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An instrument for measuring self-efficacy beliefs of secondary school physics teachers

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Abstract

This work presents the procedures and results of the validation process of a data collecting instrument to survey the self-efficacy beliefs of Secondary School Physics Teacher's. This instrument consists of a Likert scale questionnaire applied to a sample made up of 136 Physics Teacher's from Brazil. The collected data were submitted to the application of some statistical tests, as item-total correlation, reliability and factor analysis. We conclude by pointing out the congruity of our results with those of other investigations, we presented the validated version of the instrument. Among the main implications of this study we hope to contribute to the research on the self-efficacy beliefs of Physics Teachers so that we can better understand which elements influence the teacher-student relationship regarding motivational beliefs in the classroom.

Keywords: Self-efficacy beliefs; physics teacher's; secondary school; motivational beliefs; science teaching

1. Introduction

It is quite common for physics teachers to relate their students' learning difficulties to the lack of motivation in the classroom, blaming this for school failure. Some argue that better prepared and more motivated students to learn certain contents would be a necessary and sufficient condition to ensure a positive learning outcome. We agree with this position in part, seeing that teacher motivation also has a significant influence on improving the performance and interest of students, including a direct reflection regarding discipline in the classroom.

In the field of Science Education, perspectives in conceptual change research indicate the need to investigate the motivational processes in the activities of teaching and learning (Pintrich et al., 1993). Upon elaborating a review of the characteristics of the conceptual change model of the 1980s, these authors identified that this theoretical framework leaves the door open for two aspects: the influence of factors relating to the motivational beliefs of teachers and students as well as the supporting possibilities for conceptual change arising from the roles assumed by those in the classroom. In general, the models that promote the cognitive domain avoid including individual goals,

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beliefs, intentions, purposes, expectations and needs. That is, the motivational aspects are not considered in the investigation of the so-called cognitive skills for which, to some degree, students were being prepared for.

Among these aspects, the self-efficacy beliefs of both students and teachers in the motivational and self-regulation processes has attracted the interest of several researchers in the field of Science Education (Riggs & Enochs, 1990; De Souza et al., 2004; Britner & Pajares, 2006; Palmer, 2006; Barros et al., 2007, Katelhut, 2007, Silva, 2007; Smolleck & Yoder, 2008). The self-efficacy beliefs refer to beliefs in the individual capabilities of each individual to organize and implement the necessary actions to produce a specific result (Bandura, 1997). This approach endeavors responding to the revisions of that area's work, indicating that it is necessary to include socio-psychological dimensions and environmental factors in the teaching and learning process (Confrey, 1990).

In addition, Contemporary Psychology studies on school motivation have also demonstrated the growing interest of researchers in the motivational beliefs of teachers (Schunk, 1991; Pajares, 1992). The concern of such researchers has focused on the processes that take place in the classroom, valorizing self-regulation in the learning process and identifying the differences in teachers based on their knowledge of the subject and their beliefs about teaching and learning, with the beliefs of self-efficacy as one of the most important educational beliefs of teachers. As reported in these works, many of the teachers' beliefs during the development of their classes are important in the creation or maintenance of student motivation, some of them are conscious, however others relate to the routine that teachers have developed within their teaching or their practice know-how.

It is worth mentioning that one characteristic of the works that target investigating the self-efficacy beliefs of students and teachers is the use of quantitative techniques for collecting and analyzing data, as is customary in some research areas of Psychology. Applying this method requires some necessary cautions to reduce any random mistakes (Dancey & Reidy, 2006). Accordingly, the validity study of the data collection instrument is stressed as one of these procedures.

This work presents the validation results of a data collection instrument, specifically dedicated to study the self-efficacy beliefs of Secondary School Physics Teacher's. The importance of this study is justified by the lack of research in the area selected to investigate these motivational beliefs with Physics Teacher's, although there are study results with teachers of other subjects and within many contexts.

In the field of Education, studies concerning the beliefs of teachers' self-efficacy revealed the existence of other related beliefs. It is worth noting the self-efficacy belief in teaching (Woolfolk & Hoy, 1990) as particularly interesting because it represents a teaching belief in a particular discipline, assuming no personal involvement in such assessment. Our instrument covers both levels: the personal efficacy beliefs (or teacher's self-efficacy) and the efficacy beliefs in teaching Physics.

2. Research Methodology

The methodology of our investigation is of quantitative nature with correlational character. The data were collected from 136 Secondary School Physics Teachers in Brazil. The instrument used for collecting the data was a Likert questionnaire with 34 items about self-efficacy beliefs of the investigated teachers. Of these 34 items, half refers to what we term as **Personal Efficacy Belief of Physics Teachers**. The remaining items refer to the **General Efficacy Belief in Physics Teaching**. To carry this test out we have used the statistical software package SPSS® 13 (*Statistical Package for the Social Sciences for Windows*).

We chose the non-parametric testing, that is, tests not needing a set of data that has a normal distribution and does not assume prior knowledge of the sample's population origin. The use of parametric tests must be unique to the case of actual numerical variable analysis, in order to not cause data distortion and generate doubts about the validity of the drawn conclusions based on evidence.

For the elaboration of the instrument related to Physics Teaching, we began by adapting two existing instruments developed with the same theoretical assumptions; the instrument developed by Woolfolk & Roy (1990) and by Riggs & Enochs (1990).

The adaptation of these instruments was necessary given that both presented very general issues, where the first case refers to Education in general and the second case refers particularly to Science Teaching. Thus, we sought to reformulate some items and develop other aspects that corresponded with aspects of Physics Teaching, such as questions relating to specific aspects of this subject, for instance: the experimentation, conceptual structure and formalism mathematics.

3. Results and Discussion

For the first stage of the construct validation, we conducted two tests for all items of the questionnaire, the item-total correlation test and the reliability coefficient test or Cronbach's Alpha. As a cut-off values criterion for the test results of item-total correlation, we eliminated all the items that had a correlation index of less than 0.20. This resulted in the exclusion of eight items for General Efficacy Belief in Physics Teaching and six for Personal Efficacy Belief of Physics Teachers. We found the value of 0.61 for the Cronbach's Alpha regarding the General Efficacy Beliefs in Physics Teaching, and 0.79 for the items that correspond to the Personal Efficacy Belief of Physics Teachers.

Table 1 – Correlation item-total and Cronbach's alpha for General Efficacy Belief in Physics Teaching

Items regarding the General Efficacy Belief in Physics Teaching	Corrected item total Correlation	Cronbach's Alpha if the item is excluded
1 - The teachers consider the physical concepts accessible to all students.	,2 16	,60
2 - The teachers believe that the physical concepts are too abstract and barely understood by students.	,2 98	,58
4 - The teachers believe that a student who has difficulties in mathematics will not be interested in physics.	,2 37	,60
6 - The problem of the student's motivation to learn physics resides in the student.	,2 73	,58
21 - When a student's scores in physics improve, it is often due to the teacher who found more effective teaching strategies.	,2 09	,59
25 - A student's learning difficulty in physics can be overcome by a good teacher.	,3 30	,56
26 - A student's low performance in physics is not the teacher's responsibility.	,3 04	,57
28 - A teacher's significant effort to teach physics produces little change in students' performance.	,3 55	,56
29 - The students' performance in physics is directly related to the effectiveness of their teacher in teaching.	,4 11	,54

Table 2 – Correlation item-total and Cronbach's alpha for Personal Efficacy Belief of Physics Teachers

Items referent to the Personal Efficacy Belief of Physics Teachers	Correlation item-total corrected	Cronbach's Alpha if the item is excluded
3 - I feel capable of making the physical concepts accessible to all students.	,3 3	,78
9 - I feel capable of implementing experimental activities in my teaching.	,4 7	,77
13 - I can combine my academic background and my ability to motivate students during Physics class.	,4 0	,78
15 - I believe I am able to motivate my students during Physics class.	,3 3	,78
20 - I continually find better ways to teach Physics to my students.	,4 05	,78
22 - I am not very effective in developing experimental activities.	,4 9	,77
24 - I do not feel capable to teach Physics to my students.	,3 8	,78
30 - I encounter difficulties in explaining to students how the Physics experiments work.	,6 5	,74
31 - I am always able to respond to questions from students about Physics.	,4 5	,78
32 - I know that I possess the necessary skills to teach Physics to students.	,5 2	,76
33 - When a student has trouble understanding a Physics concept, I usually know how to help him to better understand it.	,5 8	,76

Finally, our data was subjected to an exploratory factorial analysis by the extraction method of the main components with equamax rotation and Kaiser Normalization (Dancey and Reidy, 2006). As the concern was to investigate the contribution of the 23 items for the two constructs studied (Personal Efficacy Belief of Physics Teachers and General Efficacy Belief in Physics Teaching), we only considered the two factors with more variance explanation. The results of the KMO test and Bartlet sphericity, which are necessary to implement such analysis, were satisfactory (KMO = 0.71 and Bartlet = 0.0001). Table 14 illustrates the factorial analysis results:

Table 3 - Factorial Analysis for Personal Efficacy Belief of Physics Teachers and General Efficacy Belief in Physics Teaching

Factorial Analysis	Personal Efficacy Belief of Physics Teachers	General Efficacy Belief in Physics Teaching
30 – I encounter difficulties in explaining to students how the physics experiments work.	**,785**	-,054
33 - When a student has trouble understanding a Physics concept, I usually know how to help him understand it better.	**,703**	,016
32 - I know that I have the necessary skills to teach Physics to students.	**,681**	,126
22 – I am not very effective in developing experimental activities.	**,607**	-,104
9 - I feel capable of implementing experimental activities in my teaching	**,6[illegible]4**	-,112
31 – I am always able to respond to questions from students about Physics.	**,532**	,252
20 - I continually find better ways to teach Physics to my students.	**,531**	,086
13 – I am able to combine my academic background and my ability to motivate students during Physics class.	**,487**	,175
24 – I do not feel capable of teaching Physics to my students.	**,4[illegible]2**	,129
29 - The students' performance in Physics is directly related to their teacher's effectiveness in teaching.	,144	**,653**
25 - The learning difficulty of a Physics student can be overcome by a good teacher.	,1[illegible]5	**,614**
26 - A student's low performance in physics is not the teacher's responsibility.	-,1[illegible]6	**,560**
28 - A teacher's major effort to teach physics produces little change in students' performance.	,0[illegible]3	**,503**
6 - The student's motivation problem in learning physics is within the student himself.	-,1[illegible]7	**,467**
21 - When Physics students' grades improve, it is often due to the teacher who found more effective teaching strategies.	,193	**,422**
2 - Teachers believe that the physical concepts are very abstract and hardly understood by students.	,0[illegible]2	**,414**
1 - Teachers consider that the physical concepts are accessible to all students.	,101	**,387**
4 - Teachers believe that a student who has difficulties in mathematics is not interested in physics.	,0[illegible]9	**,324**

Items 3 and 15 were excluded because they had significant factorial loads in two factors. We consider significant loads those that were greater than 0.30 (Hair, et. al, 2005). The new values for the reliability coefficient were 0.61 for General Efficacy Belief in Physics Teaching and 0.78 for Personal Efficacy Belief of Physics Teachers.

4. Conclusions and Implications

This work presented some procedures used to study the validity of a Likert questionnaire on Brazilian Physics teachers' motivational beliefs. The results for our instrument agree with other studies in this line of research (Palmer, 2006; Ginns et al, 1995; Enochs and Riggs, 1990 and Riggs and Enochs, 1990), whose reliability coefficient showed a higher value for the **Personal Efficacy Belief of Physics Teachers** (0.79) and less for **General Efficacy Belief in Physics Teaching** (0.61).

For the result, we presented the validated version of the instrument (Silva et al. 2006), and explained the validation process. The instrument, initially comprising 34 items, was characterized by an 18-item questionnaire, given that items 1, 2, 3, 4, 8, 11, 12, 13 and 14 of that version are related to the **General Efficacy Belief in Physics Teaching** and items 5, 6, 7, 9, 10, 15, 16, 17 and 18 are related to the **Personal Efficacy Belief of Physics Teachers**. The inclusion of the factorial analysis to validate the constructs displayed interesting results, which indicated the elimination of two items of the instrument.

We chose the non-parametric testing, that is, tests not needing a set of data that has a normal distribution and does not assume prior knowledge of the sample's population origin.

Thus, we hope to contribute to the research on the beliefs of Brazilian Physics teachers so that we can better understand which elements influence the teacher-student relationship regarding motivation in the classroom.

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