

Article

Assessing Student Motivation in Financial Literacy in Higher Education: Adaptation and Preliminary Psychometric Evaluation of the Financial Literacy Academic Motivation Scale (FLAMS)

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Abstract

This quantitative study adapted the Academic Motivation Scale (AMS) to the Financial Calculus context in higher education. It examined the preliminary psychometric properties of the resulting Financial Literacy Academic Motivation Scale (FLAMS). The 28 AMS items were translated, contextually adapted, and administered to 164 Portuguese undergraduate students enrolled in Financial Calculus during the 2023/2024 and 2024/2025 academic years. Exploratory analysis was used to inspect within-sample item patterns, while confirmatory factor analysis was conducted in the same pooled sample to compare theoretically plausible candidate structures. The refined five-factor, 21-item model, comprising amotivation, external regulation, introjected regulation, identified regulation, and a general a relative improvement over the alternative models considered. Internal consistency was acceptable to high across the retained factors. However, the model did not meet conventional close-fit benchmarks, and the analyses did not provide independent cross-validation or evidence of measurement invariance across academic cohorts. The findings should therefore be interpreted as initial evidence for a context-specific candidate structure rather than as a definitive validation of FLAMS. Future research should replicate the model in larger independent samples, test measurement invariance across cohorts and institutional contexts, and examine associations with external criteria, including Financial Calculus grades, financial-literacy learning outcomes, engagement, and persistence.



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Keywords: academic motivation scale; amotivation; intrinsic motivation; extrinsic motivation; financial literacy

1. Introduction

Higher education plays a fundamental role in any country's development and growth, and it is crucial to understand its current state to optimise educational policies and pedagogical practices. Measuring the impact and quality of higher education is a complex

challenge, as various factors influence this assessment, such as modes of access, enrolment numbers, completion rates and dropout rates. In this regard, it is essential to understand the perceptions of the key actors in this process—the students—who interact directly with the education system.

Academic motivation has been identified as a significant predictor of student academic outcomes and is strongly associated with desirable educational indicators, such as academic performance, persistence and engagement in learning activities (Barkoukis et al., 2008; Gottfried et al., 2007). With the growing emphasis on financial literacy in higher education, student motivation has become even more important. It not only contributes to success in subjects such as Financial Calculus but also helps students to apply financial concepts critically and independently in day-to-day decisions (Kaiser & Menkhoff, 2022; Lusardi & Mitchell, 2014). This behavioral dimension of financial literacy expands the understanding of academic motivation beyond strict academic performance and links it to the development of essential lifelong skills. Motivation is a complex construct that has become increasingly relevant in the academic environment and has been extensively studied within different theoretical frameworks, with particular emphasis on Self-Determination Theory (SDT) (Ryan & Deci, 2000a). In the field of financial literacy specifically, motivation is intricately linked to student learning and performance, as it directly influences their ability to understand, apply and retain financial concepts essential to their personal and professional development (Financial Accounting Standards Board, 2016). Motivation is also constantly changing over time (Brouse et al., 2010; He et al., 2015), which highlights the importance of understanding motivational dynamics in the context of financial literacy in higher education. Self-Determination Theory (SDT), considered one of the most widely applied and comprehensive theories of motivation, offers a robust theoretical framework for explaining the reasons behind motivated behaviour and how different forms of motivational regulation relate to academic outcomes and well-being (Deci & Ryan, 1985; Ryan & Deci, 2017). Within this framework, the Academic Motivation Scale (AMS), developed by Vallerand in 1989 and refined in 1992, has been widely used to assess academic motivation in diverse educational contexts.

Although the Academic Motivation Scale has been widely applied in higher education and in related accounting and finance education contexts, these applications do not demonstrate that the instrument functions equivalently when motivation is assessed in relation to a specific course unit. The original AMS asks students why they attend university in general, whereas the present adaptation asks why they invest time in studying Financial Calculus. This change in the target behavior is theoretically relevant because students' motivational regulations may vary with the perceived utility, difficulty, and learning context of a particular academic activity.

The contribution of the present study is therefore not based on an assertion that the AMS has never been used in finance-related education. Rather, it lies in adapting the instrument to the Financial Calculus context and conducting a preliminary psychometric examination of the resulting Financial Literacy Academic Motivation Scale (FLAMS) in Portuguese higher education. Financial Calculus was selected because it represents a core learning context in which students engage with quantitative procedures and financial concepts that are relevant to academic, professional, and everyday decision-making. Despite the widespread international use of the AMS, no study was identified that had adapted and psychometrically examined the scale specifically for students enrolled in a Financial Calculus course within the Portuguese higher education context.

Accordingly, this study aimed to adapt the Academic Motivation Scale (AMS) to the Financial Calculus context and to conduct a preliminary psychometric evaluation of the resulting Financial Literacy Academic Motivation Scale (FLAMS) in a sample of Portuguese

higher education students. The original seven-factor AMS structure was treated as the theoretical reference model. In addition, a theoretically parsimonious five-factor alternative, in which a broader intrinsic-motivation factor represented the three intrinsic-motivation dimension factor, and a refined five-factor model were examined as candidate structures.

The study addressed the following research questions:

RQ1. What within-sample item pattern is observed in the adapted FLAMS when administered to students enrolled in Financial Calculus?

RQ2. To what extent does the original seven-factor AMS structure, compared with theoretically plausible five-factor candidate models, demonstrate relative within-sample model fit?

RQ3. To what extent do the factors retained in the refined candidate model demonstrate adequate internal consistency and convergent-evidence indicators in the present sample?

Given the modest sample size, the use of a single pooled dataset, and the absence of independent cross-validation and measurement-invariance testing, the study does not seek to establish a definitive validation of FLAMS, demonstrate cross-cohort equivalence, or confirm the superiority of a final factor structure.

2. Theoretical Background

2.1. Self-Determination Theory and Academic Motivation Scale

Motivation is widely recognized as a central factor in academic success (Pintrich, 2003). Thus, Deci and Ryan's Self-Determination Theory (SDT) is one of the most influential theoretical frameworks for understanding motivation, well-being and optimal functioning in educational contexts (Deci & Ryan, 1985; Ryan & Deci, 2000a). According to this perspective, SDT is based on an organismic approach, which holds that individuals possess a natural tendency towards psychological growth, learning and self-integration, provided that the social context offers them favorable conditions (Deci & Ryan, 1985; Ryan & Deci, 2000a). In this regard, SDT prioritizes the analysis of the quality of motivation, distinguishing between autonomous and controlled forms of self-regulation (Deci & Ryan, 2008). In educational contexts, autonomous motivation is generally associated with greater persistence, engagement and academic adjustment, whilst more controlled patterns are associated with greater vulnerability to negative experiences. Meta-analyses consistently confirm that autonomous motivation is associated with more favorable academic and psychological indicators than controlled motivation (Bureau et al., 2022).

One of the core conceptual elements of SDT is the Theory of Basic Psychological Needs, which proposes three universal needs: autonomy, competence and relatedness/belonging as essential psychological nutrients for optimal functioning (Ryan & Deci, 2017). Autonomy refers to the experience of volition and internal alignment in action; competence to the feeling of efficacy and the ability to cope with challenges; and relatedness/belonging to the feeling of connection, acceptance and interpersonal support. When these needs are met, the likelihood of autonomous forms of motivation emerging and of maintaining more sustained engagement increases; conversely, frustration tends to be associated with patterns of controlled motivation and less adaptive outcomes. A recent meta-analysis shows that teaching behaviours that support or frustrate these needs are systematically associated with student motivational and adjustment indicators (Howard-Jones et al., 2016).

Furthermore, SDT conceptualizes motivation along a continuum of self-regulation ranging from the least to the most self-determined. At the least self-determined end lies amotivation, which is characterized by a lack of intention or perceived value. This is followed by different forms of extrinsic motivation reflecting progressive degrees of internalisation, namely external regulation, introjected regulation, identified regulation and, where applicable, integrated regulation, culminating in intrinsic motivation, in which the

activity is undertaken for its own sake and for the satisfaction it brings (Ryan & Deci, 2017). In academic contexts, this differentiation allows us to understand the underlying reasons for students' engagement with tasks and to anticipate the quality of effort, persistence and the subjective experience of learning (Ryan & Deci, 2000b). This framework can be summarised in Figure 1, which illustrates the transition from less self-determined forms (amotivation; controlled regulation) to more self-determined forms (internalized regulation and intrinsic motivation), in line with the SDT continuum (Ryan & Deci, 2000a).

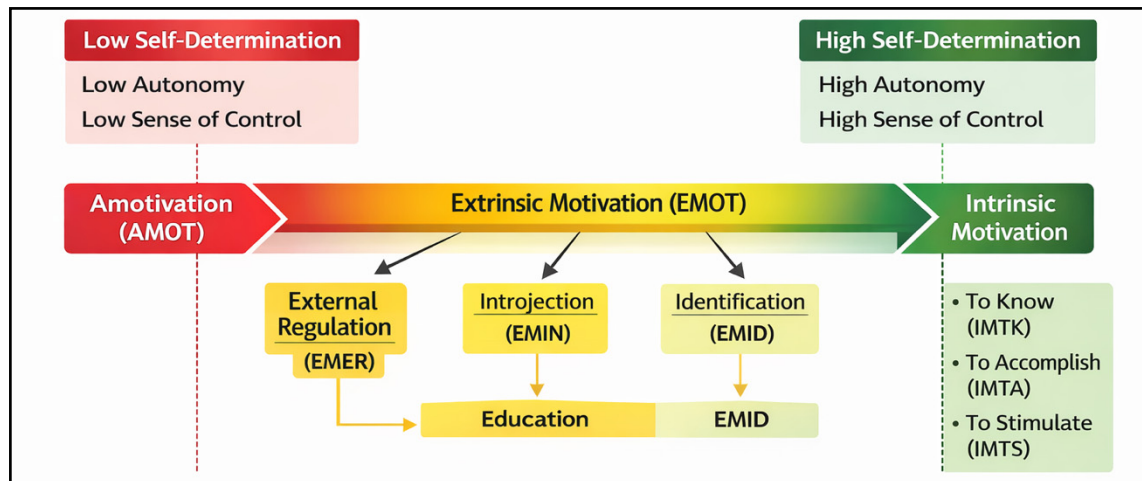


Figure 1. Self-determination continuum (adapted from Ryan & Deci, 2000b).

From a contextual perspective, SDT emphasises that characteristics of the learning environment—in particular, teaching practices that address the needs for autonomy, competence and relatedness—promote autonomous motivation. Recent studies on autonomy-promoting teaching show that teaching strategies, such as offering meaningful choices, justifying the relevance of tasks, acknowledging difficulties and providing informative feedback, foster experiences of self-determination and engagement (Aelterman et al., 2018; Reeve & Cheon, 2021), in line with the assumptions of Self-Determination Theory. Furthermore, they also indicate that support for basic psychological needs is consistently associated with motivation and academic performance across different educational contexts (Haw & King, 2022). Concurrently, educational interventions informed by SDT have demonstrated positive effects on intrinsic motivation and the fulfillment of these basic needs (Wang et al., 2024).

In summary, SDT offers a robust framework for understanding academic motivation by articulating (i) types of motivational regulation (autonomous vs. controlled), (ii) the processes of internalisation across the motivational continuum, and (iii) the contextual mechanisms that support or inhibit these processes through the satisfaction or frustration of basic psychological needs (Deci & Ryan, 1985; Ryan & Deci, 2000a, 2017). This framework justifies the use of instruments aligned with the SDT continuum to assess motivation in educational contexts and in specific domains of learning, such as financial literacy, where the perception of value, relevance and autonomy can be decisive for sustained engagement with content often perceived as instrumental and demanding.

2.2. Academic Motivation Scale (AMS)

The Academic Motivation Scale (AMS) was originally developed by Vallerand and colleagues in the late 1980s in French, based on the assumptions of Self-Determination Theory and the multidimensional nature of academic motivation (Vallerand et al., 1989). The instrument was subsequently translated into English, adapted and validated with

university students, resulting in the widely used AMS-28 version (Vallerand et al., 1992). The scale consists of 28 items organized into seven subscales: amotivation, three forms of intrinsic motivation (to know, to accomplish, to experience stimulation); and three forms of extrinsic motivation (external, introjected and identified regulation).

Since then, AMS has become one of the most widely used measures for assessing academic motivation within SDT and is applied across different levels of education and cultures. Validity studies have provided evidence in favor of the seven-factor model, as well as correlation patterns consistent with the continuum (simplex structure), and favor of the seven-factor model, as well as correlation patterns consistent with the continuum (simplex structure), and theoretically consistent relationships with related constructs (e.g., academic engagement, goals and adjustment), supporting convergent/discriminant validity (Fairchild et al., 2005). Contemporary adaptations and validations across countries and within higher education populations reinforce the relevance of this instrument and the need to confirm its structure and functioning in specific contexts (Kočvarová et al., 2024).

In the context of financial literacy, the choice of this instrument is theoretically consistent with SDT as it allows for a distinction between: (i) engagement driven by interest (intrinsic motivation), (ii) engagement for personally endorsed utilitarian value (identified regulation) and (iii) engagement due to external or internal pressure (external and introjected regulations), as well as capturing amotivation. Given the often instrumental nature of financial literacy, it is plausible that the identified regulation will take on particular relevance (as it translates to ‘it matters to me’) and become a central target for validity evidence based on relationships with indicators of persistence, attributed relevance and task engagement. This articulation between theory, instrument structure and domain specificity reinforces the relevance of testing not only the internal structure of AMS but also patterns of convergent and predictive validity in the context of financial learning.

2.2.1. Construction, Interpretation and Validation of the Academic Motivation Scale

The Academic Motivation Scale (AMS-28) empirically operationalizes the motivational continuum proposed by SDT, enabling assessment of the quality of motivation (i.e., why the student engages) rather than merely its intensity (Ryan & Deci, 2000a, 2020). In its classic formulation, AMS comprises seven subscales, each with four items, totalling 28 items, answered on a seven-point Likert scale (from ‘Does not correspond at all’ to ‘Corresponds exactly’), covering three general domains: amotivation, extrinsic motivation and intrinsic motivation, distributed along a continuum of increasing self-determination (Vallerand et al., 1989; Vallerand & Bissonnette, 1992). This structure is summarised in Figure 1 (internalized regulations), which illustrates the transition from less self-determined forms (amotivation; controlled regulation) to more self-determined forms (internalized regulation and intrinsic motivation), in line with the SDT continuum (Ryan & Deci, 2000a).

More specifically, AMS-28 assesses: Amotivation (AMOT); three subdimensions of extrinsic motivation (external, introjected and identified regulation) and three subdimensions of intrinsic motivation (to know, to accomplish and to experience stimulation) (Vallerand & Bissonnette, 1992). The interpretation of scores must respect the logic of the continuum: profiles with higher scores in intrinsic motivation and identified regulation are generally understood as more autonomous and tend to be associated with more favourable academic outcomes, whilst profiles with a greater weighting of external/introjected regulation and, above all, amotivation reflect lower self-determination (Howard et al., 2021).

Although SDT includes integrated regulation, the original version of AMS does not measure it. This omission has been discussed in the literature, as integrated regulation implies a deeper level of internalisation and is frequently associated with greater identity consolidation; consequently, several authors note that its measurement may be less salient

(or more difficult to distinguish empirically) in certain educational contexts and age groups (Ryan & Deci, 2020). Nevertheless, there are proposals to revise the instrument that explicitly incorporate items on integrated regulation (e.g., AMS-Revised), allowing for the empirical testing of the utility of this addition in specific populations (Burgueño et al., 2022).

From a validation perspective, the contemporary literature recommends that the psychometric evaluation of AMS goes beyond internal consistency and includes (i) evidence based on internal structure (e.g., CFA/SEM), (ii) invariance across relevant groups (e.g., gender, educational level, context), and (iii) evidence based on relationships with external variables (convergent/discriminant and predictive validity). Studies employing more flexible approaches, such as Exploratory Structural Equation Modeling (ESEM), frequently indicate better fit than strict CFA, reflecting expected cross-loadings between conceptually closely related regulations (Guay et al., 2015). At the same time, applied research continues to document the instrument's usefulness in different educational contexts and the need to confirm its structure and functioning in specific populations before making substantive interpretations (Matos Sousa et al., 2024).

In the context of this study, this reasoning involves testing whether: (a) the seven-subscale structure is adequately replicated; (b) the subscales are organised in a manner consistent with the continuum (stronger correlation patterns between adjacent regulations than between distant ones); and (c) the more autonomous dimensions (intrinsic motivation and, in particular, identified regulation) are consistently associated with relevant indicators in the domain (e.g., perceived importance of financial literacy, intention to persist with financial learning tasks), whilst amotivation is negatively associated with these indicators—a pattern widely supported by meta-analytic evidence in the field of education (Howard et al., 2021).

2.2.2. Psychometric Validation

AMS has been validated primarily through Confirmatory Factor Analysis (CFA) and estimates of internal consistency (often Cronbach's alpha). The scale has been translated, adapted and administered in various countries and at different levels of education, generally exhibiting adequate psychometric properties.

Several studies indicate that AMS tends to replicate, in correlational terms, the logic of the self-determination continuum proposed by SDT: the associations between adjacent motivational forms are, as a rule, stronger than between distant forms. In particular, it has been observed that intrinsic motivation is more strongly related to identified regulation (EMID) than to external regulation (EMER), in line with the simplex hypothesis (Alivernini & Lucidi, 2011; Otis et al., 2005). However, the literature also shows that this pattern is not invariant: in some validations and applications, correlations between subscales do not strictly follow the expected order, suggesting possible effects of context, sample composition, translation/adaptation, or limitations of the measurement model (Cokley et al., 2001; Fairchild et al., 2005). In this regard, more recent synthesis and psychometric re-evaluation studies have helped clarify the state of the evidence, both regarding the reliability of the subscales and the internal structure and correlational patterns, generally supporting the usefulness of AMS but recommending careful validation in each new context (Guay et al., 2015).

Some studies highlight the breadth of AMS's use and its replication across different educational levels and cultures. In secondary education, studies with moderate to large samples (e.g., n between ~200 and ~1400) tend to report acceptable to high internal consistency (frequently $\alpha \geq 0.70/0.80$), and model fits consistent with the seven-factor model when tested by AFC (Alivernini & Lucidi, 2011; Fairchild et al., 2005; Vallerand et al., 1993). In higher education, AMS has an even more extensive empirical base, including classical

validations and subsequent applications with very large samples (e.g., over 2000 and up to 4000+ participants), which generally support the multifactorial structure and report α values predominantly ≥ 0.70 , albeit with some variability between subscales and across studies (Barkoukis et al., 2008; Blanchard et al., 1997; Guay et al., 2015; Núñez Alonso et al., 2005; Smith et al., 2010; Vallerand et al., 1989; Vallerand & Bissonnette, 1992). Taken together, these data support the view that AMS is a widely tested measure, but they also highlight that not all studies report the same indicators (e.g., fit indices or subscale alphas are not always presented), which reinforces the importance of reporting complete and comparable metrics in the present validation.

In addition to the general validations already mentioned, there is a specific body of work in management/finance, notably in Accounting and Marketing (Silva et al., 2018) and other studies in related fields. This body of work suggests the relevance of applying/adapting AMS to domains where learning may be perceived as more instrumental, but also shows that, in some adaptations, alternative structures were tested (e.g., models with fewer factors), which makes it particularly relevant to empirically confirm the structure and functioning of the instrument in the target context of the present research.

It is also worth noting that AMS has been used to examine differences between groups, including gender, although the interpretation of mean differences ideally requires prior demonstration of measurement invariance. Nevertheless, several studies report trends in which women exhibit higher levels of self-determination in certain educational contexts (Acisli et al., 2012; Gülüzar & Geban, 2011; Núñez Alonso et al., 2005; Spittle et al., 2009; Vallerand & Bissonnette, 1992). These results are also observed in studies using AMS in higher education samples (Smith et al., 2010). It is recommended that appropriate psychometric tests support these comparisons.

Previous research has examined the psychometric properties of the Academic Motivation Scale across different educational levels and contexts. Table 1 presents applications of the scale in accounting and finance education.

Table 1. Applications of the Academic Motivation Scale in accounting and finance education.

Reference	Version/Language	<i>n</i>	Level	Reliability (α)	Model	Fit Indices (Reported)
(Leal et al., 2013)	Brazil	259	University	≥ 0.90	7 factors	GFI ≥ 0.8
(Silva et al., 2018)	Portugal	1923	University	≥ 0.90	5 factors	GFI ≥ 0.9
(de Souza et al., 2021)	Brazil	296	University	≥ 0.80	5 factors	CFI ≥ 0.9

The studies summarised in Table 1 demonstrate that the Academic Motivation Scale has been used in educational settings related to accounting and finance. However, their existence does not remove the need for context-specific psychometric examination. In particular, the present adaptation differs from applications assessing general academic motivation because the item wording was reframed to refer to students' engagement with Financial Calculus explicitly. Consequently, previous evidence from accounting and finance education should be regarded as a supportive background for the present study rather than as evidence that the adapted FLAMS operates equivalently in this specific course context. Within this framework, the present study provides a preliminary psychometric examination of an adaptation of the Academic Motivation Scale for Financial Calculus. The resulting FLAMS may be useful for describing motivational regulations in this specific course context. However, the present findings do not establish predictive validity, criterion-related validity, or the instrument's utility for individual diagnosis, program evaluation, or pedagogical decision-making. Such applications require replication and evidence of associations between FLAMS scores and relevant external educational outcomes.

2.3. Adapting AMS to Financial Literacy (FLAMS)

The present study does not claim that the Academic Motivation Scale has never been applied in financial, accounting, or management education. Rather, it addresses the need to examine whether an established measure of academic motivation can be meaningfully adapted to a specific Financial Calculus course context. The literature review in this manuscript is narrative rather than systematic; therefore, the study does not make an exhaustive claim concerning all prior AMS applications.

Financial Calculus provides a distinct academic setting in which students are required to engage with quantitative procedures and financial concepts that may be perceived as both demanding and instrumentally relevant. In such a context, students may study for qualitatively different reasons, including personal interest, perceived professional usefulness, internal pressure, external expectations, or lack of perceived value. Examining these motivational regulations is consistent with the Self-Determination Theory framework and may help to describe how students relate to this specific learning activity (Ryan & Deci, 2000b; Vallerand & Bissonnette, 1992).

Accordingly, the purpose of adapting the AMS was not to create a universally applicable financial-literacy motivation instrument. Instead, the aim was to develop a contextually worded version of the scale for students enrolled in Financial Calculus and to conduct a preliminary examination of its internal item pattern, candidate factor structures, and internal consistency in this setting.

In response to this gap, this study adapts the Academic Motivation Scale to the context of Financial Calculus, resulting in the Financial Literacy Academic Motivation Scale (FLAMS). The study examines the internal item pattern, candidate factor structures, and internal consistency of the adapted instrument in a sample of higher education students. The psychometric evidence is intentionally interpreted as preliminary because the exploratory and confirmatory analyses use the same dataset and because the study does not test cross-cohort measurement invariance or external validity.

3. Materials and Methods

The study was conducted in two stages: (1) Translation and adaptation of the English version of AMS into FLAMS; (2) Administering FLAMS to students in higher education. The details of each stage will be presented in the following sections.

3.1. Adapting AMS to FLAMS

FLAMS was developed to assess the academic motivation of students at a Portuguese higher education institution (UTAD) who, in the academic years 2023/2024 and 2024/2025, attended the Financial Calculus module for the first time. To ensure suitability for the study context, the introductory question of AMS ('Why do you go to university?') was reformulated to focus directly on the target behaviour, asking students about their reasons for investing time in studying the subject area/course unit in question (e.g., 'Why do you spend time studying Financial Calculus?').

The adaptation process began with translating the original English version into Portuguese, followed by a back-translation procedure (Portuguese → English) to verify the semantic and conceptual equivalence of the items. Content validity was reinforced through a review by a panel of experts (lecturers and researchers) in the field of Psychology, who analyzed the appropriateness of the reformulations and ensured that the items retained the psychological meaning underlying the motivational dimensions of SDT as represented in AMS, whilst also being suitable for students in these fields.

In total, the 28 items were reviewed and adjusted to reflect the specific context of the Financial Calculus course module, although the changes were mostly minor in nature

(Table 2). In many cases, the adaptation consisted merely of replacing generic terms (e.g., ‘school’) with the reference domain (‘Financial Calculus’) or explicitly introducing the subject area into the original statement. In more specific situations, slightly more extensive rewording was conducted to ensure clarity and linguistic appropriateness for the target population, without compromising correspondence with the theoretical dimensions.

Table 2. Original and modified items of the Academic Motivation Scale.

Items	Original Scale (AMS)	Modified Scale (FLAMS)
Question	Why do you go to university?	Why do you spend your time studying the Financial Calculus module?
AMOT1	Honestly, I don’t know; I really feel that I am wasting my time at school.	Honestly, I don’t know. I feel that studying Financial Calculus is a waste of time.
AMOT2	I can’t see why I go to college, and frankly, I couldn’t care less.	I can’t see why I study Financial Calculus and, frankly, I couldn’t care less.
AMOT3	I don’t know; I can’t understand what I’m doing at school.	I don’t know. I can’t understand what I’m doing in Financial Calculus.
AMOT4	I once had good reasons for going to college; however, now I wonder whether I should continue.	I’m not sure. I can’t see how Financial Calculus could be of any use to me.
EMER1	Because with only a high-school diploma, I wouldn’t find a well-paid job later on.	Because if I don’t get a good mark in Financial Calculus, I won’t find a well-paid job in the future.
EMER2	In order to get a more prestigious job later on.	To get a job.
EMER3	Because I want to have ‘the good life’ later on.	Because I want to have a better life in the future.
EMER4	In order to earn a better salary later on.	To have a better salary in the future.
EMIN1	Because when I do well in college, I feel important.	Because when I do well in everything related to Financial Calculus, I feel important.
EMIN2	To prove to myself that I am capable of completing my degree.	Because I want to show others (teachers, family, friends) that I can be good at Financial Calculus.
EMIN3	To show myself that I am an intelligent person.	To show myself that I am an intelligent person.
EMIN4	Because I want to prove to myself that I can succeed in my studies.	Because I want to prove to myself that I can do well in everything related to Financial Calculus.
EMID1	Because I think that a university education will help me better prepare for the career I have chosen.	Because I think that Financial Calculus can help me better prepare for my future professional career.
EMID2	Because eventually it will enable me to enter the job market in a field that I like.	Why studying Financial Calculus will be useful to me in the future.
EMID3	Because I believe that a few more years of education will improve my professional skills.	Because I believe that Financial Calculus will improve my professional skills.
EMID4	Because this will help me make a better choice regarding my career path.	Because what I will learn in Financial Calculus will be of great use throughout my university course.
IMTA1	For the pleasure I experience whilst pushing myself in my studies.	For the pleasure and experience of excelling in my studies of Financial Calculus.
IMTA2	For the satisfaction I feel when I am in the process of accomplishing difficult academic tasks.	For the satisfaction I feel when I solve difficult problems related to Financial Calculus.
IMTA3	For the pleasure I experience whilst pushing myself to new heights in one of my personal achievements.	Because I want to understand Financial Calculus.
IMTA4	Because university allows me to experience personal satisfaction in my pursuit of excellence in my studies.	Because I feel a sense of personal satisfaction when I understand Financial Calculus.
IMTK1	Because I experience pleasure and satisfaction whilst learning new things.	Because I feel pleasure and satisfaction when I learn new things related to Financial Calculus.
IMTK2	For the pleasure I experience when I discover new things I have never seen before.	For the pleasure I get when I discover new things related to Financial Calculus that I had never learnt before.
IMTK3	For the pleasure I experience in broadening my knowledge of subjects that appeal to me.	For the pleasure I get from improving my knowledge of Financial Calculus.
IMTK4	Because my studies allow me to continue learning about many things that interest me.	Because studying Financial Calculus allows me to learn many things about this field.
IMTS1	For the intense feelings I experience when I am communicating my own ideas to others.	For the pleasure and motivation, I experience when I share ideas about Financial Calculus with others.

Table 2. Cont.

Items	Original Scale (AMS)	Modified Scale (FLAMS)
IMTS2	For the pleasure I experience when I read interesting authors.	For the pleasure I experience when I learn how things work, thanks to Financial Calculus.
IMTS3	For the pleasure I experience when I feel completely absorbed by what certain authors have written.	For the pleasure I experience when I feel completely absorbed by what the leading authors who have studied Financial Calculus have written.
IMTS4	For the ‘high’ feeling I experience whilst reading about various interesting subjects.	For the heightened feeling I experienced whilst reading various interesting studies on Financial Calculus.

AMOT: Amotivation; EMER: Extrinsic Motivation External Regulation; EMIN: Extrinsic Motivation Introjection; EMID: Extrinsic Motivation Identification; IMTK: Intrinsic Motivation to Know; IMTA: Intrinsic Motivation To Accomplish; IMTS: Intrinsic Motivation To Stimulate.

Finally, the original AMS response format was retained, based on a seven-point Likert-type scale, anchored between ‘Does not apply at all’ and ‘Applies completely’, as well as the general structure of the dimensions and subscales associated with amotivation (AMOT), extrinsic motivation (EMOT) and intrinsic motivation (IMOT). All 28 adapted items were answered on a five-point Likert-type response scale ranging from 1 (“Does not apply at all”) to 5 (“Applies completely”). The adaptation retained the conceptual organization of the original AMS into amotivation, extrinsic motivation, and intrinsic motivation, while contextualizing the wording for Financial Calculus. The response format reported here reflects the scale used in the empirical dataset; it differs from the seven-point response format of the original AMS.

3.2. Participants

FLAMS was administered as a paper-based questionnaire to students enrolled in the Financial Calculus course at a Portuguese university (UTAD) who voluntarily participated in the study. All students provided written informed consent before participating, in accordance with the ethical procedures approved for this research.

The students were aged between 18 and 26 years, with a mean age of 19.43 years; 60 (36.6%) were male, and 104 (63.4%) were female. A total of 164 questionnaires were collected from a total population of 240 students, involving 80 from the Bachelor’s Degree in Economics programme and 84 from the Bachelor’s Degree in Management. Of these, 89 students were assigned to the experimental group and 75 to the control group.

The questionnaire was administered during class hours, in coordination with the lecturer responsible for the course module throughout the second semester of the 2023/2024 and 2024/2025 academic years. Participation was voluntary, and students were informed that their decision to participate would not affect their academic assessment.

FLAMS was administered between the 2nd and 3rd weeks of term. Students were given approximately 30 min to complete the questionnaire’s 28 items and provide their sociodemographic data.

3.3. Data Analysis

Data were analyzed using IBM SPSS Statistics version 30.0, and IBM SPSS AMOS version 30.0 (IBM Corp., Armonk, NY, USA). Initially, descriptive statistics, including means, standard deviations, skewness and kurtosis, were examined to characterize the sample, assess response distributions and identify potential outliers. Data quality was also assessed through missing-data checks and the examination of response patterns, ensuring that minimum conditions for subsequent psychometric analyses were met (Helena et al., 2014; Watkins, 2018).

The internal consistency of the items and factors of the Academic Motivation Scale adapted to the Financial Calculus course (FLAMS) was assessed using Cronbach’s alpha,

given its widespread use as an indicator of reliability in applied research (Watkins, 2018). In addition, composite reliability (CR) and average variance extracted (AVE) were calculated for the retained factors as supplementary indicators of measurement quality and convergent validity.

A rotated principal component analysis (PCA) was conducted as a preliminary, within-sample descriptive assessment of the item pattern. This analysis aimed to reduce and synthesise the information contained in the items, identify their empirical grouping, and examine the extent to which the retained components explained the observed variability in the sample (Costello & Osborne, 2005). The adequacy of the data for this preliminary analysis was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett’s test of sphericity, alongside the justification of the extraction and rotation procedures adopted (Watkins, 2018). However, the PCA was not used to establish a definitive factor structure for subsequent independent confirmation, as both the exploratory and confirmatory analyses were conducted using the same pooled sample. Its findings should therefore be interpreted as exploratory, descriptive and context-specific.

Confirmatory factor analysis (CFA) was subsequently conducted in AMOS using the full sample of 164 students. CFA was used to assess the multidimensional structure of the FLAMS formally, compare theoretically plausible measurement models, and evaluate the relationships between observed items and their respective latent constructs while explicitly accounting for measurement error (Brown, 2015). Three candidate models were compared: (M1) the original seven-factor AMS structure comprising 28 items; (M2) a theoretically plausible five-factor structure with 28 items, in which a single general intrinsic-motivation factor that represented the three intrinsic-motivation dimensions; and (M3) a refined five-factor structure comprising 21 items. All latent factors were allowed to covary, and no correlated residuals were introduced.

As the FLAMS items were measured using five-category Likert-type response scales, the CFA results should be interpreted cautiously as covariance-based approximations to ordinal data. Recommendations concerning the estimation and interpretation of CFA models with ordinal indicators were therefore considered when evaluating model fit and parameter estimates (Brown, 2015; Rhemtulla et al., 2012).

Model fit was assessed jointly using the chi-square statistic (χ^2), degrees of freedom (df), χ^2/df , the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Where applicable, the goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) were also reported. The interpretation of fit was based on a combined examination of these indicators rather than a rigid reliance on universal cut-off values, acknowledging that fit indices may vary with model complexity and data characteristics (Hair et al., 2010, 2013, 2017; Sarstedt et al., 2014).

Decisions concerning item retention or deletion were based on both statistical and substantive considerations. Standardized factor loadings below 0.50 were treated as clear candidates for removal. Loadings below the more stringent 0.70 benchmark were considered for deletion only when the item also displayed weak representation of its intended construct and when its removal did not compromise conceptual coverage or reduce a retained factor to fewer than three indicators. This approach is consistent with the recommendation that factor loadings should be evaluated not only statistically but also in light of item content and the theoretical coherence of the respective construct (Kline, 2023). Items were not deleted solely to maximize fit indices, and no post hoc residual covariances were added.

The resulting 21-item model should be interpreted as a provisional candidate structure requiring replication and independent cross-validation in a new sample. Model

comparisons are therefore reported transparently as within-sample comparisons and do not constitute independent validation. Moreover, comparisons involving the reduced 21-item model are descriptive, as the observed indicator set differs from that used in the 28-item models.

Finally, data were collected across two consecutive academic years and pooled for the present internal psychometric assessment because the same questionnaire, course unit, administration period and target population were used in both cohorts. Formal tests of configural, metric and scalar invariance across academic years were not conducted. Consequently, the pooled analysis does not demonstrate that the scale operated equivalently across the two cohorts, and no cross-cohort mean comparisons were undertaken.

4. Results

4.1. Exploratory Analysis

The Exploratory Factorial Analysis (EFA) was used solely to describe the item pattern in the present sample. The solution suggested that the amotivation items formed a single group, the three forms of extrinsic regulation remained distinguishable, and the intrinsic motivation items were closely associated. This pattern motivated a comparison between the original seven-factor AMS model and a theoretically parsimonious five-factor alternative in the CFA. However, because this exploratory analysis and the CFA were conducted in the same pooled dataset, the EFA results are not treated as independently validated evidence of the final structure.

Table 3 retains the exploratory matrix for transparency. The interpretation of this table has been revised to avoid claims that it confirms the structural validity of FLAMS or justifies a definitive factor solution. To verify the conformity of the AMS factor model adapted for FLAMS with the models described in the literature, an Exploratory Factor Analysis (EFA) was conducted on the original version of the scale, translated into Portuguese and administered for the first time in Portugal. The sample consisted of students attending Financial Calculus modules for the Bachelor's degrees in Economics and Management. Given the scarcity of previous studies conducted in Portugal EFA was considered an essential step in validating the scale in the Portuguese context.

Factor extraction was performed using Principal Component Analysis (PCA), followed by an oblique rotation that retained factors with eigenvalues greater than or equal to 1, in accordance with the widely accepted convention (Al-Kandari & Jolliffe, 2001). The KMO (Kaiser-Meyer-Olkin) index was 0.817, indicating a suitable sample for since values above 0.6 are considered acceptable for factor analysis (Watkins, 2018). The analysis yielded a correlation matrix indicating five principal factors that together explain 70.76% of the total variance.

The distribution of explained variance across the factors was as follows: Factor 1 (36.38%), Factor 2 (13.24%), Factor 3 (9.30%), Factor 4 (6.24%) and Factor 5 (5.60%). To investigate the robustness of the factor structure, additional simulations were performed with a higher number of factors, whilst maintaining the criterion of eigenvalue ≥ 1 . However, factor extractions with a higher number of factors did not yield an organization consistent with the theoretical structure proposed by AMS, nor with the way the variables of the AMOT, EMOT and IMOT dimensions are typically grouped in the literature (Vallerand & Bissonnette, 1992). With the extraction of five factors, the organization of the variables was consistent with that observed in previous empirical studies.

Table 3. EFA of FLAMS in the sample of Portuguese students.

Rotated Component Matrix						
Constructs	Variables	1	2	Factors 3	4	5
IMOT	IMTK1	0.813				
	IMTK2	0.695				
	IMTK3	0.686				
	IMTK4	0.327				
	IMTA1	0.678				
	IMTA2	0.680				
	IMTA3	0.412				
	IMTA4	0.686				
	IMTS1	0.308				
	IMTS2	0.681				
	IMTS3	0.369				
	IMTS4	0.386				
EMOT	EMER1		0.413			
	EMER2		0.722			
	EMER3		0.857			
	EMER4		0.812			
	EMIN1			0.605		
	EMIN2			0.342		
	EMIN3			0.738		
	EMIN4			0.789		
	EMID1				0.741	
	EMID2				0.832	
	EMID3				0.767	
	EMID4				0.657	
AMOT	AMOT1					0.740
	AMOT2					0.822
	AMOT3					0.879
	AMOT4					0.779

Specifically, the factor analysis demonstrated that the variables EMER (external regulation), EMIN (introjected regulation) and EMID (identified regulation), belonging to the EMOT dimension, were grouped into three distinct factors, followed by the variables constituting the AMOT dimension (amotivation). About IMOT, all variables were grouped into a single factor, which is consistent with the theoretical structure of intrinsic motivation, as described in the literature (Deci & Ryan, 2000).

In summary, the PCA results indicate that the AMOT dimension was consolidated into a single factor, the EMOT dimension was subdivided into three distinct factors, and the IMOT dimension remained as a single factor. This grouping reflects the expected structure based on the application and validation of AMS in various contexts over the years. For the sample in question, a perfect grouping of the variables into their respective dimensions and factors was observed, thereby strengthening the structural validity of FLAMS and justifying the use of the structural equation model in subsequent validation stages.

Table 3 presents the exploratory factor matrix for the 28 items of the adapted FLAMS, including the respective factor loadings, which show the distribution of the variables across the five factors extracted in the EFA.

4.2. Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) is a crucial step for validating theoretical models, as it is vital for determining the fit of the factor model to the observed data. CFA allows

not only for the verification of the scale's dimensionality but also for the verification of the statistical validity of the indicators and measurement errors and is essential for assessing the robustness of the structural model (Brown, 2015; Hair et al., 2010; Thompson, 2004). Furthermore, CFA requires a detailed analysis of factor loadings and standardized residuals, elements that are essential for model validation and for ensuring the variables are appropriate to the study context (Bagozzi & Yi, 1988, 2012; Schumacker & Lomax, 2016). Table 4 reports the fit indices for the three candidate CFA models. The original seven-factor model (M1) and the 28-item five-factor alternative (M2) both showed weak global fit. The refined 21-item five-factor model (M3) showed a relative improvement in CFI, TLI, RMSEA, and SRMR. Nevertheless, its global fit did not reach conventional close-fit benchmarks. Accordingly, M3 is retained only as the most promising candidate among the models evaluated in this dataset and not as a definitively validated measurement structure.

Table 4. CFA model comparison in the pooled sample ($N = 164$).

Model	Factors	Items	χ^2	df	χ^2/df	GFI	NFI	AGFI	RMSEA	SRMR
M1. Original AMS structure	7	28	1108.49	329	3.369	0.794	0.763	0.765	0.121	0.101
M2. Five-factor alternative	5	28	1289.20	340	3.791	0.749	0.721	0.817	0.131	0.094
M3. Refined five-factor candidate	5	21	536.96	179	2.977	0.932	0.917	0.918	0.005	0.030

Note: All models were estimated in the same pooled sample. M1 and M2 use the same 28 observed items. M3 uses a reduced indicator set and is therefore not a nested comparison with M1 or M2. Its relative improvement should not be interpreted as independent validation. χ^2 = chi-square; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

In conducting the AFC, the best possible factor model was evaluated, excluding loadings below 0.7, as recommended by Hair et al. (2010). Considering previous studies suggesting that intrinsic motivation variables may constitute a single construct (Alivernini & Lucidi, 2011; Otis et al., 2005) five-factor solution was evaluated, both with and without the removal of items with factor loadings below 0.5. Analysis of standardized residuals revealed that items EMER1, EMIN2, IMTA3, IMTK4, IMTS1, IMTS3 and IMTS4 had extremely low factor loadings and were therefore removed to optimize the model (Table 5).

The deletion of seven items has substantive implications. One external-regulation item and one introjected-regulation item were removed, while five deleted items belonged to the original intrinsic-motivation subscales. Although the retained factors preserved at least three indicators, the reduced model represents a narrower operationalisation of the original AMS content domain, especially for intrinsic motivation. Consequently, the 21-item candidate model should not be interpreted as equivalent to the AMS-28, and comparisons with scores derived from the original seven AMS subscales should be made only with caution. Future research should reassess the content coverage of the retained items through expert review and replicate the candidate configuration in independent samples. Following this exclusion, a final model comprising 21 items was obtained, consisting of the dimensions AMOT, EMOT (subdivided into three factors) and IMOT (grouped into a single factor), which presented the best statistical fit, as demonstrated by the following indices: $\chi^2 = 532.96$, $p = 0.001$, $\text{df} = 179$, $\chi^2/\text{df} = 2.977$, $\text{RMSEA} = 0.05$, $\text{SRMR} = 0.030$, $\text{NFI} = 0.917$, $\text{GFI} = 0.932$, $\text{AGFI} = 0.918$, and $\text{CFI} = 0.978$. These indices indicate an excellent fit of the model, confirming the suitability of the 5-factor exploratory factor model relative to the original 7-factor model, which is frequently used in the literature (Cokley et al., 2001; Fairchild et al., 2005; Vallerand & Bissonnette, 1992).

Table 5. Item deletions during within-sample refinement of the five-factor candidate model.

Item	Standardised Loading in M2	Statistical Basis	Decision Rationale
EMER1	0.413	Below 0.500	Removed as a clear weak indicator of external regulation.
EMIN2	0.342		Removed after considering its comparatively weak representation of introjected regulation in the 28-item model.
IMTA3	0.412		Removed during refinement of the general intrinsic-motivation factor.
IMTK4	0.327		Removed during refinement of the general intrinsic-motivation factor.
IMTS1	0.308		Removed during refinement of the general intrinsic-motivation factor.
IMTS3	0.369		Removed during refinement of the general intrinsic-motivation factor.
IMTS4	0.386		Removed during refinement of the general intrinsic-motivation factor.

Note: The 0.500 value was used as a strict refinement benchmark rather than as a mechanical exclusion rule. Decisions were considered alongside item content, construct coverage, and the requirement that retained factors include at least 3 indicators. The deletion process was performed in the same dataset and therefore requires independent replication.

Although the final model provided an acceptable and robust fit, this quality of fit was achieved only after excluding seven items with factor loadings below 0.7, in line with the recommendation of Hair et al. (2010). The removal of these items was necessary to improve the consistency and accuracy of the model, ensuring that all remaining items had a significant factor loading indicative of high reliability and validity. This procedure is in line with contemporary methodological standards that recommend excluding items with low factor loadings to ensure model quality (Brown, 2015; Schumacker & Lomax, 2016).

Internal consistency was assessed for the five factors retained in the refined candidate model. Cronbach's alpha coefficients ranged from 0.825 to 0.924, indicating adequate to high internal consistency for the respective item sets in the present sample. The overall alpha coefficient ($\alpha = 0.921$) is reported only descriptively because the proposed FLAMS configuration is multidimensional; it should not be interpreted as evidence that the 21 items form a single unidimensional scale or that a total FLAMS score is psychometrically justified. Likewise, internal consistency estimates do not establish factorial validity or independent validation. Composite reliability and average variance extracted were therefore examined separately for each retained factor (Table 6). The retained 21-item candidate model included four amotivation items, three external-regulation items, three introjected-regulation items, four identified-regulation items, and seven indicators of general intrinsic motivation. Table 6 reports the internal consistency and convergent-evidence indices for the retained factors. These values indicate adequate internal consistency within the present sample, but they do not remove the need for cross-validation of the factor structure.

Table 6. Reliability and convergent-evidence indices for the refined five-factor candidate model.

Factor	Items	Cronbach's α	CR	AVE
AMOT	4	0.913	0.916	0.733
EMOT	10	0.880	0.887	0.726
IMOT	7	0.931	0.924	0.637

Note: CR = composite reliability; AVE = average variance extracted. These indices are reported for the retained candidate model only and should not be interpreted as evidence of independent validation.

Furthermore, Figure 2 illustrates the standardized path coefficients in the final five-factor model, with all paths statistically significant ($p < 0.001$). AMOT showed a positive correlation with the EMER and EMIN factors and a negative correlation with all other

factors, consistent with Self-Determination Theory, which conceptualizes amotivation (AMOT) as the absence of intrinsic motivation (Deci & Ryan, 1985; Vallerand & Bissonnette, 1992). In the present sample, the items originally representing the three intrinsic-motivation subscales were closely interrelated and therefore loaded on a broader intrinsic-motivation factor in the candidate models. This finding does not demonstrate that the original intrinsic-motivation subdimensions are redundant or psychologically indistinguishable in Financial Calculus. Rather, it represents a context-specific empirical pattern that may reflect the adapted wording of the items, the course setting, the number and content of the retained indicators, the modest sample size, and sampling variation. Independent replication is required before making substantive claims about the dimensionality of intrinsic motivation in this context (Deci & Ryan, 1985; Gagné, 1970; Ryan & Deci, 2000a).

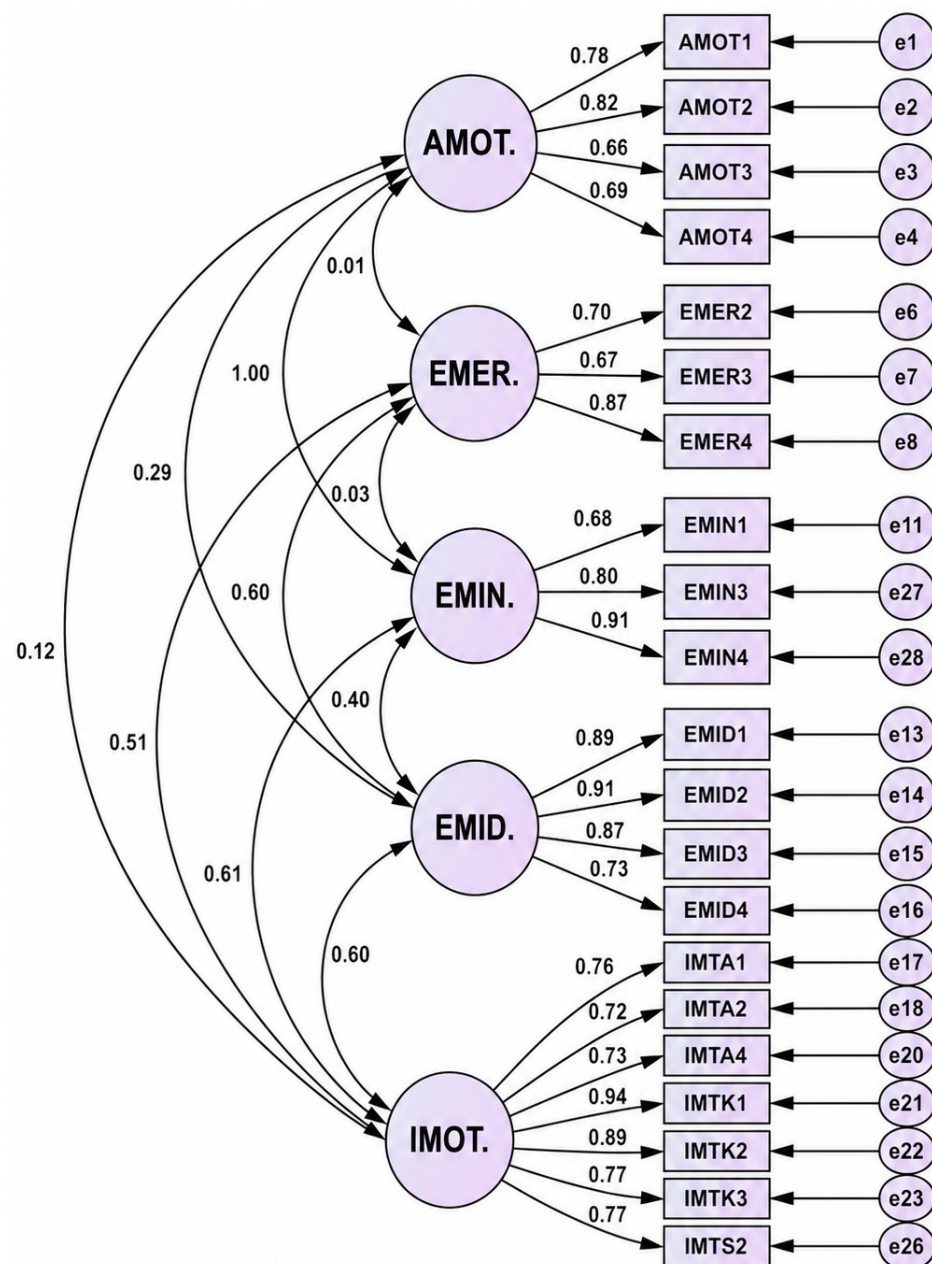


Figure 2. Final measurement model for FLAMS.

The AFC results confirm that the five-factor model offers a superior fit to the originally proposed seven-factor model, corroborating findings from other studies that have identified

difficulties in replicating the seven-factor structure of AMS across different contexts (Cokley et al., 2001; Fairchild et al., 2005; Vallerand & Bissonnette, 1992). In summary, the five-factor model presented better indices of fit and internal consistency, establishing itself as the best solution for this particular sample.

The Confirmatory Factor Analysis (CFA) conducted validates the factor structure of the adapted FLAMS and demonstrates that a single factor adequately represents intrinsic motivation (IMOT), whilst the dimensions of extrinsic motivation (EMOT) are distributed across three distinct factors, as suggested by the theory of (Ryan & Deci, 2000a). As for AMOT, it is represented as a single factor, which is also consistent with motivation models that associate it with a lack of motivation or disinterest.

The model fit indices confirm that the AFC model fits the data well overall, with the factor loadings and correlations between factors validating the scale for the sample under study. The five-factor model (AMOT, EMER, EMIN, EMID and IMOT) is the most appropriate for this sample. The exclusion of redundant items or those with low factor loadings increases the model's robustness, ensuring a more accurate assessment of student motivation.

In conclusion, the final model, after removing items of poor measurement quality, offers a more accurate and consistent solution, in line with Self-Determination Theory and best practices for scale validation in the field of academic motivation.

5. Discussion

This study adapted the Academic Motivation Scale (AMS) to the specific context of the Financial Calculus course and examined the internal psychometric properties of the resulting Financial Literacy Academic Motivation Scale (FLAMS) in a pooled sample of Portuguese higher-education students. The contribution of the present study should be understood as context-specific. The findings concern an adaptation of the AMS for Financial Calculus and do not demonstrate that the same configuration would apply to other financial-literacy, accounting, economics, or management courses. Overall, the findings provide preliminary, context-specific support for applying the Self-Determination Theory (SDT) framework in this domain. In particular, the results suggest that amotivation, external regulation, introjected regulation, identified regulation, and a broad intrinsic-motivation factor can be distinguished in the present sample. This five-factor organisation is broadly consistent with the conceptualisation of motivation as a multidimensional construct organised along a self-determination continuum (Deci & Ryan, 1985; Ryan & Deci, 2017), while reflecting an empirical structure specific to the adapted instrument, course context, and sample under study.

From an SDT perspective, these findings reinforce the importance of examining not only the intensity of students' motivation, but also its quality, that is, the reasons underlying their engagement in academic activities. Previous theoretical and empirical research indicates that more self-determined forms of motivation are associated with more adaptive patterns of engagement, persistence, and academic success (Howard et al., 2021; Ryan & Deci, 2000a; Vansteenkiste et al., 2006). The distinction between amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation is also consistent with prior AMS validation studies and with evidence suggesting that these forms of regulation play functionally distinct roles in educational contexts (Guay et al., 2015; Howard-Jones et al., 2016).

The identification of amotivation is particularly relevant in the context of Financial Calculus, as this motivational state has been associated with lower academic engagement, weaker persistence, greater disengagement, and a higher intention to drop out (Hardre & Reeve, 2003; Morelli et al., 2023; Vallerand, 1997). Conversely, the identification of more

autonomous forms of regulation, particularly identified regulation, may be especially meaningful in a subject area often perceived as instrumental or strongly oriented towards practical and professional outcomes. According to SDT, students may sustain engagement in activities that are not necessarily intrinsically enjoyable when they perceive them as personally valuable, useful, and aligned with relevant academic or professional goals (Ryan & Deci, 2020). In Financial Calculus, the perceived usefulness of the subject may therefore represent an important mechanism supporting the internalisation of learning goals and continued effort.

Accordingly, the present FLAMS version may be useful for exploratory and formative purposes. It may help identify motivational patterns that warrant closer pedagogical attention, particularly among students displaying less self-determined profiles. Such information may help teachers reflect on instructional strategies that strengthen perceived relevance, autonomy, competence, and sustained engagement with Financial Calculus content. However, the instrument should not yet be used for high-stakes decisions or for individual diagnostic purposes.

Indeed, the findings require cautious interpretation. The original seven-factor AMS structure did not show a strong global fit to the present data, and combining the three intrinsic-motivation subscales into a single factor did not improve the fit when all 28 items were retained. Although the refined 21-item five-factor candidate model showed relative improvement, its fit remained below conventional close-fit benchmarks. Therefore, the proposed structure should not be interpreted as a stable or generalisable factorial solution. Rather, it should be regarded as a preliminary candidate model for further development. The contextual adaptation of item wording, the content-specific nature of Financial Calculus, and the modest sample size may all have contributed to the observed departures from the original AMS structure.

Importantly, the findings do not imply that the original intrinsic-motivation subdimensions are universally redundant. Instead, in this specific adapted context and sample, the intrinsic-motivation items were sufficiently interrelated to justify examination of a broader intrinsic-motivation factor. This interpretation remains provisional and should be tested in larger, independent samples, including comparisons with alternative modeling approaches that permit theoretically plausible cross-loadings, such as exploratory structural equation modeling.

The two academic cohorts were pooled because the same questionnaire, course unit, administration procedures, and target population were used. Nevertheless, measurement invariance across the 2023/2024 and 2024/2025 cohorts was not formally assessed. Consequently, the findings apply only to the pooled sample and do not establish that the scale functions equivalently across academic years, programmes, institutions, or demographic groups. Similarly, the present results should not be used to support comparisons of scores between groups or claims concerning changes in motivation over time.

These methodological limitations constrain the interpretation of the findings. The exploratory and confirmatory analyses were conducted using the same pooled dataset and therefore do not provide independent cross-validation. In addition, the pooling of the 2023/2024 and 2024/2025 cohorts does not establish that the instrument operated equivalently across academic years, because configural, metric, and scalar measurement invariance were not tested. The present findings should therefore be understood as applying only to the pooled sample and not as evidence of a stable structure across cohorts, institutions, or educational contexts. Taken together, this study contributes to extending SDT-based motivation assessment to the context of financial literacy and Financial Calculus, a domain that remains comparatively underexplored in higher education research. The findings provide preliminary support for the conceptual relevance of FLAMS and suggest

that the scale may offer a useful basis for future research on motivation in this applied learning context. Further research should replicate the proposed structure in independent samples, formally assess measurement invariance, and examine associations with relevant external criteria, including academic engagement, persistence, and performance.

6. Conclusions

This study provides a context-specific adaptation of the Academic Motivation Scale (AMS) for the Financial Calculus course module and reports a preliminary psychometric evaluation of the resulting Financial Literacy Academic Motivation Scale (FLAMS). The findings provided empirical support, within the present sample of Portuguese higher education students, for a refined five-factor, 21-item candidate model. This model showed relative improvement compared with the alternative structures assessed, and the retained factors demonstrated adequate internal consistency. These results suggest that FLAMS may offer a useful basis for examining motivational profiles in Financial Calculus and, more broadly, in the context of financial literacy. However, the results should be interpreted cautiously. Although the five-factor model showed relative improvement, it did not meet conventional close-fit benchmarks. Moreover, the exploratory and confirmatory analyses were conducted using the same pooled sample, and measurement invariance across academic cohorts was not assessed. Consequently, FLAMS should be regarded as a preliminary candidate instrument rather than as a definitively validated scale. Future studies should replicate the proposed structure in larger and independent samples, test configural, metric, and scalar invariance across cohorts and institutions, and examine additional forms of validity, including convergent, predictive, and test-retest validity.

Despite these limitations, this study reinforces the potential of applying Self-Determination Theory-based motivation assessment to financial literacy, a field that remains comparatively underexplored in higher education. The availability of a context-specific instrument may support a more detailed understanding of students' motivational profiles in subjects such as Financial Calculus, where perceptions of relevance, utility, competence, and engagement may be particularly important.

From a practical perspective, FLAMS may assist lecturers and educational managers in identifying distinct motivational profiles and in reflecting on pedagogical strategies better suited to students' motivational needs. Used cautiously and primarily for formative purposes, the instrument may contribute to the development of more tailored teaching approaches that foster engagement, persistence, and academic success. In this sense, FLAMS represents a potentially valuable tool for informing pedagogical practice and supporting evidence-based decision-making in higher education contexts.

7. Limitations and Future Research

Several limitations should guide the interpretation of the present findings. First, the sample was relatively small ($N = 164$) and comprised students enrolled in two Financial Calculus course modules at a single Portuguese higher education institution. The results may therefore be influenced by local curricular characteristics, teaching practices, and the specific composition of the student population, limiting their generalisability to other courses, institutions, and educational contexts.

Second, the exploratory and confirmatory analyses were conducted using the same pooled dataset. Although this approach may be acceptable in an initial psychometric investigation of an instrument adapted from an established theoretical measure, it does not provide independent cross-validation and may limit the robustness of the proposed factor structure (Brown, 2015; Kline, 2023). A random split of the present sample would have resulted in subsamples too small to support stable factor analysis. Moreover, because

FLAMS was adapted and evaluated in relation to Financial Calculus, the present findings cannot be assumed to generalize to other forms of financial literacy education without further contextual adaptation and psychometric examination. Future research should therefore replicate the candidate structure using larger independent samples or a planned split-sample design.

Third, data from the 2023/2024 and 2024/2025 academic years were pooled because the same questionnaire, course context, and administration procedures were used. However, no formal measurement-invariance testing was conducted. Consequently, the pooled analysis does not demonstrate configural, metric, or scalar equivalence across cohorts. Future studies should retain a clear cohort identifier and formally test measurement invariance before comparing factor means or drawing substantive inferences across academic years.

Fourth, the FLAMS items were adapted to the Financial Calculus context and were answered using a five-point Likert scale. As the confirmatory factor analysis relied on covariance-based modeling, the findings should be interpreted with caution, given their status as approximations to ordinal responses. Studies with larger samples should consider estimators specifically designed for ordinal indicators and compare strict CFA solutions with alternative approaches that allow theoretically plausible cross-loadings.

Finally, the present study focused primarily on the internal structure and internal consistency of FLAMS. It did not assess test–retest reliability, convergent validity with external measures of motivation, predictive validity for engagement, persistence, or academic performance, or sensitivity to pedagogical interventions. Nor did it examine broader psychological, social, family, cultural, or demographic factors that may influence students' motivation and academic outcomes.

Future research should therefore expand the sample across different courses, disciplinary areas, and higher education institutions to test the generalisability of FLAMS. It would also be valuable to examine the relationship between intrinsic and extrinsic motivation and performance in specific financial literacy tasks, including whether more autonomous forms of motivation are associated with deeper learning, engagement, persistence, and academic success. Further studies could assess the effects of autonomy-supportive pedagogical interventions, such as constructive feedback and meaningful opportunities for choice, on students' motivation and academic outcomes. The role of gender, cultural context, social support, and other psychological and contextual variables should also be explored. These developments would strengthen the evidence base for FLAMS and deepen understanding of academic motivation and its implications for learning, well-being, and performance in higher education.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the subject(s) to publish this paper.

Data Availability Statement: The data presented in this study are not publicly available due to ethical and privacy restrictions, as established in the informed consent provided by participants. Data may be made available from the corresponding author upon reasonable request, subject to ethical approval.

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