of the teacher. Consideration of this personal variable should, however, and as a starting point, be part of the measures and initiatives of all those who are concerned with the quality of educational outcomes and with the well-being of teachers themselves.

Woolfolk and Hoy (1990) applied a 20-item questionnaire, the aim of which was to measure the personal efficacy of the teacher and the efficacy of the teaching. In this work, the authors argue that the application of the concepts of personal efficacy and efficacy in teaching, used in previous works need to be differentiated, since there has been some discussions about the significance of these concepts.

Particularly outstanding in the realm of the teaching of sciences is the research of Riggs and Enochs (1990). The authors developed two instruments for the quantification of self-efficacy beliefs among teachers of sciences in primary education. First, a Likert scale with 25 items, for the study of self-efficacy beliefs with practicing teachers of sciences called STEBI – A (*Science Teaching Efficacy Belief Instrument*). Immediately after, the authors presented a similar scale to STEBI – A, but with 23 items to research the beliefs of trainee teachers of sciences, called STEBI – B. Both instruments contain two types of question: questions that quantify the personal beliefs, which the authors term PSTE (*Personal Science Teaching Efficacy*); and questions to quantify beliefs in teaching, termed STOE (*Science Teaching Outcome Expectancy*). These instruments proved valuable for the research, since they analyze the beliefs of teachers of sciences at different stages in their career.

Barros (2005) investigated the motivational beliefs of teachers of physics in a public high school by means of semi-structured interviews. The author found the establishment of some relationships between the motivation of these teachers and their professional choice, degree of effort and of persistence, establishment of goals, and occasional failures.

Palmer (2006) presents the results of a longitudinal research project, with primary teachers of sciences, the objective of which was to make explicit the durability of the changes in the level of the self-efficacy beliefs of a group of Australian teachers. To this end, the levels of self-efficacy of teachers were measured at the start and at the end of a training course. The self-efficacy of the group of teachers increased significantly. To analyze the durability of these changes interviews were undertaken a year after the end of the course.

We would not wish to overestimate the importance of the self-efficacy beliefs of teachers, because other variables are also relevant (Schunk, 1991) in affecting teaching.

However, it is worth reiterating Bandura's affirmation (1986, 1993), based on research data, that the climate of a classroom and the goals of achievement established in it, with the consequences of pupil motivation and performance, are determined to a great extent by the self-efficacy beliefs of the teacher. Research into the self-efficacy beliefs of teachers has revealed, in addition, the existence of other related beliefs. It is worth highlighting the belief of general efficacy in teaching as particularly interesting, since it represents the belief in teaching of a particular discipline, not presupposing a personal implication in that judgment (Bzuneck, 2001).

In this chapter we present research into the self-efficacy beliefs of high school teachers of physics. We analyze, by means of correlational analysis, the beliefs of personal efficacy (or teaching self-efficacy) and of general efficacy in teaching of teachers of physics of middle school level and the relationship between the levels of the beliefs with their academic training.

It is generally agreed that the appropriate academic training of teachers should positively influence the aspects traditionally attributed to the profession, such as didactic skills and theoretical knowledge. Possibly, it should be allied also with some aspects linked to motivation of the teacher, such as self-efficacy beliefs.

As we mentioned earlier, there has been little research that investigates the types of motivational beliefs of teachers of physics. And it is upon this line of inquiry that the present study is predicated, since, from our point of view it is necessary to carry out more in-depth research into the motivational beliefs of teachers if what we are seeking is to promote an improvement in the quality of the teaching of physics.

RESEARCH AND DATA COLLECTION METHODOLOGY

Participants

Participants were 57% female and 43% male. As for age, 37% were 25 years or less; 19%, 26-30 years old; 25%, 31-40 years old; 12%, 41-50 years; 4%, over 50 years of age; and 4%, no information provided.

In relation to length of service in the teaching profession, the majority of the participants had little teaching experience (53 per cent) with length of service between 1 to 5 years; 19% had 6-10 years; 6%, 11-15 years; 9%, 16-20 years; 7%, 21-25 years; 2%, 26-30 years; 4%, no information provided.

Forty-six percent of the teachers taught in public schools, 10% in private teaching institutions, and 36% had taught in both public and private schools (8% did not provide this information). The majority of these teachers (86%) taught all three grades of high school education.

In relation to the initial training of the teachers, we found that the majority of physics teachers in the sample were qualified in mathematics, chemistry, and engineering (48%); followed by teachers qualified in physics (42%). Of the remainder of the interviewees, 5% held qualifications in general sciences and/or biology, and 5% did not respond to this item. As for studies carried out following graduation, 45% of the individuals interviewed held no postgraduate qualification, 28% had attended specialization courses, 14% had been working on a Masters course, 3% possessed a doctorate, 6% had completed professional development courses, and 3% did not answer this question.

Data Collection

Data were collected using a Likert questionnaire applied to 136 Brazilian high school physics teachers. The data were collected at two points in time, one part of the data (40 per

cent) was obtained via the application of the questionnaire in on-going teacher training courses and the remainder of the data (60 per cent) was obtained from the return of on-line questionnaires sent directly to the teachers.

To develop the questionnaire, we began by adapting two existing instruments, the version of the instrument elaborated by Woolfolk and Hoy (1990) and the original STEBI-A version (*Science Teaching Efficacy Belief Instrument*), developed by Riggs and Enochs (1990). Since our interest is to research the self-efficacy beliefs of teachers of physics, the adaptation of these two instruments was necessary, given that both offer fairly general questions, in the first case relating to teaching in general, and in the second to the teaching of sciences. Therefore, some items were adapted and we elaborated others that better corresponded with aspects of the teaching of physics, such as questions relating to experimentation and to its theoretical structure.

The data collection instrument consisted of a questionnaire of 34 items, 17 of which dealt with the Personal Efficacy Belief of the Physics Teacher, a term that was developed as an analogy of the concept of the Personal Efficacy Belief of the Teacher. The remaining items related to the General Efficacy Belief in the Teaching of Physics, a term analogous to the General Efficacy in Teaching (Woolfolk and Hoy, 1990).

Thus, when responding to the questionnaire the teacher was required to position him/herself, agreeing or disagreeing, when faced with an affirmation. The items relating to the Belief of Personal Efficacy of Physics Teacher investigated the personal relationship with the activity of teaching physics (Example: *I know that I have the necessary abilities to teach physics to the pupils*). The items of General Efficacy Belief in the Teaching of Physics had to do with the teaching of physics in general (Example: *The teachers believe that a pupil with difficulties in mathematics will not be interested in physics*). A detailed analysis of the validation process of the questionnaire applied to the teachers of physics can be found in Barros, Laburú, and Silva (2010).

The analytical process is based on the study of the differences between the levels of the factors of the Belief of Personal Efficacy of the Physics Teacher and the General Efficacy Belief in the Teaching of Physics with the academic training variable, by means of the Kruskal-Wallis test (Dancey and Reidy, 2006; Hair, Anderson, Tatham, and Black, 2005). This test is used to highlight significant differences of a particular variable in the groups researched, in our case, the teachers of physics, who were separated into three groups depending on their academic training: teachers qualified in physics, teachers qualified in exact sciences (mathematics, chemistry, and engineering) and teachers qualified in biological sciences. The results presented here were obtained using the SPSS® statistical package (*Statistical Package for the Social Sciences*) version 13.0 *for Windows* (Norusis, 2003).

RESULTS

Using Spearman's Rho, we looked for relationships of association between the variables: academic qualification, level of Personal Efficacy, and level of Efficacy in Teaching. The level of Personal and Teaching Efficacy of each teacher was obtained from the sum of the responses given to the corresponding items.

Table 1. Spearman's Rho Test

	Efficacy in Teaching	Personal Efficacy	Academic Training
Efficacy in Teaching	1	.207**	.119
Asympt. Sig.		.008	.084
Personal Efficacy		1	.273**
Asympt. Sig.			.001

** Asympt. Sig. ≤ 0.05.

* Asympt. Sig. ≤ 0.01.

We considered for academic training the following classification: teachers qualified in physics (score 3), teachers with a qualification in exact sciences[1] (score 2) and teachers with a qualification in biological sciences (score 1). Table 1 presents the results of the test.

The level of Personal Efficacy belief demonstrates a significant association with the academic training variable. It indicates that teachers with specific training possess higher levels of Personal Efficacy. Below, by means of a variance analysis, we will analyze this result in more detail. The levels of Personal Efficacy and of General Efficacy in Teaching are correlated in a positive manner, a result which suggests an association.

Despite the results of the correlations being weak (Dancey and Reidy, 2006; Hair et al., 2005), we believe it is relevant to investigate these correlations in the context of the variations in groups of teachers. The analysis of the associations between the levels of Personal Efficacy and the Teaching of Teachers of Physics with academic training was carried out using the Kruskal-Wallis test. We found statistically significant results for the levels of Personal Efficacy Belief. Table 2 presents the results of the test.

For the academic training variable, teachers with a specific physics qualification presented higher values of mean rank for Personal Efficacy, followed by teachers qualified in exact sciences, and, finally, the teachers with a qualification in biological sciences. While it is expected that teachers who opted to graduate in physics are more confident and motivated in teaching this discipline, we understand that this result underlines the importance of adequate training of teachers, in the context of the teacher's self-efficacy.

The variance analysis revealed statistically significant results only for the beliefs of Personal Efficacy of Teachers of Physics, a fact that gives rise to some reflection. For academic training, we observed that the teachers graduated in physics have higher values (mean ranks) of levels of Beliefs of Personal Efficacy (78.73) compared to teachers with qualifications in other courses in the area of exact sciences (55.40) and to those qualified in courses in the area of biological sciences (37.79).

Just as presented in a previous work (Silva, Barros, Costa, and Laburú, 2007), we found four factors that most influence the Beliefs of Personal Efficacy of the Physics Teacher: *teaching competence*, *innovation in teaching*, *motivation in teaching***,** and *teacher training*. For the General Efficacy Beliefs in the Teaching of Physics we found three principal factors: *methodology*, *involvement of the pupils***,** and *difficulties in teaching*.

[1] Teachers with a chemistry or engineering training.

Table 2. Kruskal-Wallis Test Distinguishing Academic Training Variable

	Training	N	Average Rank
Personal Efficacy	Physics	46	78.73
	Exact Sciences	72	55.40
	Biological Sciences	7	37.79
	Total	125	
Efficacy in Teaching	Physics	46	59.53
	Exact Sciences	72	65.37
	Biological Sciences	7	61.43
	Total	125	

Test statistics (a,b).

	Personal	Teaching
Chi-square	15.316	.746
Df	2	2
Asympt. Sig.	.001	.0.689

a Kruskal-Wallis Test.
b Grouping variable: Training.

These factors were found using exploratory factor analysis in order to investigate the associations between the items of the Beliefs of Personal Efficacy of the Physics Teacher and the General Efficacy Beliefs in the Teaching of Physics (Dancy and Reidy, 2006). We applied this procedure to the items of the Beliefs of Personal Efficacy of the Physics Teacher and the General Efficacy Beliefs in the Teaching of Physics separately, since in addition to being different concepts, our objective was to investigate the factors that influence these two beliefs.

By means of the linear regression method, scores were generated, for each respondent, relating to the factors of General Efficacy Beliefs in the Teaching of Physics and of the Beliefs of Personal Efficacy of the Physics Teacher. Thus, for each respondent 8 variables were investigated, four of these due to the factors of the Beliefs of Personal Efficacy of the Physics Teacher, three for the General Efficacy Beliefs in the Teaching of Physics and one due to the academic training of the teacher. For this test we consider only 125 of the 136 questionnaires collected as 11 teachers did not indicate their academic training. Table 3 and 4 presents the results of the test.

The association test showed that the factors "motivation in teaching" and "involvement of students" are associated with the academic training of teachers. With respect to the first factor, we found the highest levels of motivation for teachers with specific training (mean ranks = 79.85), followed by teachers with degrees in exact sciences (mean ranks = 53.63), and finally teachers with degrees in biological sciences (mean ranks = 48.86). A similar result was found for the factor involvement of students, with teachers trained in physics having the highest levels (mean ranks = 73.67). Those with degrees in biological sciences had a mean rank of 60.29 with respect to this factor, and finally, teachers trained in the field of exact sciences showed the lowest levels of student involvement (mean rank = 56.26).

Table 3. Kruskal-Wallis Test for the Factors of the Personal Efficacy Beliefs of the Physics Teacher and Academic Training Variable

	Training	N	Average rank
Teaching competence	Physics	46	66.72
	Exact Sciences	72	62.25
	Biological Sciences	7	46.29
	Total	125	
Innovation in teaching	Physics	46	71.57
	Exact Sciences	72	58.71
	Biological Sciences	7	50.86
	Total	125	
Motivation in teaching*	Physics	46	79.85
	Exact Sciences	72	53.63
	Biological Sciences	7	48.71
	Total	125	
Teacher training	Physics	46	61.74
	Exact Sciences	72	66.31
	Biological Sciences	7	37.29
	Total	125	

Test statistics (a,b).

	Teaching competence	Innovation in teaching	Motivation in teaching*	Teacher training
Chi-square	2.005	4.368	15.859	4.182
Df	2	2	2	2
Asympt. Sig.	.367	.113	.001	.124

* Asympt. Sig. lower than 0.05.

a Kruskal-Wallis test.

b Grouping variable: training.

Table 4. Kruskal-Wallis Test for the Factors of General Efficacy Beliefs in the Teaching of Physics and Academic Training Variable

	Training	N	Average rank
Methodology	Physics	46	57.77
	Exact Sciences	72	67.01
	Biological Sciences	7	56.14
	Total	125	
Pupil involvement*	Physics	46	73.97
	Exact Sciences	72	56.26
	Biological Sciences	7	60.29
	Total	125	
Difficulties of Teaching	Physics	46	56.03
	Exact Sciences	72	66.59
	Biological Sciences	7	71.86
	Total	125	

Test statistics (a,b).

	Methodology	Pupil Involvement*	Difficulty in Teaching
Chi-square	2.090	6.749	2.827
Df	2	2	2
Asympt. Sig.	.352	.034	.243

* Asympt. Sig. lower than 0.05.
a Kruskal-Wallis test.
b Grouping variable: training.

This result suggests a positive association between motivational factors in the teaching of physics and training of teachers in this academic discipline. This is an important finding, especially considering the Brazilian reality, in which there is a shortage of graduate teachers in physics.

CONCLUSIONS

Investigations based on self-efficacy beliefs evaluate the judgments that teachers make of themselves with respect to their beliefs about their capabilities of undertaking an academic task. For our purposes, it is important to state that the self-efficacy belief is not a feature of the global personality, but is relative to a specific situation. In the school context, this has to do with personal convictions about the capability to follow through with a certain task. It is not a question of possessing such abilities, but of believing that you possess them.

The intensity of the self-efficacy beliefs depends on the interaction between intrinsic and extrinsic factors. The (personal) intrinsic factors refer to the particularities of each individual, in this case, the teacher faced with a certain task. The extrinsic factors (environmental and social) refer to those that do not pertain to the individual sphere. From this perspective, the psychological functioning of a teacher comes to be seen as resulting from the interaction of these factors, that is, the beliefs of individuals, their attitudes, and their knowledge interact with the social and material resources available, the physical and social world, which reflects their actions. This proves to be interesting insofar as it explains the situation of many teachers who feel motivated in some school situations and de-motivated in others.

The establishment of a level of self-efficacy beliefs in a teacher determines a greater awareness of his or her capabilities and limitations in the execution of specific tasks. This is important principally when confronting particularly difficult or unexpected situations. In this case, the appearance of an occasional failure in a specific situation related to a collection of satisfactory results, on the part of the teacher, will do little to diminish that teacher's motivation. On the other hand, a positive result in the face of a whole picture of negative results will probably not increase motivation. According to Bandura (1986), an increase in the level of self-efficacy of individuals is necessary insofar as it makes it possible to provide improvements in their psychological characteristics. In this way, people who present a high level of self-efficacy beliefs, usually possess greater freedom in the choice of the execution of specific tasks, since the preference is given to situations similar to those in which earlier successes were obtained. Self-efficacy beliefs are related also to the level of effort and resistance to adversities, encouraging individuals to take on difficult and adverse situations.

People who possess a low level of these beliefs usually give up more easily, and are less immune to unexpected results.

The possibility of adjustments to the most personal language and representations, of greater cognitive and subjective proximity, is favorable to raising the level of self-efficacy of teachers, given that these teachers become more effective in the execution of their actions. This offers the potential for greater motivation and confidence, which enables them to look for a better way to implement their activities. In fact, motivated individuals demonstrate more effective patterns of thought and feeling and usually have fewer negative thoughts, greater calmness and concentration.

From the salient elements of this chapter it is possible to see that in the classroom a set of subjective elements coexist that challenge the perspectives of the research of previous decades that understood learning as a process that could be molded only by cognitive and universal factors. Consequently, a teaching practice that incorporates the dimension of individuals' subjectivity is in harmony with the variability of the elements found in the classroom that go beyond the domain of cognition. Basically this is due to a greater adaptability to the peculiarities of the profile of each teacher and his or her teaching style.

In this way, stimulating teachers to participate in multiple activities is to establish a potential approximation to their cognitive structures, to their particular psychological dimensions and subjective styles of teaching. In particular, it is reasonable to suppose that a low level of self-efficacy belief of teachers may have its origins in repeated failures when, at the outset, they are obliged to adopt a form and an exclusive mode of teaching which is substantially removed from their subjective style. A means of approximating these levels occurs, then, through the stimulus of the belief of the individual in his or her capacity to implement successfully the proposed activities, or that produces motivation by mobilization.

Although it is expected that teachers who opted for training in physics courses present higher motivation for teaching that discipline, this result points to a problem of the training of physics teachers in Brazil. This is an important question, since, if the specific academic training for the teacher of physics positively influences the motivational aspects, in addition to other aspects traditionally attributed to the teaching profession, the offer of stimulating and motivating physics teaching remains fairly compromised.

In this sense, the training of the teacher of physics is highlighted as a positive conditioning factor in the offer of "motivating" teaching. This is a big challenge for Brazil, where we have a great shortage of graduates in this discipline. Parallel to the offer of adequate training for teachers of physics it is necessary to be concerned to offer conditions and incentives for these professionals to remain in the profession, especially in the public schools.

As it has been possible to tell from this chapter, teachers vary in their motivations and preferences in relation to their affinity with knowledge. They vary equally in their specific mental abilities or beliefs in these abilities, in their level of motivation and interest in physics, in the persistence they dedicate to a problem, their ways of handling it, in addition to experiences lived or ties maintained with the social group to which they belong, or with other teachers. These factors certainly influence, among others, the quality and the depth of teaching.

With the reflections presented here we have tried to go beyond a simplistic reading which might seek to defend the inclusion of psychological variables without much theoretical foundation, arguing that the construction of self-efficacy beliefs outlined here may be

reconciled in a consistent manner with the contemporary studies that take into consideration the relevance of subjectivity inside the classroom.

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