

Student Motivational Level in Physics Lessons at High School: an Investigation About the Motivational Profiles in the Backcountry in Paraíba, Brazil⁺

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Abstract

This research aims to validate the Escala de Motivação: Atividades Didáticas em Física (EMADF) focusing on the motivation of Physics students in High School in the backlands of Paraíba/Brazil. An Exploratory Factor Analysis (EFA) was conducted and five factors were identified that represent 67.6% of the data variability: 1- Demotivation ($\alpha = 0.784$), 2- Extrinsic Regulation by Reward or Punishment ($\alpha = 0.739$), 3- Extrinsic Regulation by Social Reward ($\alpha = 0.729$), 4- Introjected Regulation ($\alpha = 0.704$) and 5- Identified/Intrinsic Regulation ($\alpha = 0.907$). The factor loadings scored above 0.450 and the internal consistency indices indicated acceptable reliability values, although indicating improvements for future investigations. Pearson correlations confirmed the structure of the motivational continuum of the Self-Determination Theory. A cluster analysis identified three motivational profiles: Low quantity ($n = 87$; 34%), High quantity ($n = 84$; 32%) and Good quality ($n = 88$; 34%). This research recorded sociodemographic data, in the studied region, for the groups of High School Grade, Sex, City and Housing Area. The EMADF proved to be reliable to assess the motivation of Physics students and the cluster analysis adopted here brings important contributions to school contexts.

⁺ O nível motivacional dos estudantes nas aulas de Física no Ensino Médio: uma investigação dos perfis motivacionais no Sertão Paraibano

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I. Introduction

Motivation is one of the most impactful issues when considering educational problems (Bzuneck; Guimarães, 2010), especially when it comes to Physics classes in Natural Sciences and its Technologies. The Self-Determination Theory (SDT) presents a study platform for human motivation, well-being and personality development (Ryan; Vansteenkiste, 2023) in a try to explain and predict why we do what we do. In this sense, the SDT is a *metatheory* about human behavior and motivation. The SDT develops six mini theories to address the complexity that involves human behavior and two of them will be briefly covered: the Organismic Integration Theory (OIT) and the Basic Psychological Needs Theory (BPNT).

In the educational environment context, the SDT aims the development of cognitive and socio-emotional abilities and it manages the psychological well-being and ability to develop healthy relationships (Ryan; Vansteenkiste, 2023). Therefore, it is essential that schools support the psychological *needs* in their educational environments.

When it comes to the topic - motivation in the classroom - we can raise the following question: is the student motivated or unmotivated? For the Self-Determination Theory, the answer to this question escapes from the dichotomy and inserts a conditioning restriction: motivated to do what?, which may be a specific behavior such as: motivated to perform activities of Physics (after all, a student may be motivated to learn Physics by watching an astronomy documentary and unmotivated to learn Physics by responding to an astronomy activity, because each behavior can present a different motivational level). However, this answer does not distinguish the motivational quality yet because a student can respond to an activity only to get a grade in the subject that he or she is interested in, or the student can answer the activity because he or she feels pleasure in learning the topic, then finding the answers to the problems proposed.

Motivation, when understood as a complex phenomenon, is addressed in the form of a taxonomy of the human motivation (Ryan, 2012; Deci; Ryan, 2000).

In this *continuum* we find qualitative types of motivation. Besides the amotivation and intrinsic motivation, we find the extrinsic motivation, which unfolds in four modalities that, the closer to the intrinsic motivation, the more externally regulated behavior grows in integration with the self. Knowing this line of thought, although categorically, allows us to understand the autonomy development process by the individual (student). There are three levels of extrinsic motivation found in this research: Reward or Punishment (REPU), Social Reward (SORE) and Introjected (INTRO). The level of autonomous motivation (INTRI/IDENT) and amotivation (AMOT) were also found. The theoretical meaning of each motivational level are described later in this text.

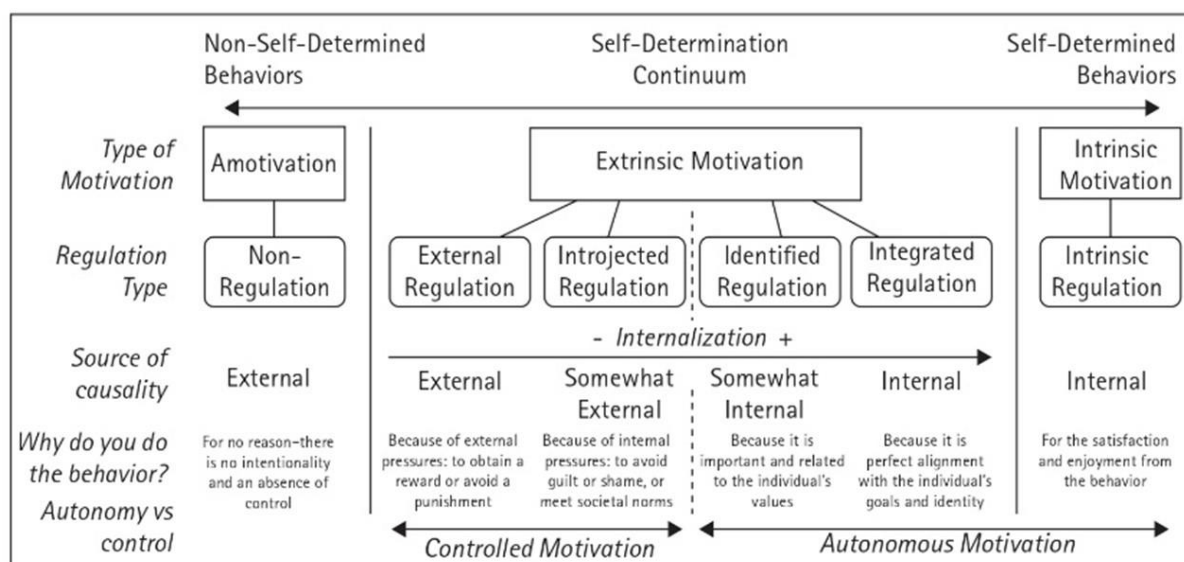


Fig. 1 – Continuum of Behavior Regulation (Organismic Integration Theory).

Source: Deci and Ryan (2000) – adapted by Pelletier and Rocchi (2023).

Besides that, the *amotivation* is characterized by the lack of behavior intentionality (Ryan; Deci, 2020), if manifested. For an amotivated individual, there is no continuity or relationship between his or her behavior and the goal (or goal) to be achieved (Vallerand *et al.*, 1992).

Regarding the Motivation by External Regulation, it refers to behaviors perceived as regulated by external reasons to the individual, usually related to the expectation of rewards, punishments and/ or social pressures (Deci *et al.*, 1991; Ryan; Deci, 2017, 2020; Guimarães; Bzuneck, 2010). This is the most extrinsic motivational level, in which there is no autonomy in behavior or decision-making, since the forces that regulate behavior are outside the individual. In this research, we identified a factor associated with the External Regulation by Rewards or Punishments (REPU), characterized by the motivation arising from school strategies to encourage or discourage students through rewards or punishments, both verbal and with impact on academic performance. In addition, we also identified the External Regulation by Social Reward (SORE), related to the ones linked to the relationship with relevant people for the student.

Therefore, the power of the extrinsic motivation should not be underestimated, because in addition to being common, external motivation can be very powerful when faced with notable rewards or severe punishments (Luria; Shalom; Levy, 2021; Ryan; Deci, 2020). Due to the dependence on external contingencies, students have a weak constancy and performance when external factors (rewards and punishments) are removed (Deci; Ryan, 2000), or expectations are not met, or when social rewards cease.

Within the scope of the Introjected Regulation, the central feature is the involvement of the ego. Phenomenologically, this means that at this motivational level, the individual is

often moved by feelings like guilt, shame or pride, experiencing an internal force that drives him or her to deal with anxiety, to protect self-esteem and achieve satisfaction or a feeling of personal pride (Bzuneck; Guimarães, 2010; Ryan; Deci, 2017, 2020). According to the APA (American Psychological Association) Dictionary, ego involvement refers to the extent to which a perceived judgment is psychologically relevant to an individual's self-esteem. In turn, self-esteem is defined as the degree to which the qualities and features contained in the self-concept of the individual are perceived in a positive way, encompassing their self-image and the perception of their achievements and abilities.

Regarding the Identified Regulation at this motivational level, the individual endorses the behavior through the alignment of values related to the action at issue, which provides greater autonomy and freedom (Clement, 2013; Ryan; Deci, 2020; Ryan, 2000). For this reason, behavior is considered important to the individual, since there is a congruence between behavior and their personal goals, needs and values (Ryan; Deci, 2017). This level may present a more internal locus of causality (ILC) (Clement, 2013). However, it cannot be considered as an intrinsic motivation, since the behavior is still instrumentalized and tends to be strictly utilitarian, as for example, to study Physics to pass ENEM or the medical entrance exam. In addition, behavior at this level is not completely integrated with the individual's identity, since it can remain compartmentalized in the cognitive structure. This is because some behaviors and values can be internalized in an unspecific or superficial way, which is reflected in situations in which the individual adopts contradictory interests, behaviors and values (Ryan; Deci, 2017).

In turn, the Integrated Regulation, although it is also part of the self-regulated motivational state, presents characteristics that distinguish it within the motivational *continuum*. This level is usually grouped with the intrinsic motivation in research, making it difficult to differentiate them (Byman *et al.*, 2012). On the Motivation Scale: Didactic Activities of Physics (MSDAP) (Clement, 2013), for example, no specific statement was included that sought to indicate this level of motivation in a prominent way of the intrinsic motivation. It is usually more characteristic of individuals who already have a well-formed identity, which is not common in adolescents and young adults, considering that aspects such as cognitive development, identity and ego are still in the process of maturing. As the totality of our sample is composed by high school students, this motivational construct naturally tends to be grouped with the identified or intrinsic motivation in the educational context (Ratelle *et al.*, 2007).

Thus, the *Intrinsic Motivation* stands out as the highest level of self-regulation in the motivational *continuum*, characterized by complete harmony between the values of the individual and his/ her actions. In this state, engagement in activities is not motivated by external rewards or pressures, but by genuine interest, curiosity and intrinsic pleasure in learning or doing something (Ryan; Deci, 2000; Deci; Ryan, 2017). This form of motivation is associated with several positive outcomes in the educational context, such as greater persistence, academic performance and emotional well-being. However, its manifestation

depends on external factors such as the environment and experiences that the person has lived, being favored in contexts that promote autonomy, involvement and competence.

In this sense, the Basic Psychological Needs Theory (BPNT) highlights autonomy as an essential need for human well-being. According to this theory, autonomous behavior is the natural state by which humans are oriented, and its absence compromises psychological health. The BPNT, inserted in the perspective of positive psychology (not to be confused with positivism), understands humans as a complex being, capable of self-regulation and psychological development, going beyond the reductionist view of a biochemical machine or of stimuli-conditioned responses. Instead, humans are seen as an active agent in pursuit of well-being and integrity (Deci; Ryan, 2000; Ryan; Deci, 2017). Thus, the BPNT proposes three fundamental psychological needs: autonomy, competence and belonging. Unlike behavioristic theories, which consider human needs as survival-oriented impulses, the BPNT defines these needs as ‘psychological and innate nutrients essential for the continuous progress of personal development, integrity and well-being’ (Deci; Ryan, 2000, p. 229).

Among these needs, *autonomy* stands out, which refers to the perception of the individual – in the school context, the student – to be the initiator and controller agent of his/her actions. This perception manifests itself as experiences of integrity, volition and vitality in a self-regulated behavior (Deci; Ryan, 2000). In opposition to these experiences, there are feelings of coercion, seduction, pressure and control. Thus, when the individual realizes himself or herself unable to deal with certain situations, behaviors or objectives, he or she tends to avoid such contexts. Autonomy, therefore, is also related to the ability to manage and meet a set of needs that can sometimes be conflicting.

In a complementary way, *competence* refers to the perception by the student that he or she is able to act effectively and achieve results. It is the need to feel confident in his or her ability to overcome challenges and fulfill their goals (Deci; Vansteenkiste, 2004). Naturally, human beings seek environment that provide them security. When exposed to situations in which they feel unable to face difficulties, the individuals tend to feel controlled by circumstances and insecure. However, in the educational context, it is essential to develop experiences that enable students to understand their actions and achieve goals aligned with their interests.

On the other hand, *belonging* encompasses the need to live positive experiences in interpersonal relationships, promoting proximity and trust. The development of the individual, as well as his or her actions, does not occur in an isolated or automatic way, but it is strongly influenced by the environment, especially by the social context (Deci; Vansteenkiste, 2004). The environment contributes to propel motivation, but not completely. For example, hindrance or punishment may be perceived as incentives rather than inducement to cease behavior. However, in the school environment, hyperchaotic or unpredictable contexts can have negative effects on the student development (Deci *et al.*, 1991).

Having said that, when the needs of autonomy, competence and belonging are met by the environment, the individual tends to integrate into the self, initially externally controlled behavior, making them more self-regulated, autonomous and genuine. In other words, extrinsically motivated behavior tends to be intrinsically regulated. However, when these needs are not respected, motivation tends to deteriorate, falling back to more externally controlled levels of motivation.

In Fig. 1, motivational *continuum* is presented and it can be divided into three levels of motivation: Intrinsic Motivation, Extrinsic Motivation and Amotivation. Intrinsic motivation is characterized by an internal locus of causality (ILC), which in practical terms means the perception of freedom in behavior, agreement with one's own interests and personal responsibility for acts (Bzuneck; Guimarães, 2010). In contrast, in the Extrinsic Motivation, we find the external locus of causality (ELC), that is, a behavior under the influence of forces that are external to the individual, which is not completely free, where the individual is pressured by factors beyond his or her control.

Thus, knowing the theories about human motivation in school context becomes particularly relevant when students face critical situations. Bonadiman and Nonenmacher (2007) highlight the presence of affective problems in Physics learning, noting that some students consider the subject 'unpleasant' and associate it with negative experiences and memories. In this sense, several authors have been researching motivation in Physics Learning at High School, using as a foundation the Self-Determination Theory (SDT).

II. Research and Method

The core question of this research is: **among high school students, what motivational profiles can be found in relation to Physics learning in the region of Cajazeiras, Paraíba, Brazil, based on the levels of the self-determination *continuum*?**

We used the *reduced version* of the **Motivation Scale: Didactic Activities of Physics (MSDAP)** prepared by Clement (2013), which is also found in Clement *et al.* (2014). The full version obtained validation for 50 items, in which the author suggests that a reduced version with 28 items can deliver similar results for the psychometric test. In Paiva *et al.* (2018) we also find a validation for the reduced version.

Each item has a five-point Likert Scale and it presents six level averages of the motivational *continuum*. We applied an **Exploratory Factor Analysis** (Damásio, 2012) to find the motivational levels indicated by the Self-Determination Theory (SDT) and then conducted a Cluster Analysis (Marôco, 2007) by the hierarchical method (using Ward Method) and the non-hierarchical method (using k-means). Cluster Analysis is used in psychometrics in the areas of psychology (Marôco, 2007), education (Ratelle *et al.*, 2007), administration and work in companies (Howard *et al.*, 2016). Finally, we applied a descriptive statistical study, observing the mean of the Z-scores to evaluate if the clusters (grouping of respondents) have a score tendency that is linked to intrinsic and extrinsic motivation (Dulark, 2009).

III. Participants

The study included 259 students from the 1st year (29.7%), the 2nd year (41.7%) and the 3rd year (28.6%) of High School. The majority of them were male (52.4%), while 46% were female and 1.6% preferred not to report their gender. The majority of the sample is resident in the town of Cajazeiras, Paraíba, Brazil (85.7%) and the other students live in nearby cities (14.3%), in which 76.7% are from the urban area and 23.3% from the rural area.

VI. Data Analysis

An Exploratory Factor Analysis (EFA) was performed in the FACTOR program (12.03.02 Version of October 20, 2022) with the aim to evaluate the factorial structure of the Motivation Scale: Didactic Activities of Physics - MSDAP (**Table 2**) (Paiva *et al.*, 2018). The analysis used a polychoric matrix and appropriate model estimator for the data, Unweighted Least Squares (ULS) (Asparouhov; Muthen, 2010), while the rotation used was Weighted Varimax (Lorenzo-Seva; Ferrando, 2019).

Initially, the preliminary indices of adequacy of the sample and the correlation matrix indicated that the technique was enough to the data collected, through KMO = 0.811 and significant Bartlett's test of sphericity [χ^2 (300) = 2864.8; $p < 0,001$]. The five expected dimensions together explained 67.8% of the total variance of the items, with eigenvalues ranging from 7.85 to 1.21.

In the extraction of the number of factors, we based on the eigenvalues scores greater than 1 and thus we kept the decision due to the number of factors for the scale of this study as we will see on Table 1.

Table 1 – Extraction of the main components with eigenvalue greater than 1.

Factor	Eigenvalue	Variance Ratio	Cumulative Variance Ratio
1	7.846	0.314	0.314
2	4.233	0.169	0.483
3	2.131	0.085	0.568
4	1.512	0.061	0.629
5	1.213	0.049	0.678
6	0.992	0.040	
7	0.753	0.030	
8	0.664	0.027	
9	0.602	0.024	
10	0.589	0.024	

Source: personal collection of the researcher.

To identify the items that belong to each factor, it was established, as criterion, the factorial load equal or greater than 0.30 and the consistency of the items, also measured by the Cronbach's alpha coefficient. In these conditions, we have determined the need to exclude some items. To help us in this decision, we applied the discrimination tests (how much the item differs from the other motivational levels, and in our survey, how easy it was to answer the item).

The discrimination (parameter a) and the thresholds (parameter b - difficulty), which varied from d1 to d4, were assessed. The results showed that the vast majority of items presented high capacity to discriminate individuals with different levels of score ($a > 0.60$), except item 6 ($a = 0.46$), item 8 ($a = 0.53$), item 21 ($a = 0.38$), which were the least discriminative. The thresholds indicated wide amplitude of the latent trace by the items. The item with the greatest ease of agreement was item 18 ($d4 = -0.66$), while the item with the greatest difficulty of agreement was item 7 ($d4 = 3.53$).

This index shows that people of different motivational levels will, in fact, score differently (they will be discriminated or identified by the questionnaire). In the case of low-scoring items, the motivational levels of respondents cannot be discerned well.

The good score of the other items indicates that the exclusion of questions 6; 8 and 21 can improve the quality of the questionnaire. The low factor loads of these items also point to the improvement in the questionnaire quality and these items were excluded. KMO test, Bartlett's test of sphericity and the extraction of the main components presented above (Table 1) are related to the questionnaire with the exclusion of these items (6; 8 and 21). First, we tested 28 items, and we did not get as good results as with the 3 excluded items. The results of Table 1 are already the results with the excluded items. Thus, we show the results after the exclusion and then justify such removal by saying on what we had based for such a procedure, totaling 25 items below (Table 2).

Table 2 – Factorial structure with five factors.

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1. I try to do the activities because they help me to detect and overcome my doubts. (INTRI/IDENT)				0.700	
2. I do them because I will feel bad about myself even if I don't. (INTRO)	0.650				
3. I do the activities because I feel it is a good way to improve my understanding about the topics covered by the subject. (INTRI/IDENT)				0.718	
4. I do the activities in order to be praised by the teacher. (SORE)					0.471
5. I have no interest in Physics, so I do almost nothing in class. (AMOT)		0.622	0.311	-0.404	

7. Physics activities are not important to me, so I do not do them. (AMOT)		0.747			
9. I want the teacher to think that I am a good student, so I do the activities. (SORE)	0.350		0.370		0.455
10. I do the activities so I learn more and more. (INTRI/IDENT)				0.883	
11. I do the activities because it is pleasant to learn from them. (INTRI/IDENT)				0.823	
12. I do not do the Physics activities because I see no use in this knowledge. (AMOT)		0.686		-0.317	
13. I will be ashamed of myself if I do not do the activities. (INTRO)	0.654				
14. I am rewarded by my parents, so I do the activities. (SORE)					0.745
15. I think it is a waste of time doing the activities during Physics classes. (AMOT)		0.533		-0.489	
16. To impress my school mates, I end up doing the activities. (SORE)					0.687
17. I do the activities because I think it is cool to learn from them. (INTRI/IDENT)				0.829	
18. I end up doing the activities so as not to fail at school. (REPU)			0.812		
19. I do the activities not to be sent to the school board room or pedagogical guidance. (REPU)			0.506	-0.348	0.337
20. I do them because I enjoy Physical activities. (INTRI/IDENT)		0.323		0.583	
22. I do the activities so my school mates will not say I am stupid. (REPU)					0.571
23. I do the activities because they will give me a good understanding about Physics. (INTRI/IDENT)				0.735	
24. I do the activities because they will make me happy (INTRI/IDENT)				0.631	0.385
25. I do them because I avoid problems or punishment at school. (REPU)			0.655		0.325
26. Not to get a low grade, I end up doing the activities. (REPU)			0.771		
27. Because I feel good doing the activities so I do them. (INTRI/IDENT)				0.60 2	
28. I do the activities because I feel distressed if I don't. (INTRO)	0.805				

Source: personal collection of the researcher.

When analyzing the distribution of the factor loads of the five-factor structure and comparing it with the results of the study by Paiva *et al.* (2018), it was found that **Factor 1** (INTRO) corresponds to the Introject Motivation dimension, with factor loads that saturate correctly (items 2, 13 and 28). **Factor 2** (AMOT) represents the Amotivation dimension, with all items saturating correctly (items 5, 7, 12 and 15) with loads above 0.30. **Factor 3** (REPU) brings together items from the External Regulation for Rewards and Punishments dimension in which the four items are correctly saturated (items 18, 19, 25 and 26). **Factor 4** (INTRI/IDENT), which represents the Identified/Intrinsic Motivation dimension, whose result showed that all expected items were correctly saturated (items 1, 3, 10, 11, 17, 20, 23, 24 and 27). Finally, **Factor 5** (REPU) correctly saturated Extrinsic Motivation items by Social Reward (items 4, 9, 14, 16 and 22). Thus, we find all the motivational levels theorized within the previous factor solutions.

All factors presented good reliability by internal consistency, since their indices were higher than the recommended value (0.60). We can see on Chart 1 that the motivational level with the highest average of all respondents in the Likert Scale was External Motivation by Reward or Punishment (REPU), followed by Intrinsic/Identified Motivation (INTR/IDENT).

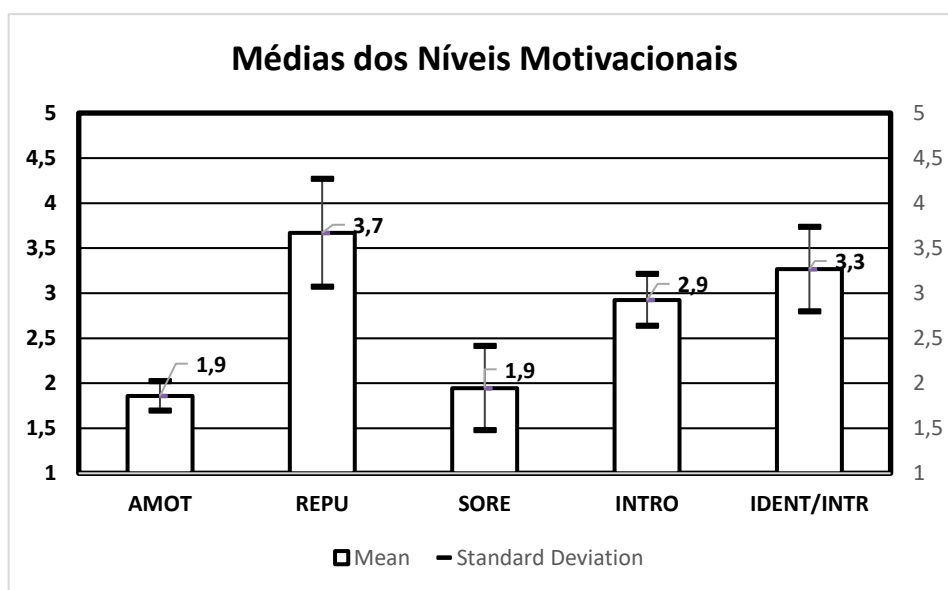


Chart 1 – Motivational Level Average

Source: collection of the researcher

The measurement reliability was checked by two techniques: 1) internal consistency, using the Cronbach's alpha coefficients (α) obtained by SPSS 25.0 version and McDonald's omega (ω), obtained by the JASP software (Jeffrey's Amazing Statistics Program, 0.16.4.0 version); and 2) the composite reliability (CR) for each instrument dimension (Raykov, 2007)²

² Carried out with the help of the specific website: <https://www.thestatisticalmind.com/composite-reliability/>), considering the indices above 0.60 as satisfactory.

(Table 3).

Table 3 – Reliability indices and descriptive statistics.

Factor	McDonald's Omega (ω)	Cronbach's Alpha (α)	CC	Average	SD
F1 - INTRO	0.706	0.704	0.841	2.924	0.235
F2 – SORE	0.736	0.729	0.793	1,945	0.419
F3 – AMOT	0.785	0.784	0.820	1.857	0.141
F4 – REPU	0.732	0.739	0.834	3.700	0.52
F5 – INTRI/IDENT	0.908	0.907	0.911	3.267	0.44

Source: collection of the researcher.

What can be understood through the data presented by the averages? Are the responding students externally controlled for reward and punishment? If this is the case, why does the second highest average value represent autonomous motivation? Is it possible to be regulated externally and internally? Is the *continuum* structure in this research adequate? Are there groups of respondents with distinct and well characterizable levels of motivation? Throughout this research we will try to answer these questions.

In order to justify the structure of the motivational *continuum*, correlations between factors were studied using the Pearson's r coefficient (Table 4) on JASP software (0.16.4.0 version). The correlations that range from 0 to 1 were interpreted with the following cutoff points, according to Field (2013): weak (0.10-0.30); moderate (0.30-0.50) and strong (> 0.50).

Bivariate correlations showed significant relationships among the factors. The factor Intrinsic Motivation/ Identified correlated negatively and strongly with the factors Amotivation ($r = -0.661$; $p < 0.001$) and Reward or Punishment ($r = -0.448$; $p < 0.001$), in other words, the higher the intrinsic motivation, less amotivation and motivation by rules and punishments. This adequacy standard follows the correlation among the following factors: the adjacent factors correlate positively and the extreme factors correlate negatively, following the order of the motivational *continuum* theorized by the SDT. The relationship between the Introjected Motivation (INTRO) and Amotivation (AMOT) that failed to correlate and obtained a p-value that does not indicate confidence in this correlation between these two factors specifically ($r = 0.069$; $p < 0.271$). Seeking to find a possible cause for this situation, there is an anomaly in the study by Clement *et al.* (2014) with the factor referring to the Introjected Motivation, but in relation to Intrinsic Motivation, with correlation values higher than the Identified Motivation. It is possible that this situation occurs because the instrument has only three items for Introjected Motivation, which is a weak point identified in the research by Clement *et al.* (2014).

Table 4 – Pearson Correlation of the simple factorial scores³.

Variable	F2 – DESM	F3 – REPU	F5 - RERS	F1- INTRO	F4 - IDENT/INTR
1. F2 - DESM	Pearson's — p-value —				
2. F3 - REPU	Pearson's r 0.760 p-value < .001	— —			
3. F5 - RERS	Pearson's r 0.371 p-value < .001	0.506 < .001			
4. F1- INTRO	Pearson's r 0.069 p-value 0.272	0.365 < .001	0.764 < .001	— —	
5. F4- INTRI/IDENT	Pearson's r -0.661 p-value < .001	-0.448 < .001	0.310 < .001	0.496 < .001	— —

Source: personal collection

It is possible to observe a difference in our factors and those ones by Clement *et al.* (2014), because the motivational levels, “intrinsic motivation” and “identified motivation”, were grouped into a single factor, similar to Paiva *et al.* (2018). When seeking an explanation for this situation, it was noticed that this condition is repeated in other studies. The most comprehensive study that addresses this question is brought by Howard, Gagné and Bureau (2017). When the *motivational continuum* is tested in the literature review with psychometric analysis of the data, we have the following:

correlations between the ‘autonomous’ types of regulations (identified, integrated and intrinsic) are much higher than those between the other adjacent regulations [...] correlations between identified, integrated and intrinsic range from .818 - .913, whereas correlations between adjacent ‘controlled’ pairs range from .510 - .603 (Howard; Gagné; Bureau, 2017, p. 19.).

An interesting question arises: *is it possible to be extrinsically and intrinsically motivated at the same time?* Let's see: MSDAP (Table 2) by Clement (2013), is similar to the questionnaire entitled Academic Motivation Scale (AMS) and also to the Self-Determination Questionnaire (SDQ). In the studies of Howard, Gagné and Bureau (2017), we found a trend of the means of the Identified and External Motivation to score high simultaneously in the AMS. We did not observe this pattern in the other questionnaires, since these are related to self-

³ Amotivation (AMOT); External Regulation by Reward or Punishment (REPU); External Regulation by Social Reward (SORE); External Regulation by Introjection (INTRO); Intrinsic Motivation (IDENT/INTR).

regulation in work, physical exercise practice contexts and others (including SDQ). The AMS (or EME, the original scale was produced in France and translated into English) is found in Vallerand *et al.* (1992). In other words, we can observe that this pattern is characteristic of educational contexts.

For Lepper, Corpus and Iyengar (2005), the students, in order to adapt to school reality, develop intrinsic and extrinsic motivations simultaneously, seeking personal fulfillment in learning, valuing knowledge, pleasure in activities (intrinsic motivation features), but also, they sought a good academic performance with better grades to avoid reprimand (an extrinsic motivation feature). For Ratelle *et al.* (2007), *it is possible to develop autonomous and controlled motivations at the same time.*

It is worth remembering that, for the SDT, the most adapted individuals will be those ones with higher levels of self-regulation. In the investigations by Lepper, Corpus and Iyengar (2005), it is possible to conceptualize a phenomenological combination between the two motivational domains. *It is not the issue, for these authors, whether the student is intrinsically or extrinsically motivated, but how much he or she is intrinsically and extrinsically motivated.* If the student is only concerned about having fun and learning what arises his or her own curiosity and taste, they would probably miss opportunities to improve their academic performance or to reasonably perform in less pleasant school activities, what, in turn, can lead even to loss of scholarships and to more modest scores in tests and entrance exams. On the other hand, students who only seek academic performance, without engaging in pleasurable activities or focused on their interests and genuine tastes, may depreciate their intrinsic motivation, leading to worse emotional state and more mechanical learning.

Having said that, could we interpret that the average of the motivational levels indicates that the students in this research have intrinsic and extrinsic motivation simultaneously? *It would be premature to say yes.* There is the possibility of two distinct and well-defined groups in which some of them are extrinsically motivated and others intrinsically.

In Ratelle *et al.* (2007) and Vansteenkiste *et al.* (2009), we found studies that sought to discern these respondents, using a ‘person-centered approach’ (Hong; Bernacki; Perera, 2020). In this sense, the groups of respondents were distinguished and we could trace *motivational profiles*. In one of the studies by Ratelle *et al.* (2007), we have the profiles (groups): 1- a lot of autonomy/ a lot of control; 2- low autonomy and little control; and 3- autonomous. In Vansteenkiste *et al.* (2009), a group with the profile of *good motivational quality* (a lot of autonomy, low control), a second group with *poor motivational quality* (low autonomy, a lot of control), a third group with the profile of *low motivational amount* (low autonomy, low control), and a fourth group with the profile of *high motivational amount* (high autonomy, high control). Ratelle *et al.* (2007), Van den Berghe *et al.* (2014) and Howard *et al.* (2016) showed evidence that there is *motivation quality and amount*. All things considered, we are dealing with a new depth layer of human motivation. The quality would be how close to the self-regulated level the group is (extrinsically or intrinsically motivated), and the amount would be the

representativeness (average) of each motivational level (i.e.: if extrinsically motivated, how motivated this individual would be).

In Pelletier and Rocchi (2023), it is observed that one of the fundamental propositions of the OIT is that motivation can be described in terms of *continuum* when extrinsic motivation, as already seen, manifests itself in distinct types, involving internalizations of behavior, more controlled and heteronomous to the individual, based on external controls of reward or punishment⁴ and also internal control of affective contingency and self-esteem⁵. The more external types (rewards and external punishments and internalizations for ego defense and self-esteem) we can understand that behavior has a *controlled* motivation. On the other hand, the regulations linked to identification⁶, the identity and personal taste of the individual present an *autonomous* motivation (Pelletier; Rocchi, 2023). Free actions, characterized by satisfaction and autonomy experience, are the main characteristics of an *autonomous* motivation behavior.

The *continuum* presents a representative and explanatory model for the types of human motivation, but do these ones, in fact, indicate a *controlled or autonomous* behavior (Ryan; Deci, 2017) as points out by the SDT. For Howard *et al.* (2020), they do, as multi-dimensional methods (such as the factorial analysis for this research), used to represent *autonomous and controlled* motivation, as well as the types of motivation, *are the most accurate methods of presenting them and explaining the variance of the results*. This interpretation is corroborated by Pelletier and Rocchi (2023).

The approach of motivation in terms of *quality* (controlled and/or autonomous) and amount (means of motivational variables), within groups of respondents to the survey, is able to reveal more intervention-needed groups, to interpret more clearly the data collected in surveys with the distinct social groups, as well as pointing out predictive factors of behavior.

IV. Clusters

Cluster Analysis was adopted, which is used in psychometrics when it is intended to identify groups of respondents by their similarity. Different from the factorial analysis, used for the variables analysis of the questionnaire from the respondents' response patterns, cluster analysis can be used to evaluate the structure of variables (here we consider the individual as a variable, and motivational levels as a metric unit). Cluster analysis consists of finding groups of similar individuals (or variables) with common characteristics from each variable-dimension (or individual). The most homogeneous respondents are grouped (similarity measures) and differentiated from other groups (difference or dissimilarity measures), which have their own

⁴ In this research, it represents External Regulation by Reward and Punishment (REPU) and External Regulation by Social Reward (SORE).

⁵ In this research, it represents External Regulation by Introjection (INTRO).

⁶ have importance in the perspective of the individual values, showing External Regulation by Identification, which in this research, grouped with Intrinsic Regulation (INTRI/INDEN).

homogeneity characteristics.

Although we use the MSDAP instrument, which presents five motivational levels, we can find two motivational dimensions, already discussed, which are the *controlled* Motivation and the *autonomous* Motivation. Thus, it is possible to determine the motivational profiles qualitatively and quantitatively.

Excluding the items of the *amotivation* factor, it was possible to create a composite index of the variables of the *autonomous* motivation ($\alpha = 0.90$) and the controlled ($\alpha = 0.74$) one. The identified and intrinsic motivation factors (INTRI/IDENT) are scored as *autonomous* motivation and the introjected motivation factors (INTRO), external for reward or punishment (REPU) and social reward (SORE), are scored as *controlled* motivation. So, we performed this approach, as Vansteenkiste *et al.* (2009), for which an analysis of the main components was carried out, indicating a fall in eigenvalues from the second to the third factor (i.e., 5.84, 3.41, 1.60, 1.42). Together, the two components explained about 44% of the motivational item variance. After a VARIMAX rotation, the loads remained above 0.60 for *autonomous* and 0.35 for *controlled motivation*. No cross-loads were present. The autonomous and controlled dimensions did not show correlation, $r(259) = .000$.

In order to find the groups of respondents within the survey, we used SPSS Statistics - 25.0 version and we chose the square of the Euclidean distance between the individual homogeneity parameters. To form clusters, we can resort to hierarchical and non-hierarchical methods. Among the various methods for hierarchical clustering in the literature, we used the Ward Method as indicated by Ratelle *et al.* (2007) and Van der Berghe *et al.* (2014), allowing more stable clusters. At the end of this process, we find a dendrogram, which indicates the various groupings (homogeneity groups) and the distance between these groupings (heterogeneity), allowing us to find the number of clusters, which will be established in the non-hierarchical method.

The non-hierarchical cluster analysis is more suitable for a larger data matrix and allows a respondent to be regrouped throughout the analysis, making it less likely to be grouped "erroneously" (Marôco, 2007). On the other hand, the method requires a prior number of clusters to perform the grouping. The previous number is difficult to be intuited in a large and raw database. By the hierarchical method, described above, we have a notion of how many homogeneous groups exist. The 'cut' is performed qualitatively, considering the used literature (Ratelle *et al.*, 2007; Vansteenkiste, 2009) and the heterogeneity distance between the groups found. We used the K-means Method to find the clusters pointed by the hierarchical method. The study of homogeneity and explanatory power of each cluster was carried out in a preliminary way. However, one of the clusters (autonomous motivation profile) did not reach the minimum value of 50% of explained variance. The clusters found were named according to Vansteenkiste *et al.* (2009) standards and their study was qualitatively developed with the support of descriptive statistics.

Table 5 – Motivational profiles according to Vansteenkiste *et al.* (2009).

Good quality	High intrinsic and identified motivation, low introjected and external motivation.
Low amount	Low intrinsic and identified motivation, low introjected and external motivation.
High amount	High intrinsic and identified motivation, high introjected and external motivation.
Poor quality (not found in this research)	Low intrinsic and identified motivation, high introjected and external motivation.

Source: personal collection of the researcher.

After finding the clusters for each respondent, we plotted the averages for each one, finding, thus, the *motivational profiles* (Chart 2). These are the clusters: 1- Low amount of motivation (n = 87, 34%); 2- High amount of motivation (n = 84, 32%); 3- Good quality of motivation (n = 88, 34%). The poor-quality profile of motivation was not found. The averages of each group are described below:

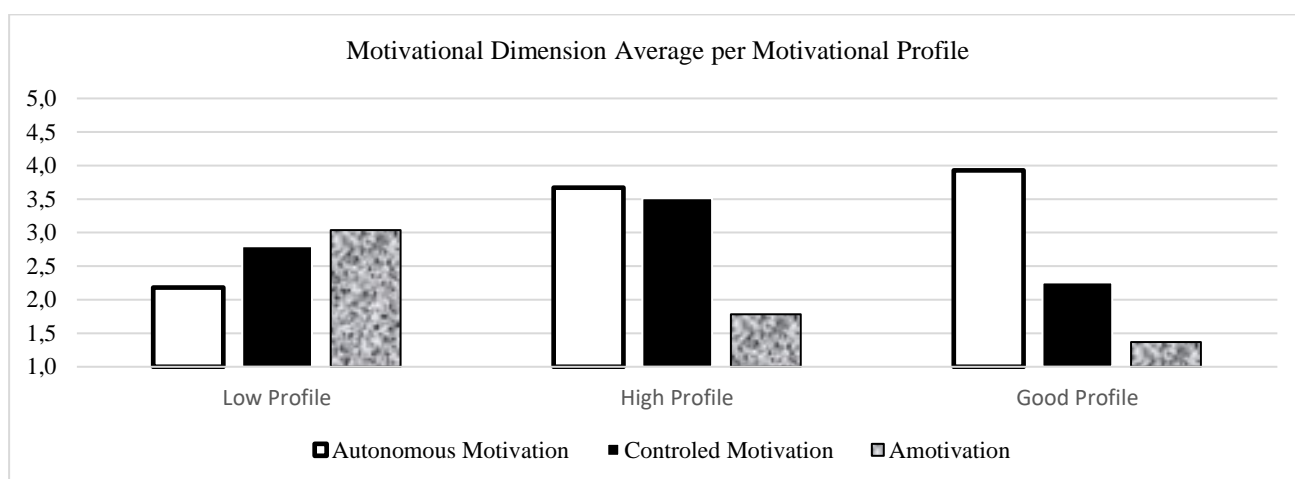


Chart 2 – Motivational Dimension Average.

Source: personal collection of the researcher.

To evaluate the motivational profiles of the respondents, the Z-score average was used. The calculation of Z-scores was performed by data sheets (Microsoft Excel and Google Sheets), through which Z-score average was calculated among motivational groups. Z-scores can be understood as the distance between the individual's response to the survey and the average response of all respondents measured in standard deviation units (a 2-point Z-score is equivalent to the distance from the standard deviation twice). Within each selected group, we will find different Z-scores, revealing a response tendency within them allowing us to observe their distinctions. The Z-scores charts are represented below:

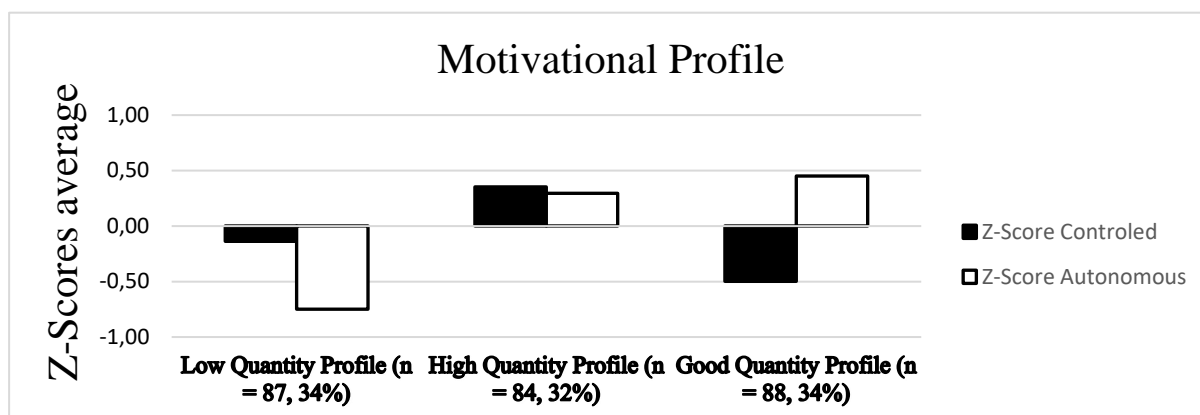


Chart 3 – Z-Score Average of the Motivation Profile.

Source: personal collection of the researcher.

The chart above shows the distances among the cluster averages and the average of the entire sample. This distance is measured in standard deviation units. The interpretation of these scores is similar to *Cohen's d* (Vansteenkiste *et al.*, 2009). The Standard Deviation value is equal to 1 on this scale (if positive and since it is a proportion). We have the small effect magnitude for an average of Z-scores between 0.2 and 0.5; average between 0.5 and 0.8 and large if greater than 0.8 (Scholte *et al.*, 2005). Regarding the research in education, magnitudes above 0.2 can already be considered relevant with regard to academic performance. However, it is worth remembering that the measurements of Magnitude of Effect need to be studied within a research context to infer the importance and practical value of these indices (Durlak, 2009). This study has not been found in the Brazilian research for motivation in Physics learning.

On the Chart 3 above we can observe interesting features in our motivational profiles. The low profile (n = 87, 34%) partially escaped from the expected pattern. The average Z-scores of the autonomous motivation items were low, which was expected, but the controlled motivation items were with very modest averages in this research (between 0.2 and -0.2), slightly outstripping the expected features for this profile. It should be taken into account that the trend of the chart seems to point to low autonomous and controlled motivation. These indices may indicate an amotivated profile. In Vansteenkiste *et al.* (2009), it is considered the possibility of a fifth profile, 'unmotivated', which can be presented from the poor or low profile, if some research investigates the motivational level 'amotivation' and this higher score. We did not characterize this profile as unmotivated but poor, because the amotivation average was three points, indicating that respondents were not sure whether they agreed or disagreed they were unmotivated. This profile is not usually found at school, since a student with this profile would probably not be in the classroom.

The Combined Motivation profile (n = 82; 32%) presented values within the expected ones, above 0.2 for both, indicating that this group of respondents combines external and internal regulation processes in the behavior to perform the Physics activities.

The Autonomous Motivation profile ($n = 88$; 34%) showed scores as predicted theoretically, with low scores for controlled motivation and higher scores for autonomous motivation.

V. Sociodemographic Data Collected in the Survey

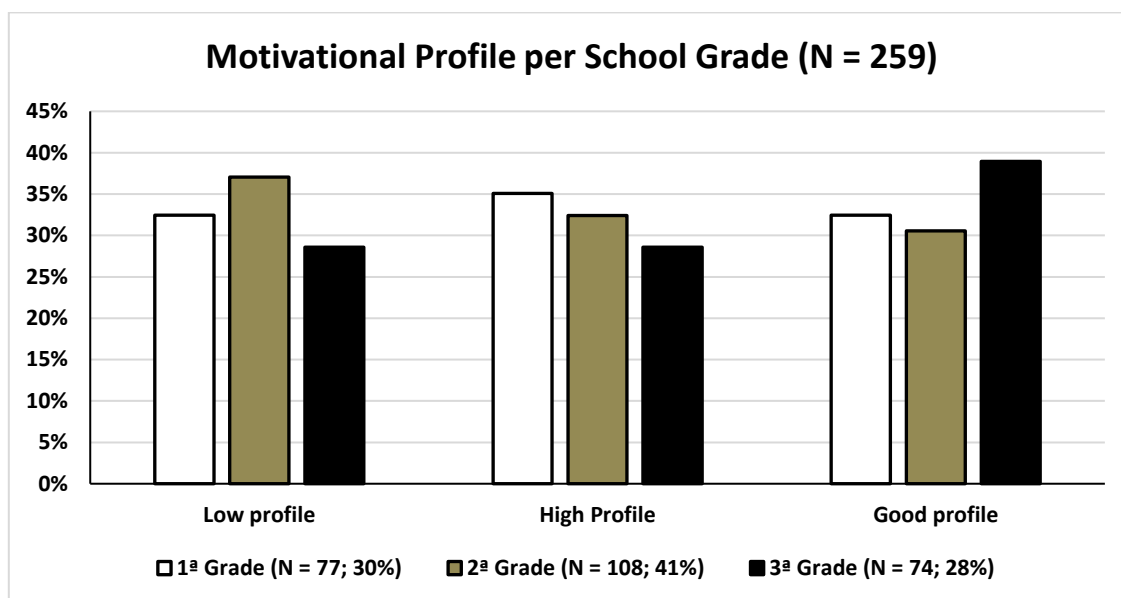


Chart 4 – Motivational Profile per School Grade.

Source: personal collection of the researcher.

The most representative profile for the first school grade was *High* amount, while for the second one, we found *Low* amount. For the third school grade, for the surprise of this research, the profile *Good* quality was more representative. It was expected that, along time at High School, autonomous motivation would decrease and the levels of controlled motivation increase, as we see in some Brazilian studies about Elementary School (Rufini; Bzuneck; Oliveira, 2012) and High School overseas (Ryan *et al.*, 2023; Lepper; Corpus; Iyengar, 2005). We observed this phenomenon between the first and second school grades, but not in the third one, which exceeds the first and second school grades. Further investigation is necessary to confirm and find the causes for this phenomenon and if these data would not be a local feature.

For the first and third school grade general averages, we found that the motivation identified is the second highest average, with reward or punishment as the highest overall average. This may be because, in the identified motivation, we find a superficial appreciation about performing the activities of Physics. A hypothesis that worths investigation may be that the university entrance exams and ENEM are valued as a means to achieve an end, which would be a kind of long-term reward or a reason, as one of the micro-theories in the Self-Determination Theory predicts.

VI. The Motivational Profiles per Gender

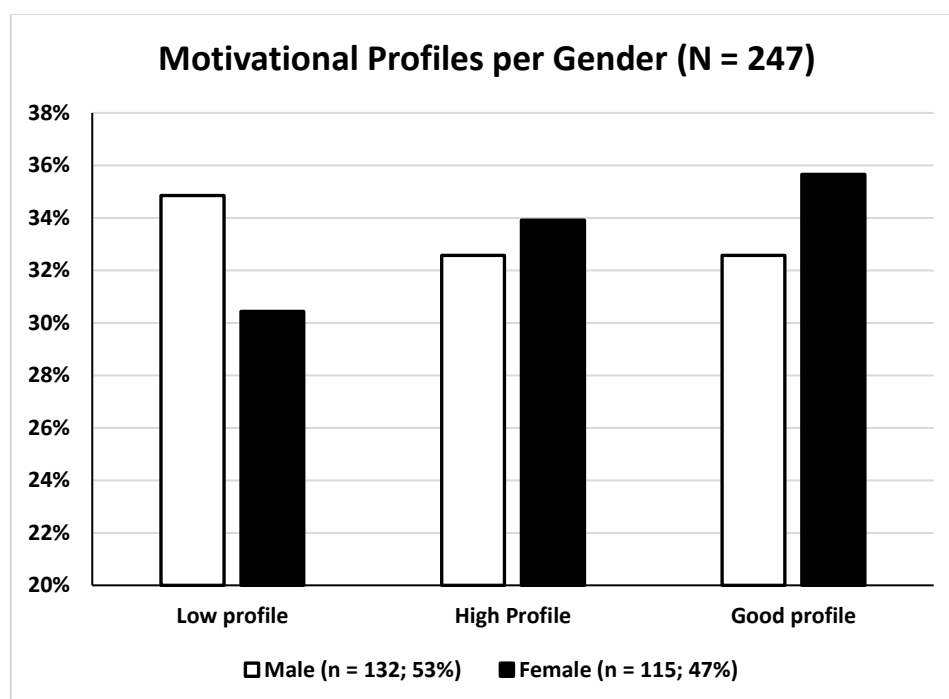


Chart 5 – Motivational Profiles per Gender.

Source: personal collection of the researcher.

The most representative motivational profile for males was *Low* amount, for females it was *Good* quality. The gender averages show that female and male respondents do not have many differences in their motivational levels. It would be interesting to investigate if affirmative action in schools has contributed to a better motivational result. Byman *et al.* (2012), who conducted a motivational investigation for learning Physics (Physics Learning Orientation Scale - PLOS), in what would be similar to our high school but in Finland, points to personality features, presenting the female gender with a tendency to greater conscientiousness in terms of learning Physics, since being a subject more dominated by males, women would be pressured to conceptualize their relationship with Physics. In this way, people of female gender that are already motivated (a minority of students according to those researchers), would rationalize their motivational orientation. In this way, they could express the questionnaire more precisely. Males, following the stereotype of the subject, would not have been pressured to think about their relationship with Physics, marking more uncertain answers.

In this research, we find data that may point to some convergence with Byman *et al.* (2012), because the means of motivational levels are considerably similar, as well as the proportion of profiles. In the general averages, we found that women have greater introjected motivation, indicating internal pressures of guilt, shame and/ or pride, which may be an indication that females, in fact, tend to think about their relationship with Physics knowledge, influenced by the pressure of a certain stereotype. In this sense, investigations can be developed

to understand sociocultural issues, or even, as the different personality trends, possible to be influenced by gender, interact in the development of relations with Physics knowledge.

VII. The Motivational Profiles per Town of Residence and Zone

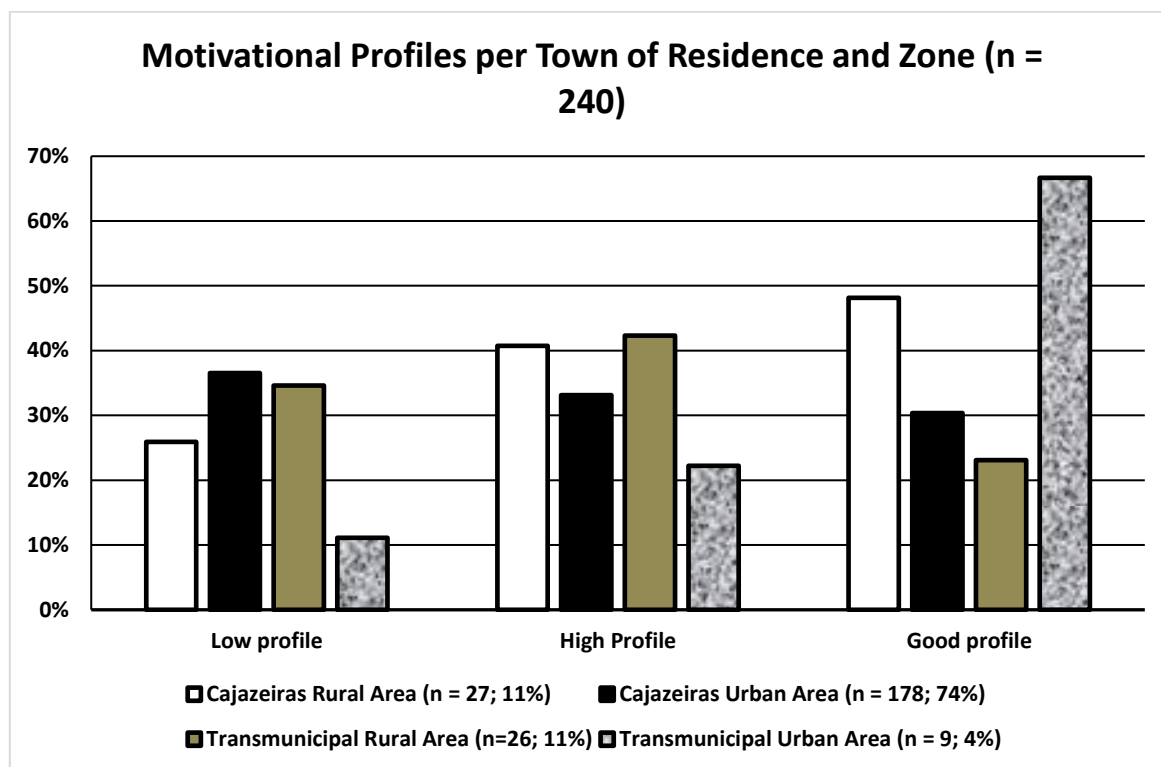


Chart 6 – Motivational Profiles per Town of Residence and Zone

Source: personal collection of the researcher

The data for the town of residence show different values for residents from Cajazeiras, Paraíba, Brazil and other towns (trans-municipal students)⁷, as it is observed that the students from the urban area in Cajazeiras have the lowest Identified/Intrinsic motivation average in the groups and the most representative profile for this group was the *Low amount*, while the trans-municipal students from the urban area have greater Intrinsic/identified motivation and lower averages for the External Motivations. Students from the rural area in Cajazeiras obtained the highest average for Identified/Intrinsic, External for Reward or Punishment motivation and Introjected motivation, being more representative characterized by the *Good Quality* profile. One hypothesis is that transport cost from rural to urban areas naturally select students and, along time, produce greater self-regulation by students' personal investment in their education, favoring the value *integration* (considering the OIT). This research points to this phenomenon

⁷ Trans-municipal students here are the ones who travel daily from their home town to the town of Cajazeiras, Paraíba, Brazil which is considered a regional pole for education and some families from neighboring towns seek transport for their children so as to have better academic training.

when we see the trans-municipal students, both from urban and rural areas, scoring significantly higher in relation to the students from the urban area in Cajazeiras, but not from the rural one. It is also observed that the trans-municipal students from the rural area have one of the lowest percentages in the *Good* quality profile, being more characterized by the *High* amount profile. It is also noted that the highest average for external motivation by reward or punishment is from this group. This may be an indication that excessive difficulties linked to transport can devalue the autonomous motivation state. More research on how the process of motivation *integration and depreciation* operates in these groups of students who face transport difficulties would be necessary to confirm these data and better explain this phenomenon.

VIII. Final Remarks

This research was able to find high school student motivational profiles in Physics and validate the MSDAP instrument in its reduced version. The results show three profiles with the most varied implications.

The *Good* quality of motivation profile is characterized by self-regulated motivation. For Vansteenkiste *et al.* (2009) presents the optimal learning state, as it correlates with cognitive processing (mental activity to develop, process and use information), metacognition (e.g.: planning, monitoring, management of difficulties and demands, development and use of strategies), metacognitive regulation (time allocation, use of the environment and anxiety management) and determination (avoid procrastination and effort maintenance). Finally, it presents lower rates of behavior and cheating attitudes. For Ratelle *et al.* (2007), the profile (autonomous for this author) is linked to higher academic success, school satisfaction, less distraction and anxiety.

The *Good* quality of motivation profile presents lower average of controlled motivation. The motivational profile that presents high average for autonomous motivation and controlled motivation is the profile *High* amount of motivation and it was found in this research. An important observation that Vansteenkiste *et al.* (2009) point out to this group is that having a greater amount of motivation (in autonomous and controlled dimensions) does not imply better rates of school success and metacognitive conditions, since they present higher levels of anxiety, procrastination, more attitude to cheat and they had lower scores in the research of that author compared with the *Good quality* of motivation profile. Thus, having more motivation (in the controlled dimension beyond the autonomous dimension), only devalues the student's ability to self-regulate besides pressure and stress by external interests. Ratelle *et al.* (2007) confirm these findings.

There is a motivational profile characterized by the lowest average for autonomous and controlled motivation dimensions. This profile is the *Low* amount of motivation. For Vansteenkiste *et al.* (2009), this profile resembles the *High* amount profile, because although it does not have autonomous motivation that favors adaptation to the activities necessary for learning, it also has no controlled motivation, which generates stress and anxiety. Ratelle *et al.*

(2007) found that this group is more likely to drop out of school precisely because of the lack of autonomous motivation, which is an indicator of persistence. It is worth mentioning that these two authors did not present similar results for this profile, because for Ratelle *et al.* (2007) this profile does not resemble the *High* one but the *Poor* one (or *controlled*, which was not found in our research). It is important to highlight that the profile found in our research presents a difference compared to those ones of the before mentioned researchers, as it presents a moderate level in the dimension of amotivation, which impacts the characterization of this group of students. Based on the low average for the motivation dimension and moderate score for amotivation (3 on a scale of 1 to 5), this profile appears *apathetic*. It presents low motivation, whether intrinsic or extrinsic, and demonstrates difficulty in affirming or denying disinterest in the proposed activities. This profile seems to be more similar to the description of Ratelle *et al.* (2007), which points to school dropout. Hong, Bernacki and Perera (2020) indicate that profiles that do not have extrinsic or intrinsic motivation resemble the ‘high cost’ profile, which, for the Expectancy-Value Theory in educational context, the cost indicates how much student need to sacrifice themselves to learn. Thus, this group is interested in learning only in situations which the cost is low and the gain is high. For these authors, this profile has negative attitudes and emotions to learn if the cost is high (such as effort, time and other material and psychological resources), implying *amotivation*. This information is alarming since the number of students grouped in it is 34% of the total respondents.

A fourth motivational profile reported by Vansteenkiste *et al.* (2009), but not found in this research is the *Poor* motivational quality one. It is characterized as a motivational state, in which there is low intrinsic motivation and high extrinsic motivation. The depreciation of learning, due to external pressures, undermines learning in such a way that it would be better to have low intrinsic and extrinsic motivation (as low amount of motivation profile). This profile is the other extreme compared to the *Good* quality one, presenting the lowest rates of academic success, cognitive processing, metacognition and metacognitive regulation.

In Vansteenkiste *et al.* (2009), it was found that students who presented motivational quality (higher scores in the autonomous dimension, i.e. *good* and *a lot* profile) also perceived that their teachers developed well-structured practices that supported autonomy and there was emotional involvement. According to Ratelle *et al.* (2007), the school environment could be improved to meet students' *needs* and thus develop their autonomous motivation. This requires training for the managers and professionals at the school, so that they take initiatives that promote *autonomy, competence and belonging* to reach more students in the profile of *good* quality.

For Ryan *et al.* (2023), the OIT⁸ states that motivation becomes more autonomous as practices and values are *internalized*. Teachers who adopt teaching practices that support the autonomy of students tend to promote *intrinsic motivation*. These practices include: 1- recognizing students' perspectives; 2- providing meaningful choices for the student (*the feeling*

⁸ Organismic Integration Theory.

of choice⁹); 3- provide activities aligned to their needs and interests; 4- value and encourage individual efforts; 5- offer opportunity for speech; 6- pay attention and know how to recognize the student's progress; 7- give clues patiently when students present difficulties (without giving the answer at first); 8- be responsive to comments and questions; 9- offer the necessary time for the student to perform the didactic activities (Ryan *et al.*, 2023). In addition, by presenting meaningful reasons for the assignments, these teachers help students to find purpose and intrinsic engagement in their activities. In contrast, controlling teachers, who use rigid guidelines and external pressures, monopolizing learning materials, insinuating directives (both in action and execution as well as in solution), using controlling words like 'must do' or 'have to do' usually reduce intrinsic motivation, increase stress and limit curiosity and performance (Ryan *et al.*, 2023). Teaching that is aimed at student's autonomy improves motivation, stimulates interest, curiosity and total development.

It is worth mentioning that the research already presented shows that the educator makes a bad decision when inserting external controls and/or introjections¹⁰ (increasing controlled motivation) in their interaction in the classroom at the cost of investing in autonomous regulation, because this hinders the development of a motivational state optimal for learning.

Finally, the motivational profiles allow to carry out a more detailed diagnosis of a group of students, helping the teacher's planning, because students with more controlled profiles (*poor* quality of motivation, or our *low* amount profile, pointing to amotivation) may not react well to interventions that require more self-regulation and autonomy from the students, considering the lack of persistence and higher levels of anxiety and stress by this profile, resulting the need for the teacher to seek strategies that develop their autonomy firstly.

The levels of introjected regulation and amotivation remained with low average or in inconclusive values for all groups, showing that *students, in general, are not unmotivated in the strict sense of the Self-Determination Theory because they are not completely regulated by introjection or by social punishments and rewards, but approval and good grades are the elements that weigh the most in their behavior to perform the activity. The students superficially value learning, understanding the knowledge of Physics as a possibility to open good paths for the future, but they do not see exactly how these advantages would be translated into their future, neither identify themselves by using that knowledge and nor find much pleasure in the activities. In this sense, the need to not to fail a school grade and get better grades seems more*

⁹ Ability to feel autonomy in the sense of volatile behavior, intrinsic motivation.

¹⁰ Which impact on the ego or may cause shame to the student.

important than learning (Clement *et al.*, 2014; Paiva *et al.*, 2018).

To better exemplify these results, we highlight that the highest statement average by respondents as true or totally true were for items 26: 'Not to get a low grade, I end up doing the activities.' (4.32) and 18: 'I end up doing the activities not to fail at school' (4.31), linked to external motivation for reward or punishment. No other item exceeds the average of 4 points like these. The third highest average is the item 10: 'I do the activities because I learn more and more' (3.93), linked to the identified motivation. These averages resemble the studies of Marchiore and Alencar (2009), showing that students have more interest in avoiding reprimand and obtaining school approval.

However, this motivation is linked to less integrated and more mechanical learning (Clement, 2013), which would explain the common perception among teachers that students would be amotivated (Bzuneck, 2010).

This research also highlights the importance of evaluating student motivational state, considering the MSDAP reduced version as an instrument that can assist the teaching staff and professionals who seek intervention strategy development and monitoring in Physics teaching, capable of raising data for group identification and different Motivational Profiles, and this is the strong point in this research; but another important one to be highlighted was the difficulty by the *Good* quality profile to achieve the minimum homogeneity and explanatory power, being below 50% variance explained, unlike the other profiles that reached higher values. Nevertheless, the instrument ability to develop EFA and reliability indices was observed in a relatively low number of respondents ($n = 259$), compared to other studies in Brazil (Clement *et al.* 2014; Paiva *et al.* 2018). It is noted that this lower number of respondents already stresses the instrument, which is one of the possible invalidation causes for three of the items proposed by Clement *et al.* (2014) and Paiva *et al.* (2018).

Considering the reliability indices and results found, it can be said that this scale is trustworthy and it can be used in the motivation level assessment of students of Physics at High School. However, it is worth mentioning that, although average calculation is simple if executed by a software as Excel (enough to study individual students or all respondents at once), the need for data processing (cluster analysis) to find the motivational profiles can become a barrier, requiring that the school has a professional capable of performing the data analysis, which is usually common only in large companies and rarely in educational settings. Bringing to the educational context statistical data and more advanced methods of techniques and theories can be of great help to teachers. In certain educational contexts, there is an increasing automatic approval of students to the next school grade, a change in the environment where school dropout persists in growing, despite the measures implemented to contain it. In this sense, the instrument can be used to observe students or group of students who present *Low* amount or *Poor*-quality motivational profile, considering that they have greater chances of evading school, classes and Physics activities.

The SDT and its various instruments can be strong allies in the education field and licentiate degree research. In elementary school studies like this one (in Science classes for example) can be carried out to understand and study methods to reverse the fall in numbers of students entering courses related to scientific development, making possible to follow student motivational development along the years within a region (such as in the backcountry of Paraíba, Brazil). In this sense, with a larger number of respondents, and distinct and even more sophisticated methods of validation can be used to promote improvement of the instrument (MSDAP), such as the Hull Method and the Parallel Analysis, thus accompanying the changes that science usually promotes.

Further research could be conducted seeking to understand the relationship among *motivational objectives* and the SDT, trying to seek patterns of motivation, and deepening even more correlated with academic performance standards. Another suggestion is the study of approaches and teaching materials aimed at improving student motivation through a platform, which would be very useful for the teachers and the academic community, because raising awareness of education professionals about the importance of using materials and different approaches allow creating an educational and market motivation, supporting professionals and companies to solve serious Brazilian educational problems.

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