ACTA MÉDICA PORTUGUESA
A Revista Científica da Ordem dos Médicos

Motivating Medical Students: Adaptation of the Academic Motivation Scale within the Framework of the Self-Determination Theory

Motivando Estudantes de Medicina: Adaptação da Escala de Motivação Académica no Âmbito da Teoria da Autodeterminação

Rita MATOS SOUSA✉[1], Nuno Gabriel SILVA GONÇALVES[1], Vítor Hugo PEREIRA[1], John NORCINI[1]
Acta Med Port 2024 Nov;37(11):757-766 ▪ https://doi.org/10.20344/amp.21926

ABSTRACT

Introduction: Motivation plays a crucial role in the academic success and professional development of medical students. Understanding the intricacies of motivation within the context of medical education is essential for designing effective interventions and support systems. The aim of this study was to explore the adaptation of the Academic Motivation Scale within the framework of the self-determination theory and of the self-efficacy theory to assess motivation among medical students.

Methods: The study adapted the Academic Motivation Scale to the Portuguese context, drawing upon insights from the self-determination theory. Two existing Portuguese scales, MATAMS and Ribeiro *et al* scale, served as foundational frameworks for the adaptation process. The study included qualitative interviews, which informed the creation of the Minho Medical Academic Motivation Scale – Minho-MEDAMS. This scale was applied to 281 medical students. To assess the scale's validity, we used the exploratory and confirmatory factor analyses, and the Cronbach's alpha to measure internal consistency.

Results: The exploratory factor analysis showed strong results with a KMO of 0.862, leading to five factors and the removal of two items. The initial confirmatory factor analysis indicated poor fit, prompting the removal of items with low R-squared values. The final Minho-MEDAMS includes 18 items: six for intrinsic motivation, nine for extrinsic motivation and three for amotivation. This refined scale demonstrates high internal consistency (α = 0.831), making it a reliable tool for assessing medical students' motivation.

Conclusion: The successful adaptation of the Academic Motivation Scale within the self-determination theory framework presents a valuable instrument for assessing motivation in medical students. The Minho-MEDAMS offers a comprehensive understanding of motivational dynamics, facilitating targeted interventions and support mechanisms to enhance student engagement and success. Its validity and reliability render it a practical tool for educators, administrators, and researchers in the field of medical education. Ultimately, the Minho-MEDAMS contributes to the advancement of strategies aimed at cultivating motivated and proficient healthcare professionals.

Keywords: Models, Psychological; Motivation; Personal Autonomy; Self Concept; Students, Medical/psychology

RESUMO

Introdução: A motivação desempenha um papel crucial no sucesso académico e no desenvolvimento profissional dos estudantes de medicina. Compreender as complexidades da motivação no contexto da educação médica é essencial para a construção de intervenções eficazes e sistemas de apoio. O objetivo deste estudo foi explorar a adaptação da Escala de Motivação Académica no âmbito da teoria da autodeterminação e da teoria da autoeficácia para avaliar a motivação entre os estudantes de medicina.

Métodos: O estudo utilizou uma metodologia rigorosa para adaptar a Escala de Motivação Académica ao contexto português, recorrendo à estrutura da teoria da autodeterminação. Duas escalas portuguesas existentes, a MATAMS e a escala de Ribeiro *et al*, serviram como as bases fundamentais para o processo de adaptação. O estudo incluiu entrevistas qualitativas que contribuíram para a criação da Escala de Motivação Académica para Estudantes de Medicina da Universidade do Minho – Minho-MEDAMS. Esta escala foi aplicada a 281 estudantes de medicina. Para avaliar a validade da escala, utilizámos análises fatoriais exploratória e confirmatória, e o alfa de Cronbach para medir a consistência interna.

Resultados: A análise fatorial exploratória apresentou resultados sólidos com um KMO de 0,862, resultando em cinco fatores e na remoção de dois itens. A análise fatorial confirmatória inicial indicou um ajuste inadequado, o que levou à remoção de itens com valores baixos de R-quadrado. A versão final do Minho-MEDAMS inclui 18 itens: seis para motivação intrínseca, nove para motivação extrínseca e três para desmotivação. Esta escala refinada demonstra uma elevada consistência interna (α = 0.831), tornando-se uma ferramenta fiável para avaliar a motivação dos estudantes de medicina.

Conclusão: A adaptação bem-sucedida da Escala de Motivação Académica dentro do quadro da teoria da autodeterminação apresenta um instrumento valioso para avaliar a motivação nos estudantes de medicina. A Minho-MEDAMS oferece uma compreensão abrangente das dinâmicas motivacionais, facilitando intervenções direcionadas e mecanismos de apoio para melhorar o envolvimento e o sucesso dos estudantes. A sua validade e confiabilidade tornam-na uma ferramenta prática para educadores, administradores e investigadores no campo da educação médica. No final, a Minho-MEDAMS contribui para o avanço de estratégias destinadas a cultivar profissionais de saúde motivados e proficientes.

Palavras-chave: Auto-Conceito; Autonomia Pessoal; Estudantes de Medicina/psicologia; Modelos Psicológicos; Motivação

1. Escola de Medicina. Universidade do Minho. Braga. Portugal.
✉ **Autor correspondente:** Rita Matos Sousa. rita.msousa5@gmail.com
Recebido/*Received*: 08/06/2024 - **Aceite/*Accepted*:** 09/09/2024 - **Publicado/*Published*:** 04/11/2024

KEY MESSAGES

- Motivation is an essential factor for the academic success and professional development of medical students.
- Understanding motivation within the context of medical education is crucial for developing effective interventions and support systems.
- The Minho-MEDAMS is composed of five dimensions of motivation: intrinsic motivation, identified regulation, external regulation, introjected regulation, and amotivation.
- Psychometric analysis has demonstrated that the Minho-MEDAMS possesses high reliability and validity, confirming its suitability for assessing the motivation of medical students in the Portuguese context.
- The Minho-MEDAMS can be a valuable tool for understanding the motivational dynamics of medical students.

INTRODUCTION

Motivation serves as the driving force that instills purpose and direction into behavior, operating at both conscious and unconscious levels. The study of motivation explores the processes linking individual needs to behavior, aiming to understand the fundamental reasons behind actions. Theories of motivation organize these findings to explain the 'why' of behavior.[1-3]

One pivotal theory in the domain of motivation is the self-determination theory (SDT), that offers a perspective on human motivation and personality.[2] Within the framework of SDT, intrinsic and extrinsic sources of motivation can be defined, elucidating the roles of intrinsic motivation (IM) and various types of extrinsic motivation (EM) in cognitive and social development and individual differences. This conceptualization has led to the creation of a framework illustrating the continuum between motivation types, their regulatory styles, perceived causes, and relevant regulatory processes.[4]

Another theory indirectly contributing to the construct of motivation is the theory of self-efficacy, that underscores the importance of an individual's perception of their personal capabilities as key determinants of successful outcomes.[5,6] This is crucial in understanding the students' confidence in their ability to succeed in the highly demanding environment of medical education. By integrating aspects of self-efficacy with the SDT, a framework emerges that allows a better understanding of students' motivations but also their belief in their capability to achieve desired outcomes.

Medical training is a context that demands high levels of motivation, stress resilience, and constant adaptation. Research on motivation in medical education has grown significantly, offering insights into how motivation affects learning experiences.[7-14] Studies show a positive correlation between medical students' motivation, learning quality, persistence, and performance.[10-15] These findings highlight the importance of educational strategies that enhance motivation of medical students.[16,17]

To understand and study motivation in medical students, the availability of suitable and contextually adapted scales is essential. The Academic Motivation Scale (AMS) was originally developed by Vallerand *et al* and comprises 28 items rated on a seven-point Likert scale, that are divided in seven subscales that respect the different dimensions of motivation described in the SDT: IM, EM and amotivation (AMOT).[18] Interestingly, while the original SDT defined the dimension of IM as a global construct, Vallerand *et al* divided this dimension into three subtypes and excluded the 'EM – integrated' subtype, explaining that this dimension of motivation only appears later in adult life with much less expression in the academic range.[19] With these concepts present, the AMS' items are distributed over the three dimensions defined by the SDT: four items for AMOT, 12 items for EM and 12 items for IM. The AMS assumes that stronger positive correlations should be present between adjacent dimensions as opposed to the dimensions that are further apart; and that the strongest negative correlation should appear between AMOT and IM items.[18,20-22] It is important to highlight that the AMS has been used in many studies to evaluate motivation and has demonstrated a robust internal and external reliability across diverse research studies and countries.[18,19,23-31]

The AMS has been widely used and validated across diverse studies and countries, making it a robust tool for evaluating motivation. However, given the unique demands of medical education, there is a need for a tailored scale that addresses the specific motivations of medical students. Thus, the aim of this study was to develop a simple, intuitive motivation scale for medical students, using the AMS as its foundation due to its comprehensive coverage of motivation types.

METHODS

Study design

We conducted an exploratory mixed-methods study to adapt the AMS based on a protocol for contextualized measurement scale adaptation.[32] We took two different perspectives of the validation process: a qualitative and a quantitative phase. The study took place at the School of Medicine of the University of Minho (EM-UM).

A comprehensive literature review on motivation scales

– with a primary focus on the AMS, including its variations, design, validation process, and impact assessment – was conducted through various databases.[7-18,23-25]

Qualitative phase

For the qualitative perspective, two distinct approaches were employed to address the research questions: Steps 1 and 2; where interviews were conducted following a semi-structured guideline. In Step 1, we used the grounded theory approach,[33] with a focus on the participant's understanding of motivation in medical education. Interviews continued until no additional information was acquired during the process. The participants were asked the following questions: (1) "What motivates medical students to study medicine?" (2) "What stimuli can increase the motivation of medical students?" (3) "What stimuli can decrease the motivation of medical students?" (4) "Can the environment in which medical students are placed alter their motivation levels? Why?" (5) "What intrinsic motivation factors can be identified in medical students?" (6) "What extrinsic motivation factors can be identified in medical students?" (7) "Why is motivation important for medical students?" The interviews lasted 30 - 80 min and were filled with open-ended questions; the interview outline was not strictly followed to obtain more information.

Based on the results of Step 1, we developed adapted items to measure motivation in medical students. In Step 2, we employed think-aloud methods to test the understanding of the measurement scale in the new context.[34]

In both interviews, no answer options were presented, as the focus was solely on respondents' reasoning.

Scale development and adaptation

Building upon the insights gained from the qualitative phases of Steps 1 and 2, a new adapted scale was crafted – the Minho Medical Academic Motivation Scale (Minho-MEDAMS). It is important to note that we used not only the original AMS, but also two already validated translations into Portuguese of the AMS, as the original framework.[18,20,35] The first version of Minho-MEDAMS was composed by 28 visual analogue scale (VAS) items and conceptually divided in seven subdimensions: IM to know, IM to accomplish, IM to stimulate, EM - Introjection, EM - Identification, EM - External Regulation and AMOT.

Quantitative phase

In this phase we assessed the psychometric properties and performance of the Minho-MEDAMS, adhering to criteria for scale construction.[36] The effectiveness of the quantitative measurement instrument in the new context was evaluated through several methods.

Participants

For the qualitative phase, we selected several groups including medical students, alumni, and faculty members. For Step 1, using the grounded theory approach, we conducted interviews with 13 participants, comprising six medical students, one alumnus, and six faculty members. For Step 2, we had a total of 10 medical students, two alumni and three faculty members. For this phase, the inclusion criteria were being a medical student/alumni/faculty member from the EM-UM. There were no exclusion criteria. All participants were contacted via the institutional e-mail.

To assess the validity of the scale, the inclusion criteria was being a medical student from the first to the sixth year of medical school at the EM-UM. There were no exclusion criteria. The sample size was calculated using a ratio of 10:1 (10 respondents for each scale item), with a minimum of 280 respondents for a total of 28 items.[36] The final sample size for the scale validation was 281 respondents. The participants were recruited via institutional e-mail and during seminars. The scale was shared on a website created for the purpose of this study.

Analysis

For Steps 1 and 2, qualitative content analysis was employed. The coding system for the interviews was discussed and validated amongst the authors. The results of the data analysis after three interview rounds showed that the community's acceptance, the choice of specialty and the notion of acquiring a good quality of life are essential for medical students, along with the feeling of personal accomplishment and social recognition. At that point, we achieved theoretical saturation, where additional data no longer generated new theoretical insights or uncovered new aspects of the existing theoretical categories.

For the quantitative phase, to test the normality assumption, we used the following rules-of-thumb: absolute skewness (Sk) and kurtosis (K) values lower than 3.0 and 8.0, respectively, indicate normal distribution. Items with Sk and K over the limit were eliminated. To assess the construct validity of the Minho-MEDAMS, an exploratory factor analysis (EFA) was performed. To test the suitability of the scale for the factor analysis, we used the Kaiser-Meyer-Olkin (KMO) test, which measures sampling adequacy, ranging from 0 to 1, in which higher values mean higher suitability and a value of 0.6 is a suggested minimum; we also used the Bartlett's test of Sphericity, which tests the hypothesis that the correlation matrix is an identity matrix, and that would indicate that the variables are unrelated and therefore unsuitable for structure detection. We used the maximum likelihood analysis as the extraction method. To confirm the findings, a confirmatory factor analysis (CFA) was also performed, using the comparative index of fitness (CFI) with values greater

than 0.90 being considered a good fit. Finally, the root mean square error of approximation (RMSEA) was examined: values below 0.06 indicate a good fit, and values that are above 0.08 indicate reasonable approximation errors. We used the coefficient alpha (Cronbach's alpha) to estimate the internal consistency of the scale. Cronbach's alpha of at least 0.70 was considered to indicate adequate internal consistency.

Ethical considerations

The experimental protocol of this work was approved by the Ethics Committee of the University of Minho (CEICVS-121/2023). All participants signed an informed consent form and all the data regarding personal information of the participants was pseudoanonymized. Adherence to the Helsinki Declaration and the Convention on Human Rights of the Council of Europe was strictly observed. Written informed consent was obtained from each participant before data collection.

RESULTS

Is the motivation concept relevant and understood in a new context?

For Step 1, we used a predetermined coding system, which was derived from the SDT and the AMS. This system included seven primary codes corresponding to key motivational dimensions: IM to Know, IM to Accomplish, IM to Stimulate, EM - Identification, EM - Introjection, EM - External Regulation, and AMOT.

During the coding process, the transcripts of interviews were carefully reviewed, and segments of text were assigned to one of the seven predefined codes. The coding was both deductive, using the predefined categories based on SDT and AMS, and inductive, where new insights emerged from the data and were integrated into the existing framework.

The participants gave several perspectives regarding motivation, but all participants perceived that motivation is a major player for medical students' success, giving different justifications for this perception, such as "motivation allows you to overcome the most difficult moments" and also "[It is] the stimulus that makes people have the willingness and the volition to do and achieve their goals."

On the other hand, some participants talked about how an amotivated student can be problematic, saying, "I think that the student who is not motivated is not going to be the student that society needs."

Regarding IM, the participants were asked what factors might play a key role in intrinsically motivating medical students, and these factors appeared in several ways: "the social factor, the community factor of wanting to help, of wanting to evolve into society, of wanting to help people," and that drive to "always want to be better and always want to know a lot, which is also a direct or almost direct link between the more they study and the more they know, the better they will be able to help from a cognitive and technical point of view".

Other intrinsic dimensions were also noticed, such as the need for control of the situation: "the person feels that they have a role in that process, that they have some control over what is asked of them," which may contribute to the notion that they are "building a path [they]'re proud of."

Looking into 'IM to know', participants also talked about the excitement of learning and surpassing their own obstacles and difficulties. They count this as an important part of feeling intrinsically motivated because it gives them the drive to continuously pursue better results: "I'm learning something new and I'm starting to make new connections – it is starting to get interesting which is very stimulating." They also highlighted that "studying medicine is challenging but there is great satisfaction in learning things I'd never learned before."

When asking about EM, the answers of the participants were more fluid: "It is easier to think about what I want to obtain in return of my effort, than to think about what might drive me to start the effort from the beginning."

Regarding 'EM for identification', in which an external stimulus is perceived by the self as an individual choice or even when the external stimulus is the self, this specific type of motivation is one of the most frequently referred to during the interviews: "I believe that being a doctor is a noble profession, and I want that for myself." On the other hand, some said that while studying medicine they seem to have difficulty stopping the revision of the content for exams because they do not want to fail themselves and would feel embarrassed if they failed.

When accounting for the social effect, some behaviors are indeed driven by external stimuli that the student internalizes as a socially accepted behavior. Some of the participants said, "A lot of medical students chose to study medicine because when they finish high school, they have good grades, and everyone expects them to choose medicine." While others added that "a good medical student will always study because that is what they're supposed to do."

Reaching the last dimension of EM, the true external regulation, many participants focused on external stimuli that directly affect medical students' motivation. One of the biggest factors was the assessments they are put through. External validation in the form of a grade is perceived as being both a positive and negative stimulus for studying medicine. One participant mentioned that "most medical students are highly driven and competitive people, they compare themselves by their grades, but the system makes them that way." The 'system' referring to the several

selections that medical students go through in which they are selected by grade, mostly overlooking the remaining curricula. Other external stimuli are high salaries, social prestige, the possibility of having access to 'good quality of life'.

Finally, AMOT was regarded by most as a major problem when seen amongst medical students and perceived as being related to mental health issues such as depression, generalized anxiety, and burnout.

Are the motivation scale and its items understood?

In Step 2, we tested whether the items of the newly adapted scale were understood in the context of medical education. All the participants understood the purpose of the scale, while some had difficulties regarding the main question of the scale: "Why do I go to medical school?" When asked why, most participants pointed out that it seemed more adequate to specify "Why do I study medicine?" to be focused on the activity throughout the medical degree, while the first question seemed more appropriate for students starting medical school.

When thinking aloud while responding to the items, participants perceived that the questions were specific to medical students and focused on stimuli referring to different dimensions of motivation. Initially, the items were written in the third person, but participants raised concerns about whether medical students would truly relate to the question, making the items more easily understood if they were written in the first person.

Overall, the scale items were well understood and did not raise other significant concerns. Items in the negative form, which were specifically related to the AMOT dimension, were considered harder to understand for being generalist and abstract and were rephrased.

The adapted questionnaire was tested and understood by the participants. By changing the initial question and rephrasing the items, we adapted the scale minimally but still precisely for the new cultural context.

Is the scale valid and reliable in the new context?

The first version of the Minho-MEDAMS was composed of 28 items, scored with a VAS ranging from 1 to 10. Higher scores indicate a higher grade of correspondence of why the medical student studies medicine. The scale was tested on 281 students, with an average age of 20.7 years-old, the majority being in the first year (n = 99; 35.3%) and of the female sex (n = 224, 79.7%) (Table 1). This distribution is in line with the general sex distribution of the students in EM-UM as is the average age. There was a total of 281 answers and no missing values because every item was of mandatory response.

When testing the scale's items for its normality assumption, one item presented absolute skewness scores above 3 and kurtosis higher than 8, showing a deviation from the normal distribution; for that reason, item P19 was excluded from the scale.

Table 1 – Descriptive statistics regarding the medical students that answered the Minho-MEDAMS

	n	%
Sex		
Female	224	79.7%
Male	55	19.6%
Other	2	0.7%
Year		
1st year	99	35.2%
2nd year	36	12.8%
3rd year	37	13.2%
4th year	48	17.1%
5th year	32	11.4%
6th year	29	10.3%
Total	281	100.0%

The factor analysis was firstly assessed by an EFA on a 140 random sample of the results with maximum likelihood as the extraction method (Table 2). Test suitability was ensured by the KMO measure (KMO = 0.862) and the Bartlett's test of sphericity [χ^2 (281) = 2161.015; df = 351.0; $p < 0.001$]. Five factors were extracted, which are further detailed on Table 2 that presents the exploratory factor matrix regarding the 27 adapted items of the Minho-MEDAMS and their respective factor load, showing how variables are distributed into these five EFA ensuing factors. In this analysis, items P4 and P25 were not included in any factor, and after careful analysis, the authors decided to exclude both items from the final scale. Considering the original scale – the AMS – and the SDT already explained previously in this work, the authors classified the five factors as: IM, EM - Introjection, EM - Identification, AMOT and EM - External Regulation.

To confirm the EFA, we performed a CFA on a 141 random sample of the results and on a first model compiling five latent variables, as suggested by the EFA, revealing inadequate goodness of fit. The next step for the authors was to assess the R-squared value of each individual item. The R-squared of items refers to the proportion of variance in each observed item that is explained by its underlying latent construct or factor, measuring how well the latent factor accounts for the variability observed in each item. A higher R-squared value indicates that the latent factor explains a larger portion of the variance in the observed item, suggesting a stronger relationship between the item and

Table 2 – Exploratory factor analysis

Construct	Item	Factor				
		1	2	3	4	5
Intrinsic motivation	P2	0.435				
	P6	0.521				
	P9	0.623				
	P11	1.010				
	P13	0.574				
	P16	1.042				
	P23	0.738				
Extrinsic motivation - Introjection	P7		0.816			
	P18		0.431			
	P20		0.475			
	P21		0.764			
	P27		0.553			
	P28		0.581			
Extrinsic motivation - Identification	P3			0.460		
	P10			0.755		
	P17			0.446		
	P22			0.810		
	P24			0.606		
Amotivation	P5				0.855	
	P12				0.701	
	P26				0.988	
Extrinsic motivation - External Regulation	P1					0.525
	P8					0.405
	P14					0.500
	P15					0.874

the underlying construct, being interpreted as evidence of good construct validity, indicating that the item is a reliable and valid indicator of the intended construct. The post-hoc analysis of the model revealed low R-squared values for items P1, P10, P13, P18, P20, P22 and P27. When looking closely at these items, the authors concluded they were distributed between the different factors and considered there would not be significant changes to the overall construct if removed. For these reasons, those items were excluded from the final scale.

As such, the final model (Fig. 1) has good statistical results (χ^2 = 199.249, p < 0.001, df = 125, χ^2/df = 1.594, RMSEA = 0.065, SRMR = 0.079, GFI = 0.869, and CFI = 0.935). Also, the relationship between the dimensions of IM and AMOT showed a negatively correlation and, in the same way, the sub-dimensions of EM - Identification and AMOT showed a negative relationship between them. The sub-dimensions of EM - Introjection and EM - External Regulation did not show a negative correlation with AMOT, but the strength of the correlation was low. There was a positive relationship between the dimension of IM and the sub-dimensions of EM, with a special remark to the EM - Identification sub-dimension showing a very strong relationship with IM.

The evaluation of the internal consistency of the final version of the Minho-MEDAMS with 18-items was finally assessed by the Cronbach's Alpha revealing a value of 0.831, clearly higher than 0.70, which is considered the cut-off for good consistency. Considering that the five-factor structural model that was adopted, the internal consistency of the factors was as follows: IM (α = 0.876); EM - Introjection (α = 0.774); EM - Identification (α = 0.721); AMOT (α = 0.774), EM - External Regulation (α = 0.880).

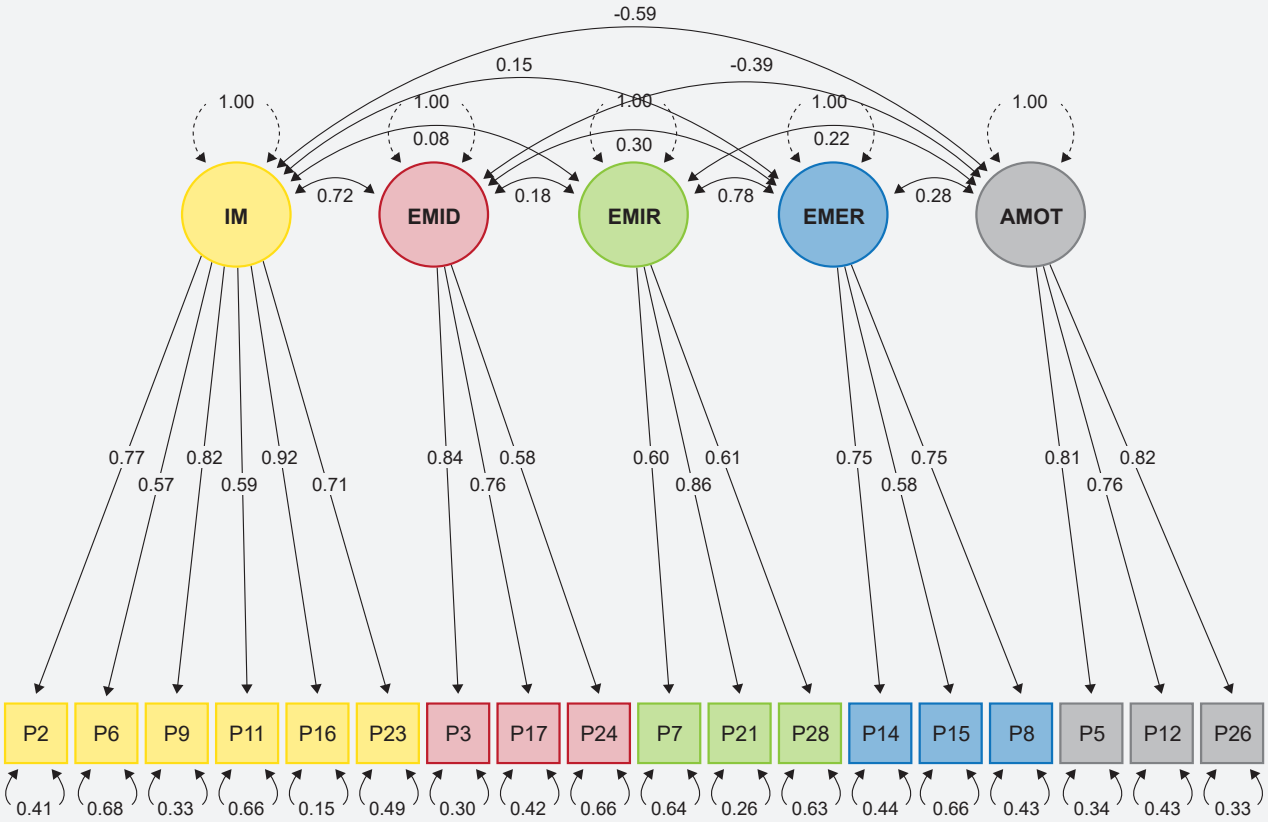

Figure 1 – Confirmatory factor analysis – Minho-MEDAMS final measurement model. The final model demonstrates strong statistical results. The relationships between IM and AMOT and between the EM - Identification and AMOT both show a negative correlation. While the sub-dimensions of EM - Introjection and EM - External Regulation do not show a negative correlation with AMOT, the correlation strength is low. There is a positive relationship between IM and the sub-dimensions of extrinsic motivation, particularly a strong relationship between IM and EM - Identification.

DISCUSSION

In this study we focused on the assessment of motivation levels in medical students in a Portuguese medical school, following a conceptual structure focused on the SDT and the theory of self-efficacy. One of the most important scales in this area that follows the SDT is the AMS, that is widely used to measure motivation in academic settings. However, we believe that the medical context deserves an adjusted perspective to fully understand what drives medical students' motivation. For this reason, we adapted the AMS to the medical students' context and submitted the new Minho-MEDAMS.

The process of adaptation and validation was performed in two different phases: a qualitative analysis of motivation in the context of a Portuguese medical school, and a quantitative analysis focused on the validation of a new adapted motivation scale for medical students – the Minho-MEDAMS. In the first phase, we understood that motivation for medical students follows the purposes of the SDT, and we identified several aspects that should be reinforced on a motivation scale for this population, such as the community's acceptance, the choice of specialty, and the prospect of acquiring a good quality of life. Through several interviews, we were able to formulate items that respected the dimensions of motivation identified in the original scale but were tailored for medical students. The items were then submitted to syntax and comprehensive analysis by medical students, faculty and alumni to ensure they were clear and easily understood. Through this process, a first sample of the Minho-MEDAMS was created.

During the quantitative analysis of the scale, one item (P19) was first removed from the scale to ensure a normal distribution of scores. In the factor analysis, the EFA results were satisfactory (KMO = 0.862), with the extraction of five factors and the exclusion of P4 and P25. However, the first model assessed by the CFA revealed inadequate

goodness of fit. To improve the model, we identified the items with lower R-squared values: P1, P10, P13, P18, P20, P22 and P27. These items showed distribution along the different identified factors but also along the different conceptual subtypes defined at the beginning of the process: IM, EM - Identification and EM - External Regulation, and were removed. The exclusion of items with low R-squared values ensured the model's fit and relevance. At this point, the Minho-MEDAMS's final version consisted of 18 items, six for IM, nine for EM (three for EM - Identification, three for EM – Introjection, and three for EM - External Regulation), and three for AMOT. It is important to note that we subsequently analyzed the reduction of the scale's items with the concern of maintaining the theoretical structure of the SDT while addressing the redundancy of some of the items within each dimension of the scale. We believe that the final version of the Minho-MEDAMS follows the principles of the SDT with significant representation of each dimension of motivation and the spectrum itself. Regarding internal consistency, Minho-MEDAMS reveals high consistency for all five dimensions and excellent results if all the items of the scale are considered, which reflects that Minho-MEDAMS is an appropriate instrument to measure motivation amongst medical students.

To develop this scale in Portuguese, we drew upon the AMS and two existing Portuguese scales that had already translated and validated the AMS.[20,35] The MATAMS focused solely on mathematics and extracted seven factors, aligning closely with the dimensions of motivation in the AMS.[20] Conversely, the scale by Ribeiro *et al* that directly translated the AMS to the Portuguese language was validated with only five factors that corresponded to the following dimensions of motivation: IM, AMOT, EM - Introjection, EM - External Regulation and EM - Integrated Regulation.[35] This is an interesting finding that goes in line with the results of this study, where only five factors were extracted with the difference lying in the inclusion of the EM -Identification and exclusion of the Integrated Regulation dimension in the Minho-MEDAMS. These two dimensions lie closely on the SDT spectrum and that might be a sufficient explanation of why these two subdimensions might even be presented as one given their proximity.[37] Another interesting topic of the Minho-MEDAMS is the lack of differentiation between the IM subdimensions. This follows the SDT that addresses IM as a whole and does not describe the subdimensions proposed on the AMS.[4,18] For this reason, we believe that the Minho-MEDAMS respects the SDT continuum and is a conceptually valid choice to remain only with the broader dimension of IM. Additionally, the emphasis on extrinsic motivation subtypes highlights the role of external expectations and professional standards, which are critical in the medical field.

In adapting the Minho-MEDAMS, the theory of self-efficacy also played a crucial role in shaping how we approached the formulation and validation of items. Self-efficacy theory emphasizes the importance of an individual's belief in their ability to succeed in specific situations, which directly correlates with their motivation levels.[5,6] During the qualitative phase of our research, we paid special attention to how medical students perceive their capabilities in relation to the challenges they face in their education. This influenced the design of items that aimed to capture not only their intrinsic and extrinsic motivations but also their confidence in successfully meeting academic and professional demands.

There are some limitations that should be considered when interpreting these results: i) the design of the study did not allow convergent and divergent validation mechanisms, which could be important to establish construct validity; ii) the number of participants, despite being adequate for validation, could still be improved in order to strengthen the results of this work; iii) students were recruited from a single medical school; and iv) students from the first year of medical school had a slightly bigger representation in this study, which may have influenced some of the results.

With these results, we propose that the implementation of the Minho-MEDAMS can help medical educators to get a better insight into the motivations of medical students in the Portuguese medical school's context. Looking ahead, the longitudinal application of the Minho-MEDAMS might be able to facilitate tracking and understanding of motivational shifts throughout the medical education journey. In the future, the scale might be adaptable to other contexts, such as residency training and continuing medical education.

CONCLUSION

In summary, by effectively capturing five essential dimensions of motivation with good psychometric properties, this scale may be a valuable tool for examining and comprehending the motivational dynamics among medical students. The comprehensive validation process underscores the reliability and validity of the Minho-MEDAMS, confirming its suitability for use within the Portuguese context. The scale highlights motivational factors such as professional identity and external expectations, offering educators insights into the intrinsic and extrinsic motivations specific to medical students. This understanding can inform curriculum development, enhancing student engagement and success.

The Minho-MEDAMS has broader implications for medical education, with potential adaptability to contexts such as residency training and continuing medical education. It serves as a valuable instrument in optimizing teaching strategies and learning outcomes, contributing to a deeper understanding of motivation in medical education.

AUTHOR CONTRIBUTIONS

RMS: Study design, data acquisition, analysis, and interpretation, writing of the manuscript.

NGSG: Data acquisition, analysis, and interpretation.

VHP, JN: Study design, writing and critical review of the manuscript.

All authors approved the final version to be published.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

FUNDING SOURCES

The work presented in this thesis was performed in the School of Medicine and in the Life and Health Sciences Research Institute, University of Minho. Financial support was provided by Grupo Fuste and 2CA Braga – Centro Clínico Académico, Braga.

REFERENCES

1. Pelaccia T, Viau R. Motivation in medical education. Med Teach. 2017;39:136-40.
2. Ryan RM, Kuhl J, Deci EL. Nature and autonomy: an organizational view of social and neurobiological aspects of self-regulation in behavior and development. Dev Psychopathol. 1997;9:701-28.
3. Morris LS, Grehl MM, Rutter SB, Mehta M, Westwater ML. On what motivates us: a detailed review of intrinsic v. extrinsic motivation. Psychol Med. 2022;52:1801-16.
4. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am Psychol. 2000;55:68-78.
5. Gallagher S. Multiple aspects in the sense of agency. New Ideas Psychol. 2012;30:15-31.
6. Schunk DH, DiBenedetto MK. Self-efficacy and human motivation. In Elliot AJ, editor. Advances in motivation science. Cambridge: Elsevier Academic Press; 2021. p.153-79.
7. Kusurkar RA, Ten Cate TJ, Vos CM, Westers P, Croiset G. How motivation affects academic performance: a structural equation modelling analysis. Adv Health Sci Educ Theory Pract. 2013;18:57-69.
8. Kusurkar RA, Croiset G, Mann KV, Custers E, Ten Cate O. Have motivation theories guided the development and reform of medical education curricula? A review of the literature. Acad Med. 2012;87:735-43.
9. Wu H, Li S, Zheng J, Guo J. Medical students' motivation and academic performance: the mediating roles of self-efficacy and learning engagement. Med Educ Online. 2020;25:1742964.
10. Assing Hvidt E, Søndergaard J, Wehberg S, Hvidt NC, Andersen CM. A cross-sectional study of student empathy across four medical schools in Denmark - associations between empathy level and age, sex, specialty preferences and motivation. BMC Med Educ. 2022;22:489.
11. Muntean LM, Nireștean A, Sima-Comaniciu A, Mărușteri M, Zăgan CA, Lukacs E. The relationship between personality, motivation and academic performance at medical students from romania. Int J Environ Res Public Health. 2022;19:8993.
12. Findyartini A, Felaza E, Setyorini D, Mustika R. Relationship between empathy and motivation in undergraduate medical students. GMS J Med Educ. 2020;37:Doc43.
13. Oláh B, Münnich Á, Kósa K. Identifying academic motivation profiles and their association with mental health in medical school. Med Educ Online. 2023;28:2242597.
14. Atalay KD, Can GF, Erdem SR, Muderrisoglu IH. Assessment of mental workload and academic motivation in medical students. J Pak Med Assoc. 2016;66:574-8.
15. Kunanitthaworn N, Wongpakaran T, Wongpakaran N, Paiboonsithiwong S, Songtrijuck N, Kuntawong P, et al. Factors associated with motivation in medical education: a path analysis. BMC Med Educ. 2018;18:140.
16. Viau R. La motivation en contexte scolaire. 5th ed. Pratiques pédagogiques. Paris: Deboeck Supérieur; 2009.
17. Eccles JS, Wigfield A, Schiefele U. Motivation to succeed. 5th ed. In Damon N, Eisenberg N, editors. Handbook of child psychology: social, emotional, and personality development. New York: John Wiley & Sons, Inc; 1998.
18. Vallerand RJ, Pelletier LG, Blais MR, Brière NM, Senécal CB, Vallières ÉF. Academic motivation scale (AMS, AMS-C 28, EME). Washington DC: APA PsycTests. 1992.
19. Stover JB, de la Iglesia G, Boubeta AR, Liporace MF. Academic motivation scale: adaptation and psychometric analyses for high school and college students. Psychol Res Behav Manag. 2012;5:71-83.
20. Sousa SP, Silva R. Validity and reliability of the portuguese version of mathematics academic motivation scale (MATAMS) among third cycle of basic school students. Mathematics. 2021;9:2049.
21. Fairchild AJ, Horst SJ, Finney SJ, Barron KE. Evaluating existing and new validity evidence for the academic motivation scale. Contemp Educ Psychol. 2005;30:331-58.
22. Can G. Turkish version of the academic motivation scale. Psychol Rep. 2015;116:388-408.
23. Al Ansari AM, Kumar AP, AlSaleh AF, Arekat MR, Deifalla A. Validation of academic motivation scale among medical students using factor analysis and structural equation modeling: middle eastern perspective. J Educ Health Promot. 2021;10:364.
24. Cadête Filho AA, Peixoto JM, Moura EP. Medical students' academic motivation: an analysis from the perspective of the theory of self-determination. Rev Bras Educ Med. 2021;45:e086.
25. Sobral DT. What kind of motivation drives medical students' learning quests? Med Educ. 2004;38:950-7.
26. Vallerand R, Pelletier L, Blais M, Brière N, Senécal C, Vallières E. On the assessment of intrinsic, extrinsic, and amotivation in education: evidence on the concurrent and construct validity of the academic motivation scale. Educ Psychol Meas. 1993;53:159-72.
27. Utvær BK, Haugan G. The academic motivation scale: dimensionality, reliability, and construct validity among vocational students. NJVET. 2016;6:17-45.
28. Guay F, Vallerand RJ, Blanchard C. On the assessment of situational intrinsic and extrinsic motivation: the situational motivation scale (SIMS). Motiv Emot. 2000;24:175-213.
29. Ayub N. Effect of intrinsic and extrinsic motivation on academic performance. PBR. 2010;12:363-72.
30. Alivernini F, Lucidi F. Relationship between social context, self-efficacy, motivation, academic achievement, and intention to drop out of high school: a longitudinal study. J Educ Res. 2011;104:241-52.
31. Barkoukis V, Tsorbatzoudis H, Grouios G, Sideridis G. The assessment of intrinsic and extrinsic motivation and amotivation: validity and reliability of the greek version of the academic motivation scale. Assess Educ Princ Policy Pract. 2008;15:39-55.

32. Ambuehl B, Inauen J. Contextualized measurement scale adaptation: a 4-step tutorial for health psychology research. Int J Environ Res Public Health. 2022;19:12775.
33. Belgrave LL, Seide K. Grounded theory methodology: principles and practices. In Handbook of research methods in health social sciences. Berlin: Springer; 2019. p.299-316.
34. Charters E. The use of think-aloud methods in qualitative research: an introduction to think-aloud methods. Brock Educ J. 2003;12:68-82.
35. Ribeiro MF, Saraiva V, Pereira P, Ribeiro C. Escala de motivação académica: validação no ensino superior público português. Rev Admin Contemp. 2019 23:288-310.
36. Anthoine E, Moret L, Regnault A, Sébille V, Hardouin JB. Sample size used to validate a scale: a review of publications on newly-developed patient reported outcomes measures. Health Qual Life Outcomes. 2014;12:176.
37. Smith KJ, Davy JA, Rosenberg DL. An empirical analysis of an alternative configuration of the academic motivation scale. Assess Educ: Princ Policy Pract. 2012;19:231-50.