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The sense of competence; a moderator between motivation and academic performance in physical education: An application by the principal component analysis

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Abstract

The current study tried to verify whether motivation and sense of competence interfere with the students' academic performance and, if it is the case, whether this interaction is decreased by the participants' age and gender. To deal with these hypotheses, we resorted to investigate certain variables in a population of 343 students from five regions of Tunisia (Tunis, Sfax, Mahdia, Beja and Kébili) aged between 13 and 15 and attending colleges or secondary schools.

The targeted variables are: school absenteeism, school anxiety, intention of dropping out, academic performance, students' involvement in education, measurement of physical skills, the availability of sports activities at their schools, and a qualitative evaluation of students (age, gender, size and weight).

As expected, motivation and sense competence are positively and significantly correlated with a student's performance. However, for students who have a low competence feeling, the relationship between motivation and sense of competence did not change significantly. Indeed, the relationship between the two is affected neither by age nor by sex and not even by academic performance.

Keywords: Physical education achievement, motivation, feeling of competency, interaction, moderator, age, gender.

JEL Classification: C24, C25, I24, I26.

1. Introduction

In developed countries, the professional success is reflected in the well-being, happiness, satisfaction and better physical and mental state of an individual (Borooah, 2006; Davidson; Kitzingerb and Hunt, 2006) [7, 12]. One of the major indicators of an individual professional success is his successful career. In a meta-analysis of 25 studies, Stenza (2007) [37] shows that academic achievement is positively and significantly related to income, employment and educational level. Other authors stipulate that there are no great differences between the intellectual capacities which are necessary for academic success and those that exist in the labor market (Kuncel, Hezlett and Ones, 2004) [20].

Along his school career, the student faces several challenges through which he/she can earn a sense of self-esteem, develop his/her intellectual and physical abilities, solve possible problems and also develop personal qualities that are much requested on the job market (Shieman, 2002) [31]. Thus, success at the economic scale originates from the school career and thus contributes to the quality of the future human life.

In addition, success has several immediate effects on an individual's life. Thus, a successful student will be confident, have positive feelings and set high quality objectives. On the other hand, a student who fails or does not do well will probably end up depressed suffering from psychological disorders that may lead him to despair. Indeed, he/she may eventually leave school, get hooked on drugs and plunge into delinquency (Alexander, Entwisle and Kabbani, 2001; Beauvais, Chavez, Oetting, Deffenbacher and Cornell, 1996; Herman, Lambert, Reinke and Lalongo, 2008; Lackaye, Margalit Ziv and Ziman, 2006; Wood, 2007) [40, 1, 5, 16, 21]. In order to anticipate such negative consequences as well as others, already associated with poor professional performance, it is important to know the variables that are likely to influence a student's success. A better understanding of these variables allows us to effectively reduce the dropout rates, and help students who face difficulties to have better chances of success.

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1.1 School performance

Performance in the academic field is a concept traditionally tied to the mark or grade a student gets for homework or an exam. During the school experience, several factors, such as the socioeconomic status, are involved in this process and may affect a student's school performance. Indeed, in the 90s of the twentieth century, Coleman *et al.* (1966) [11] and Coleman (1972) [10] found that poor children and teenagers have very low intellectual capacity and, therefore, lag behind their peers at school, which explains their absenteeism and subsequently their dropping out. This idea was unfortunately confirmed later by Bradley and Corwyn (2002) [9]; Janosz, LeBlanc, Boulerice and Tremblay (1997) [19]; Milne and Plourde (2006) [4]; Ram and Hou (2003) [30]; Sirin (2005) [34]. However, apart from the socio-economic status, there are other equally important factors for the understanding of students' academic performance. According to Markus, Cross and Wurf (1990) [22], success in any field requires the individual to have and be aware of some necessary abilities or skills. Indeed, if the individual is aware of his abilities, he will be able to control himself when taking up any activity. Thanks to one's perceptions, he/she can choose the important methods enabling him/her to succeed in the undertaken task, multiply his/her chances of success or failure, and finally feel competent. If an individual believes he/she is not competent to achieve a given task in any field, he/she will feel uninterested to commit himself and end up hesitating, putting his performance at risk (Montague and Applegate, 2001) [25]. In reality, success requires the individual to have both the required capacity and the way to be able to think effectively (Markus *et al.*, 1990) [22].

1.2 The relationship between the feeling of competence and academic performance

Several studies have addressed the perceived competence impact on school performance (Harter, Whitesell and Kowalski, 1992; Marsh, Trautwein, Ludke, Trolker and Baumert, 2005; Montague and Applegate, 2001; Montague and Van Garderen, 2003; Shen and Tam, 2008) [15, 23, 25, 26, 32]. According to these authors, the feeling of competency is the ability of the student to evaluate his/her skills and abilities after any success or failure in his/her studies. These studies have revealed that there is a significant positive relationship between the feeling of competency and students' academic performance. They concluded that students who have a high sense of expertise get the best results. In other words, these students are more motivated, have clear objectives, choose the most difficult tasks, make a lot of effort, and focus more on their studies rather than their peers who have a low feeling of competence (Bandura, 1994; Jacobs, Lanza, Osgood, Eccles and Wigfield, 2002) [2, 17].

In fact, academic performance is reflected more by the feeling of competency rather than student's abilities (Phillips, 1987) [28]. A feeling of low expertise, however, induces low academic performance, less effort and thus a higher risk of dropping out (Skinner, Zimmer-Gembeck and Connel, 1998) [35].

Moreover, low achieving students are unable to succeed. Although the tasks they are expected to perform are often within their reach, these students see that the main cause of their lack of success is due to their low abilities. These students will give up searching for solutions because they feel they are unable to overcome such obstacles like their peers who consider themselves competent. Thus the feeling of competency has an impact -positive or negative- on school performance (Montague and Plegate, 2001) [25].

In reality, the perceived competence impact on academic performance has been the subject of a great deal of research on student samples from several countries. Shen and Tam (2008) [33], for instance, showed the relationship between the feeling of competence and school performance on a sample of students from over 40 countries from the different continents.

Their results showed that there are positive links between the feeling of competence and achievement in physical education and science in all the investigated countries. As for Markus *et al.* (1990) [22], they showed that these dimensions interact with each other and with other characteristics, such as age and gender for the prediction of students' academic success.

Indeed, if students try to understand the others' attitudes and compare them to theirs, they may have a more correct judgment though often against their own will (Bouffard, Vezeau, Chouinard and Marcotte, 2006; Eccles, Wigfield, Harold and Blumentfeld, 1993; Jacobs *et al.*, 2002; Stipek and Hoffman, 1984; Wigfield, Eccles, Yoon, Harold, and Arbreton Blumentfeld, 1997) [8, 13, 18, 36, 39]. Consequently, they will have a sense of reduced competence, which will affect their school performance and may weaken their physical abilities in case of absence of motivation. However, this assumption has not been checked so far.

Moreover, there is a dearth of research that addressed the issue of indirect effects of the perceived competence on the relationship between motivation and academic performance. For this reason, this study tried to delineate this relationship. Then it investigated whether age and /or gender may alter the impact of this feeling of competence in physical education on the relationship between motivation and students' performance.

2. Objectives, hypotheses and methodology

The objectives of the current paper are twofold: The first aims at checking the moderating impact of the perceived competence on the link between motivation and academic performance. The second attempts to see if this moderating impact is modified by age and gender. All the hypotheses related to these two objectives were verified through a cross-sectional design. The first hypothesis argues that academic motivation and perceived competence are expected to positively predict the average performance of students in physical education. The second hypothesis states that motivation and students' perceived competence in physical education are expected to tighten the bond between motivation and academic performance. Thus, the impact of motivation on academic performance would be clearer among students who feel a sense of competence than those showing a low sense of competence. The third hypothesis states that the moderating effect of perceived competence on the relationship between motivation and performance in mathematics is expected to be itself moderated by students' age and gender. In other words, this perceived competence moderating effect is expected to be lower among girls and older students.

In this study, we used a sample of 343 students, 44.9% of whom are boys selected arbitrarily from a larger sample. Indeed, the data were collected from students aged between 13 and 15 attending 11 schools. In fact, the sample was classified according to the socio-economic environment they live in (rural and urban). Thus, schools in underprivileged areas were allocated lower ranks compared to those in advantageous areas. That is why only the respondents who provided valid responses were included in our sample.

2.1. Measures

The students' performance in physical education, their motivation and feeling of competence were assessed using a survey involving general measures such as age and gender, and three basic variables: feeling of competence, motivation and performance. It should be noted that 100 questionnaires were distributed in each governorate for both sexes, in both

urban and rural areas. Table 1 shows the answers partition to the survey per governorate.

From this table we can see that 343 students among 500 answered the various questions of the investigation, representing a rate of 68.6%. The city of Beja has the highest number of respondents with 95 students. In contrast, the governorate of Mahdia ranks fifth with 50 students.

Table1: A Global analysis of the respondents

Governorate	Respondents' number	Gender		Lodging	
		Male	Female	Urban	Rural
Tunis	65	46.2%	53.8%	66.2%	33.8%
Sfax	72	44.4%	55.6%	70.8%	29.2%
Mahdia	50	22.0%	78.0%	58.0%	42.0%
Beja	95	50.5%	49.5%	55.8%	44.2%
Kébili	61	54.1%	45.9%	82.0%	18.0%
Total	343	44.9%	55.1%	65.9%	34.1%

Source: Authors' estimates of the data source.

As this Table indicates, it is revealed that the vast majority of the respondents are females. They represent 55.1% of our sample against 44.6% of boys except for Beja and Kébili. This distribution is consistent with the demography of the study environment. Indeed, there are more girls in the Tunisian educational institutions.

Using a multidimensional scale for academic learning, we evaluated the majority of the variables including the feeling of competence (Gurtner, Monnard and Ntamakiliro 1999) [14]. This question has to be answered according to the five-point Likert scale. Indeed, Cronbach's alpha was applied to the analysis to measure the questionnaire reliability. In addition, Bartlett's sphericity test and the sampling adequacy measures were also used before the Principal Component Analysis (PCA).

We also chose to perform the Kaiser-Meyer-Olkin (KMO) index and Bartlett's sphericity test. The KMO index is particularly useful because it allows evaluating how all the selected variables are a coherent set defining a relevant solution in conceptual terms. The higher this index is, the more satisfactory the factorial solution will be. Bartlett's sphericity test, however, is used to check whether all correlations are equal to zero. We accept that all correlations are not equal to zero if the significance (risk) index is less than 5%. But, this test is very sensitive to the number of cases and it is almost always significant when we have a very large number of cases, which makes it meaningless.

In both theory and practice, the PCA is implemented on the variance-covariance matrix or the correlation matrix. Here, we are interested in the correlation matrix. Indeed, achieving a PCA on the variance-covariance matrix does not eliminate the individual dimensions of the studied variables. This behavior is automatically set with the correlation matrix. It is worth noting is that there are cases where a PCA is totally unjustified. It is not enough to produce a table containing quantitative variables and individuals to delve into a PCA; it is still necessary that the table first checks certain criteria.

2.2. Data

To achieve a causal link between the competence, performance and motivation, we relied on a survey with a total of 35 items distributed on three variables defining competence, performance and motivation, respectively. Each variable is decomposed in sub-variables to better identify its characteristics. Table 2 summarizes all the variables and sub-variables.

Table 2 shows that there are 8 general variables identifying the student and his/her social environment such as age, gender, weight, size and place of residence. The 3 basic variables are spread over 35 items that required factorization by the PCA.

The feeling of competence was divided it into three groups: The first is related to School absenteeism (2 items), the second addresses school anxiety (3 items) and the third focuses on the intention of dropping out (8 items). The variable of performance was also split into three groups: the first group focuses on academic performance (2 items), the second is related to students' involvement in education (3 items) and the third group addresses the measurement of physical skills (7 items). The last variable deals with motivation and consists of two groups: the first group deals with the students' quantitative evaluation (3 items) while the second treats the students' qualitative evaluation (7 items).

3. Factorization and interpretation of results

The question addressed in this paper focuses on multidimensional data processing techniques. Factor analyzes allow treating data more effectively, both in terms of individuals considered (n = number of lines = 343) and variables characterizing these individuals (p = number of columns = 35).

It is possible to proceed with an axis rotation when the component matrix [i.e. the matrix defining new dimensions (axes) = co-ordinate array of the initial variables on the axes], does not permit to clearly discern which variables make up a given dimension. We often resort to use the axes rotation to change the coordinates of the variables relative to the axes. We cannot conduct such rotation initially; we always start with a basic analysis without rotation. The factorization results before and after rotation are shown in Table 3.

According to Table 3, the factorization of the first variable has led to a prime factor explaining 57.1% of the total information with an average validity ($KMO = 0.5$) despite the high reliability ($\alpha_{Cronbach} = 0.75$). The first figure shows the eigenvalues and presents the variables and individuals in the first factorial plan. It is clear that the feeling of the students in this sample is strongly connected to the school Anxiety and Intention of dropping out.

Table 2: Description of items

Variables	Sub-variables	Name	Designation
		representative	A representative of pupils in each governorate
		Age	Pupil's age
		Gender	Pupil's gender
		Size	Pupil's size
		weight	Pupil's weight
		Town	Where the pupil lives
		Governorate	Governorate
Feeling of competence	School absenteeism	V1101	Since the beginning of the school year, how many days have you missed the physical education session?
		V1102	What were the reasons for these absences?
	school anxiety	V1201	Are you worried about the idea of failure in sports?
		V1202	Are you afraid to practice sports activities ahead your friends?
		V1203	After your sports exercises, you feel:
	Intention of dropping out	V1301	Have you ever seriously thought about giving up sports?
		V1302	When you establish sporting objectives, is it rare that you reach them?
		V1303	Have you been able to overcome the physical problems?
		V1304	When you try to learn a few things again, do you give up quickly?
		V1305	Have you been appreciated by your friend because you have good qualities in sports and physical activity?
		V1306	If you meet someone interesting in your sport specialty, with you find it is difficult to establish a friendship, do you avoid him/her?
		V1307	Do you ask questions when you have some notions in physical activity and sport beyond your understanding?
		V1308	When you find an answer to a problem, do you just reply or look for other solutions?
	Performance	School Achievement	V2101
V2102			During this school year, what are your grades?
Students' involvement in education		V2201	Do you spend part of the evening to improve your sports skills?
		V2202	Can't you provide great efforts in sport and physical activity at school?
		V2203	When you exercise a sporting activity at school, do you make it perfectly?
Measurement of physical skills		V23011	How much time do you run a 40 m race?
		V23012	How much time do you run a 60 m race?
		V23021	How long do you achieve in Long Jump?
		V23022	How far do you throw at launch weight?
		V2303	You favourite sports :
V2304	Is it true that one of your problems is that you cannot be physically present as it is required?		
V2305	Usually you do not like so much the regulations?		
Motivation	Quantitative assessment of students	V3101	How were you informed of the existence of the sporting activity association?
		V3102	What are the objectives provided in your institution underlying the creation of these associations?
		V3103	Did you follow a training course?
	Qualitative assessment of students	V3201	Will you make a performance test?
		V3202	If you have done this test, what are the emerging key points?
		V3203	Will you make a comparative assessment of skills with other students?
		V3204	Do you think you are a valuable person?
		V3205	Are you able to do things as well as the majority of your friends?
		V3206	If you fail something the first time, do you keep trying until you make it?
		V3207	Do you like to know if you have a chance to win a new game?

Table 3: Factorization results by the CPA

Variables	Nb. of item	Analysis before Rotation			Chosen Factors	Analysis after Rotation		
		Alpha de Cronbach	KMO	% Variation		Alpha Cronbach	KMO	% Variation
Feeling of competence								
School absenteeism	2	0.547	0.445	38.2	No	0.748	0.5	57.1
school anxiety	3				Yes			
Intention of dropping out	8				Yes			
Performance								
School Achievement	2	0.327	0.480	35.0	Yes	0.702	0.5	52.4
Students' involvement in education	3				No			
Measurement of physical skills	7				Yes			
Motivation								
Existence of sports activities in your institution	3	0.738	0.5	56.7	Yes			
Qualitative assessment of students	7				Yes			

Source: Authors' estimates of the data source.

The factorization of the performance variable yielded a first factor explaining 52.4% of the total information with an average validity (KMO = 0.5) despite the high reliability ($\alpha_{Cronbach} = 0.7$). The second figure shows the eigenvalues and

presents the variables and individuals in the first factorial plan. It is clear that the feeling of the students in this sample is strongly linked to academic achievement and the measurement of physical skills.

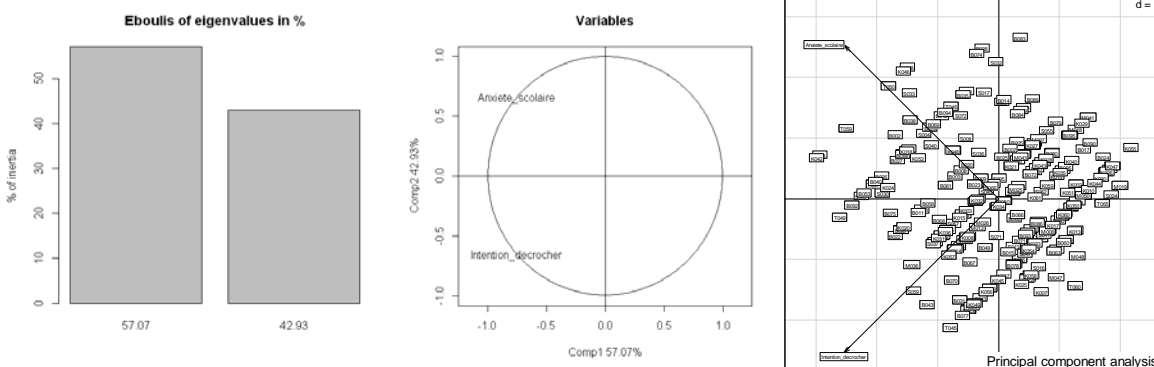


Fig 1: Presentation of eigenvalues, variables and individuals: Feeling of competence

The factorization of the motivation variable gave a factor explaining 56.7% of the total information with an average validity (KMO = 0.5) despite the high reliability ($\alpha_{Cronbach} = 0.74$). The third figure shows the eigenvalues and

presents the variables and individuals in the first factorial plan. It is clear that students' motivation in this sample is strongly tied to the availability of sports activities at school and the students' qualitative evaluation.

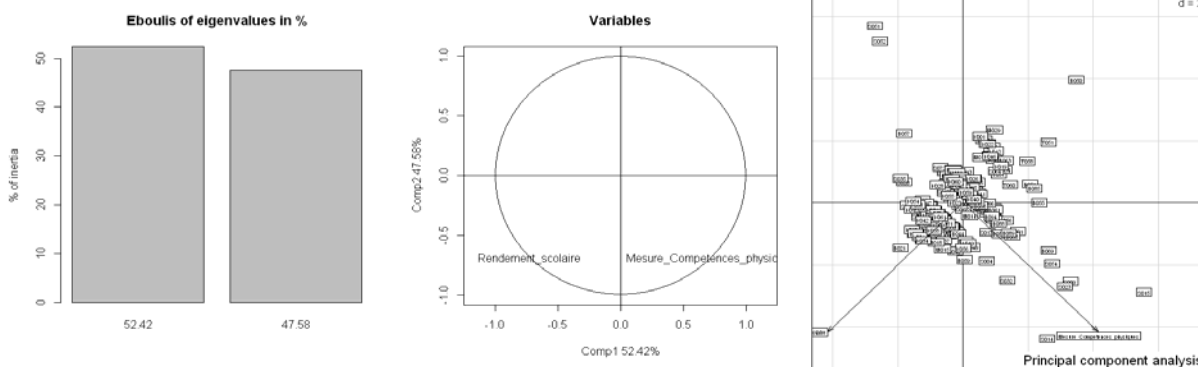


Fig 2: Presentation of eigenvalues, variables and individuals: Performance

The structural modelling indicates a structure beyond four factors with one second order factor and three first-order ones. The prognostic validity of these feeling dimensions, performance and motivation are confirmed by the correlations

between different dimensions and measurements obtained from the students for the physical performance assessments. However this research shows that it is performance rather than the feeling of competence that best explains the overall results.

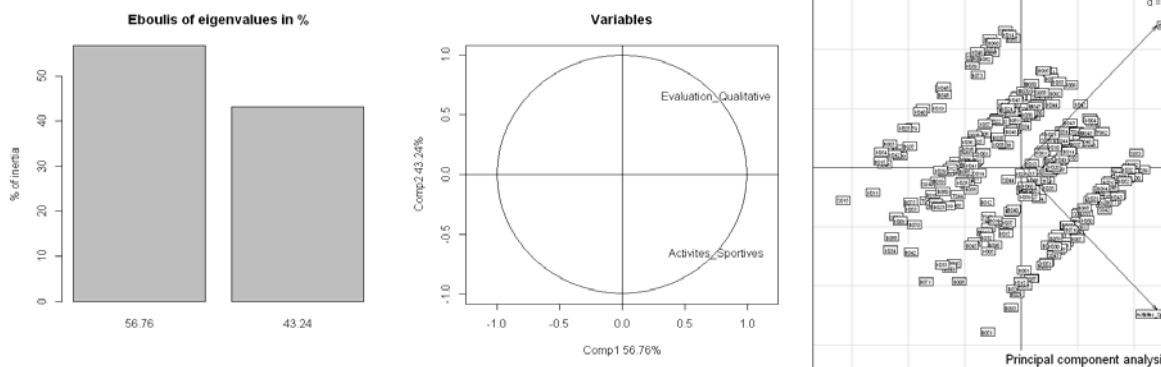


Fig 3: Presentation of eigenvalues, variables and individuals: Motivation

In what follows, we tried to look for the type of relationship that might exist between these three indicators applying a regression model. Indeed, the fact that the common factors were estimated, we would apply the Tobit approach. This

econometric model, proposed by James Tobin (1958) [38], is used to describe the relationship between an estimated censored dependent variable and an independent variable.

4. Causality test: Tobit approach

At this stage of our research, we tried to look for the impact of the three variables on themselves while taking into account the effect of auxiliary variables measuring the students' behaviour (gender, age, ...) using the Tobit model approach. Table 4 summarizes all the selected scenarios. Undoubtedly, Table 4 reveals some very interesting results.

Indeed, for the impact on the sense of competence, both performance and motivation variables have positive and significant effects on whatever model (1 or 2). In addition, a positive and significant effect of size and dwelling are easily remarked while weight has a negative and significant effect on pupils' feeling in the second model.

Table 4: Regression Study: Tobit Model

Variables	Feeling of competence		Performance		Motivation	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Feeling	*****	*****	0.132**	0.105**	0.026**	0.058**
Performance	0.133***	0.120**	*****	*****	-0.089*	-0.009**
Motivation	0.025**	0.008*	-0.088*	-0.042*	*****	*****
Constant	*****	-2.275*	*****	2.201**	*****	0.474
Gender	*****	0.183	*****	0.034**	*****	0.089**
Age	*****	0.029	*****	-0.111*	*****	-0.002*
Size	*****	0.827**	*****	1.417**	*****	0.579**
weight	*****	-0.008**	*****	-0.031***	*****	-0.024
Dwelling	*****	0.041*	*****	0.036*	*****	-0.165
σ	0.989***	0.971***	0.986***	0.776***	0.992***	0.985***
pseudo R2	0.132	0.049	0.099	0.028	0.237	0.062

Source: Authors' estimates of the data source.

Note: *, ** and *** show significance at 10%, 5% and 1%, respectively.

For the performance variable, the Tobit model estimation claims a significant positive effect of perceived competence whereas motivation is negative and significant for our sample. For the control variables, opposite to gender, size and urban housing that act positively on performance, weight and age have a negative impact.

As for motivation eventually, model 1 shows a significant and positive effect of feelings and a negative effect of performance at 10%. The same effects were observed in Model 2 with the significance of gender, age and size. These results confirm the previous idea that just like age, gender (females mainly) has a negative impact on motivation.

In total, the models showed the combined effects of different variables with different levels of significance. Indeed, numerous studies have shown that the feeling of competence is able to affect the academic performance of pupils (Bandura, 1997) [3]. Similarly, Pintrich and DeGroot (1990) [29] show an indirect relationship between the sense of competence and academic performance, particularly in physical education. Indeed, a student endowed with a high sense of competence will use more efficient cognitive strategies and thereby achieve better results. Bembentuty and Zimmerman (2003) [6] have also highlighted an intricate mechanism that shows how the feeling of competence fosters achievement.

5. Conclusion

Bandura defines the feeling of self-efficacy as "the belief in his own ability to organize and execute a series of actions required to achieve the situation referred". In this framework, the students in our sample are not directly controlled by environmental or biological factors, but by internal cognitive mechanisms. They have knowledge about themselves that enables them to evaluate and control their feelings and their actions. The belief that the individual has in his own abilities is a key element.

The concept of self-efficacy has several characteristics: it is primarily based on the individual's elaborated perception of his/her own abilities, neither on a personality trait nor a psychological characteristic. Besides, the feeling of competence, though contextualized in a specific activity, may be transferable in case several activities require the same

skills. Finally, it evolves over a performance level not against an established standard. Hence, it is the personal ability to succeed a task rather than doing better than the other which is put at stake.

One of the strengths of self-efficacy is its impact on success and this is particularly true in the field of education. Many researchers have investigated its effect on the students' academic performance (Bandura, 2007; Pajares and Valiante, 1997) [4, 27] and found a significant impact emphasizing that the same capacity of two students does not necessarily result in their success in the same way.

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