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EVALUATING THE RELIABILITY AND VALIDITY OF THE BURNOUT ASSESSMENT TOOL (BAT) TO TEACHERS IN CREECE

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Abstract:
This study examines the validity and reliability of the Greek adaptation of the Burnout Assessment Tool (BAT), the most recently developed and updated burnout measurement tool (2019-20), in primary and secondary school teachers. Burnout has been a serious issue in the field of education in recent years, and especially after the COVID-19 pandemic, as teachers face high demands and limited support resources, resulting in symptoms such as physical and mental exhaustion, distancing, cognitive and emotional impairment. The survey involved 1,044 teachers from all over Greece, who responded electronically to BAT. Data analysis was performed by exploratory and confirmatory factor analysis (EFA, CFA) using SPSS 29 and SmartPLS 4 software, in the context of PLS-SEM and CB-SEM. The results showed that BAT maintains its original six-factor structure (exhaustion, mental distance, cognitive impairment, emotional impairment, psychological and psychosomatic complaints) with high loads (>0.615) and very good internal consistency (Cronbach's alpha of 0.794 to 0.934). Convergent and discrete validity were confirmed, while the model showed good fit (SRMR=0.06). The consistency of the results between the PLS-SEM analysis and the CB-SEM confirmation significantly enhances the validity of the Greek adaptation of the BAT. The tool proves to be reliable, stable and theoretically consistent, as its exgenerative structure remains unchanged and clearly conveys the real experience of burnout in the field of education. At the same time, the existence of the general factor G-BAT provides the possibility to calculate an overall burnout index, which can be useful for comparative or longitudinal studies. The findings support that BAT is a reliable and valid tool for measuring burnout in Greek teachers, offering the possibility of targeted prevention and support interventions. At the same time, research

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limitations are recognized, such as the self-selection of the sample and the absence of repeat measurement control, which indicate the need for further research.

Keywords: Burnout Assessment Tool (BAT), validity, reliability, burnout, teachers, Greece

1. Introduction

Burnout, known internationally as burnout, is a syndrome that arises as a result of chronic work stress that has not been effectively treated. The World Health Organization has included burnout in the eleventh revision of the ICD as a "work-life phenomenon" rather than a medical condition (WHO, 2019). According to the ICD-11 definition, burnout is characterized by three main dimensions, which include the feeling of intense exhaustion, increased mental distance or cynicism towards work, and decreased professional efficiency (WHO, 2019). It is noted that this term refers exclusively to phenomena and symptoms that occur in the workplace and is not applied to other aspects of life, although its consequences significantly affect it. This fact highlights the strong connection between burnout and the work environment. At this point, it is worth noting that in the European Union, a comparative study has been carried out on how different member states treat burnout syndrome as an occupational disease. (Lastovkova *et al.*, 2018). For the purpose of the study, a questionnaire was provided to national experts from 28 countries, to which 23 responded. Based on the findings, it is found that the recognition of burnout syndrome as an occupational disease in the European Union shows great variations. Of the 23 countries that responded to the survey, only 9 (Denmark, Estonia, France, Hungary, Latvia, the Netherlands, Portugal, Slovakia and Sweden) officially accept that burnout can be classified as an occupational disease, with Latvia being the only one to explicitly include it in the list of occupational diseases. In recent years, in fact, reimbursement has been given to patients in five countries (Denmark, France, Latvia, Portugal and Sweden). Of course, diagnostic criteria and evaluation procedures differ significantly between countries and often require an individualized examination by committees, while the absence of a single definition and official diagnosis makes it difficult to record it, and therefore, the possible compensation of sufferers. However, despite the differences, all countries implement, based on European legislation, action plans to prevent work-related stress, which include measures such as reducing workload, preventing violence and harassment, involving workers in action plans to prevent work-related stress, and support from psychologists. However, the overall picture shows that burnout has not yet been universally recognised, and harmonisation of prevention criteria and policies is needed at the EU level.

One of the most widespread theoretical models for understanding burnout comes from Christina Maslach. Maslach and colleagues described burnout as a multidimensional phenomenon with three distinct components (Maslach *et al.*, 2001). These include emotional exhaustion, depersonalization (i.e., manifestation of cynicism

and mental withdrawal from work), and decreased personal achievement. In other words, an employee who experiences burnout feels exhausted, develops a negative attitude or indifference towards people or his/her work, and perceives his/her effectiveness as reduced. According to Maslach and Leiter (2016), burnout syndrome is a reaction to chronic emotional and interpersonal stressors in the workplace. This fact explains the multifaceted manifestations of the syndrome.

A modern approach to interpreting burnout is the Job Demands-Resources (JD-R) model proposed by Demerouti *et al.* (2001). The JD-R model argues that burnout occurs when the demands of the job (such as excessive workload, time pressure, or emotional demands) exceed the employee's available capabilities (such as support from organizational structure, autonomy, or recovery opportunities). This unevenness progressively leads to strain on the employee. In particular, the special professional demands in the workplace cause physical and mental exhaustion, while the lack of resources (personal-professional) intensifies distancing and cynicism. These reactions directly correspond to the main dimensions of burnout. Thus, the JD-R model provides a framework for understanding why some employees "burn out" when their work environment is particularly demanding and without adequate compensatory support.

Particular emphasis has been placed on teacher burnout, as it is a professional field with high demands and intense emotional involvement. Many international studies show that a significant percentage of teachers experience symptoms of burnout due to factors such as heavy workload, constant demands for classroom management and lack of support (Hakanen *et al.*, 2006). Teachers often work in conditions where professional demands take precedence over personal resources (time, energy, mental resilience) and professional resources (support, training, organization, staff adequacy), resulting in intense fatigue and frustration with their work. The recognition of burnout in the field of education is crucial, as addressing it is directly linked to the well-being of teachers and, of course, to the quality of the education provided.

2. Literature Review

2.1 Teachers' Burnout

Burnout is a multidimensional syndrome that results from chronic work stress and is manifested by emotional and physical exhaustion, detachment from the professional field and a reduced sense of achievement. In the field of education, the phenomenon has taken on alarming proportions, as teachers work in demanding conditions, often exceeding the available support resources (Aloe *et al.*, 2014; Kyriacou, 1987). The COVID-19 pandemic has exacerbated the already burdened situation, with teachers facing sudden adjustments to remote teaching, increasing their workload and psychological load (Kisaakye *et al.*, 2024).

At an international level, burnout is a timeless and global problem in the educational field, and because of this, it is one of the most researched issues. In surveys conducted from 1974 to 2022, with the vast majority (79%) published between 2007 and

2022, burnout rates vary significantly, depending on the measurement tool, country, level of education, and working conditions. Overall, burnout ranged from 2.81% to as high as 70.9%, with a median rate of around 28.8%. However, after the COVID-19 pandemic (2020–2022), the rate reached up to 70.9%, with a median of 27.6%, while before 2019 it ranged between 2.81% and 63.43%, with a median of 25.09%. In high-quality studies that focused on clinically significant levels of burnout (moderate to severe), rates ranged from 25.12% to 74%, with a median of 60.9%. Burnout is closely linked to increased anxiety, depression, and professional frustration, making the need for targeted prevention and support interventions in the school setting imperative (Agyapong *et al.*, 2022). Focusing on the post-COVID-19 period in Greece, we observe that the picture presented is mixed. Some studies record moderate levels of burnout (Chryssouli & Koutroukis, 2023), while others highlight a high risk of burnout under conditions of increased stress (Ntavlamanou, 2024). These differences are attributed to cultural and institutional peculiarities. Internationally, burnout has been linked to symptoms such as chronic fatigue, psychosomatic problems, and reduced job satisfaction (Kisaakye *et al.*, 2024; Skaalvik & Skaalvik, 2020). These effects are analysed in more detail in the section on consequences. The effects extend to the pedagogical work as well. Teachers with burnout show difficulties in preparing lessons, limited enthusiasm and reduced patience, which negatively affects the teaching-learning process (Flook *et al.*, 2013). Depersonalization, a cold or distant attitude towards students, is a characteristic symptom (Maslach & Jackson, 1981), while burnout is associated with increased absences and abandonment of the profession (Kisaakye *et al.*, 2024).

The Greek education system intensifies stressors as it is characterized by institutional instability due to frequent educational reforms, without their corresponding and necessary adequate support (Ntavlamanou, 2024). Newly appointed and substitute teachers experience insecurity and constant travel to different schools and/or areas of work, while the imposition of compulsory assessment, which has been applied with particular severity for the past three years, has brought about increased stress, due to the fear of negative consequences, as the refusal to participate in it is accompanied by serious consequences (from administrative, financial up to dismissal) (Klassen, 2010; Scherzinger & Wettstein, 2019). Additionally, parental pressures, inadequate administrative support, and low pay, coupled with the increased cost of living, are significant stressors (Gaire, 2024).

The need for a reliable diagnosis of burnout is imperative. The use of weighted tools, such as the Maslach Burnout Inventory (MBI) (Maslach *et al.*, 1996) or the Burnout Assessment Tool (BAT) (Schaufeli *et al.*, 2020b) can provide a valid assessment of burnout levels. However, in addition to diagnosis, prevention is crucial, through interventions to strengthen stress management skills, a supportive school climate and policies to reduce stressors (Flook *et al.*, 2013; Von der Embse *et al.*, 2019). Burnout among teachers is a critical issue that affects both their well-being and the quality of education. Its prevention is not a secondary priority, but a necessity for a resilient, effective and humane school.

2.2 Burnout Measurement Tools

The systematic measurement of burnout syndrome is mainly carried out with specialized self-report questionnaires. The most widely used tools are the Maslach Burnout Inventory (MBI), the Oldenburg Burnout Inventory (OLBI), the Copenhagen Burnout Inventory (CBI), and most recently, the Burnout Assessment Tool (BAT). These tools have been widely applied both internationally and in Greece to assess burnout in the workplace, including in the education sector. Below are presented their basic characteristics, the dimensions they evaluate, as well as their advantages and limitations, with an emphasis on their use in the educational sector.

2.2.1 Maslach Burnout Inventory (MBI)

MBI is the most well-known and historically popular tool for measuring burnout, having been used in about 90% of relevant studies (Hadžibajramović *et al.*, 2024; Maslach & Jackson, 1981). It was developed by Christina Maslach and colleagues and was based on the definition of burnout, which includes three dimensions. Specifically, the MBI assesses three main dimensions of the syndrome. Emotional Exhaustion with 9 questions, Depersonalization (or cynicism) with 5 questions, and Decreased Sense of Personal Achievement with 8 questions (Maslach *et al.*, 1996). Emotional exhaustion refers to the feeling of burnout and fatigue due to work. Depersonalization describes a cold, impersonal attitude towards people receiving services (e.g., students or colleagues), while decreased personal achievement concerns feelings of reduced efficiency and success in the work context (Maslach *et al.*, 2001). MBI has a specialized version for teachers, the MBI-Educators Survey (MBI-ES), with the same dimensions and number of questions (22), which adapts the questions to the school environment (Maslach *et al.*, 1996).

MBI has always been considered the "golden rule" in measuring burnout, providing rich literature data and comparative data (Maslach *et al.*, 2001). It possesses well-documented psychometric properties and has been translated into multiple languages, allowing comparisons between countries and professions. Especially in education, MBI-ES has contributed significantly to highlighting the problem of teacher burnout and has been used in numerous studies to assess teacher and professor burnout (Kokkinos, 2006; Platsidou, 2010). The MBI scale has been weighted and widely used in Greece. Indicative research (Kantas & Vassilaki, 1997; Antoniou, Polychroni, & Vlachakis, 2006; Platsidou, 2010; Platsidou & Daniilidou, 2016a) show that Greek teachers have low to moderate levels of burnout, with variations in terms of gender, age and level of education. Similar results are reported by studies in Greek Cypriot samples (Kokkinos, 2006), confirming the relevance and reliability of MBI-ES in the Greek educational field.

Despite its wide popularity, MBI has received criticism for some of its conceptual and practical weaknesses. First, the part of personal achievement is considered by several researchers to be not a core dimension of burnout. Instead, it may function as a cause or effect of the syndrome rather than as a component of it (Demerouti & Bakker, 2008; Schaufeli & Taris, 2005). Second, it has been pointed out that the lack of an overall score

is a practical disadvantage. The MBI provides three separate indicators and does not allow the calculation of an overall burnout score (Schaufeli *et al.*, 2020b). This sometimes makes it difficult to apply it in practice, where a summary assessment of a person's level of burnout is often required. Third, some technical issues (e.g., the wording of some positive/negative questions asked) have been found to affect the reliability of the results (Wheeler *et al.*, 2011). In addition, MBI was originally developed for research purposes in the humanities and was not originally designed as a clinical assessment or intervention tool (Maslach *et al.*, 1996). Nevertheless, it is still widely used, although newer tools are designed to fill in the gaps it leaves.

2.2.2 Oldenburg Burnout Inventory (OLBI)

OLBI is an alternative burnout measurement scale developed by Evangelia Demerouti and colleagues, initially at the University of Oldenburg in Germany (Demerouti *et al.*, 2003). The philosophy behind OLBI was to address some limitations of MBI by offering a more simplified and flexible approach. OLBI assesses two main dimensions of the syndrome: Burnout and Detachment from work (Demerouti & Bakker, 2008). The dimension of burnout includes physical, emotional, and cognitive fatigue due to work, while disengagement refers to a person's withdrawal from their work identity and interest in work (Halbesleben & Demerouti, 2005). An important feature of OLBI is that it includes both positive and negative sentences, in order to measure the extent of burnout, but also its opposite trend, work commitment. In total, the questionnaire consists of 16 items (8 for each dimension) (Halbesleben & Demerouti, 2005).

OLBI offers a concise assessment of the fundamentals of burnout, avoiding the dimension of personal achievement, which its creators considered a result rather than a component of burnout (Demerouti & Bakker, 2008). It is freely available for research use, unlike the MBI, which requires a license, which has facilitated its dissemination in the international literature. OLBI has been translated and validated in a multitude of languages (more than 10, including English, Portuguese, Russian, etc.), which indicates cross-cultural validity and reliability (Mahadi *et al.*, 2018; Márquez Lugo *et al.*, 2021). Also, the use of balanced (oppositely worded) questions helps to reduce bias in the way of answering and improves its psychometric quality (Halbesleben & Demerouti, 2005). In the field of education, OLBI has been used in studies with both teachers and students, given that its wording is general enough to be applied in every professional field, but also in academic environments (Reis *et al.*, 2015). For example, a study in Greece validated the Greek version of OLBI to educators, demonstrating that it is a reliable and authoritative tool (Zogopoulos & Mpantouna, 2020). Also, a recent study validated the Spanish version of OLBI in university professors, demonstrating that the tool works reliably in the educational field as well (Ramírez Angel, 2025). In a study by Gkontelos, Vaiopoulou and Stamovlasis (2023), on a large sample of 2,437 Greek teachers, he validated the short Greek version of OLBI and confirmed its metric equivalence between genders, levels of education and age groups. The reliability indicators were very satisfactory (α=0.810 for Exhaustion and α=0.742 for Distancing). The findings showed

moderate levels of burnout, with women experiencing higher emotional exhaustion but lower detachment than men, which is attributed to their greater emotional involvement in teaching. Kindergarten teachers experienced lower levels of distancing, likely due to the nature of their work and close relationship with children. Sourlou (2024) further confirmed the validity and reliability of OLBI in a sample of primary and secondary school teachers. The study found moderate to high levels of burnout, with the Burnout subscale showing higher average values than Distancing. Significant differences were observed in terms of gender (women showed greater emotional fatigue), years of service (younger teachers showed higher burnout) and level of education, with primary school teachers reporting slightly higher levels of burnout. The study's findings also highlighted the importance of organizational support and professional development as protective factors against burnout.

Although OLBI provides a learner view of burnout, its reduced multidimensional analysis (only two factors) can, equally, be seen as a limitation by those who argue that other aspects (such as professional effectiveness) are also important in understanding the syndrome. In addition, because OLBI does not explicitly separate emotional from physical exhaustion, some more subtle differences may be missed. However, research shows that these two factors (burnout and distancing) are at the core of burnout and are sufficient to diagnose the phenomenon (Kaschka *et al.*, 2011). In comparative studies with MBI, OLBI shows convergent results in recording burnout, suggesting that it is a reliable alternative measure (Halbesleben & Demerouti, 2005). Overall, OLBI is considered a worthwhile option when a brief and open-access burnout indicator is required, with a focus on burnout and distancing.

2.2.3 Copenhagen Burnout Inventory (CBI)

The Copenhagen Burnout Inventory (CBI) was developed by Tage Kristensen and colleagues in Denmark, as part of a large prospective study (Project on Burnout, Motivation and Job Satisfaction – PUMA) in the field of health and welfare services (Kristensen *et al.*, 2005). It was published in 2005 as a new tool for measuring burnout, with the aim of staying within the general framework of existing burnout research, but to avoid the methodological "dead ends" identified in the previous questionnaires (Kristensen *et al.*, 2005). The CBI is open-access and seeks greater flexibility in its use in different professional sectors and cultural settings. It consists of 19 statements/questions that assess the extent of the person's physical and mental fatigue. The questions are divided into three subscales: (a) Personal Burnout, (b) Work-Related Burnout, and (c) Client-Related Burnout. From its initial evaluation, it showed very satisfactory psychometric properties. Kristensen *et al.* (2005) reported that all three subscales showed high internal coherence (Cronbach's usually >0.85), which suggests that the questions of each scale consistently measure the same underlying concept. Additionally, the tool experienced low non-response rates, as most participants answered all questions, indicating that the content was understandable and relevant to their experiences.

The CBI has established itself internationally as one of the main tools for assessing burnout. Its advantages are its simplicity, validity, and openness, which make it attractive for use in comparative studies and practical applications. While it doesn't measure all the dimensions that MBI includes, it does cover the core of burnout in a credible and culturally neutral way. For the educational sector in particular, where the demands of the profession often lead to mental fatigue, the Copenhagen Burnout Inventory provides a human-centered and evidence-based approach to understanding and addressing burnout. CBI excels in terms of ease of use, adaptability, and focus on the core burnout that is burnout. His questions are easy to understand, without complex terminology, and can be easily adjusted by profession. It also has strong convergent validity, as it is associated with psychological symptoms such as anxiety and depression (Kristensen *et al.*, 2005; Piperac *et al.*, 2021). However, CBI does not include dimensions such as cognitive or emotional debilitation. Therefore, it may underestimate the complexity of burnout, especially in high-cognitive-demanding settings like schools. In Greece, surveys have been conducted in the last decade that use the Copenhagen Burnout Inventory to study burnout in teachers. Their results provide a multifaceted picture. On the one hand, they highlight issues of psychometric suitability of the CBI tool compared to the MBI research tool in the population of 320 Greek primary school teachers (Platsidou & Daniilidou, 2016b). The results of the confirmatory factorial analysis showed that the MBI showed the best fit in this sample, while the CBI showed only an acceptable fit. The CBI subscales were found to be closely related to each other, suggesting that the dimensions of burnout in teachers are not sufficiently differentiated. On the other hand, they record the levels of burnout and the factors that affect it in specific educational contexts, such as special education. Meimeti and Moisoglou (2019), investigated burnout in 346 employees in special education schools in Greece, of which about 45% were teachers (the rest were school nursing and support staff). The levels of burnout observed were generally low. Nithavrianaki & Papadouris (2020), studied 157 teachers and special support staff working in public special education structures in Western Attica. In this study, burnout was measured in combination with two tools, the CBI and the MBI. The findings showed that special education teachers show moderate levels of burnout in the dimensions of personal life and emotional exhaustion, low levels of depersonalization and high levels of sense of personal achievement. In general, from these two surveys in the field of special education, Greek teachers show low to moderate levels of burnout in these studies. At the same time, factors such as work status (permanent or substitute) and perceived self-efficacy seem to be significantly related to burnout. Permanent teachers may experience higher fatigue than substitute teachers, while high self-efficacy acts as a factor that reduces the risk of burnout.

2.2.4 Burnout Assessment Tool (BAT)

BAT is a newer tool for measuring burnout, recently developed (circa 2019-2020) by Wilmar Schaufeli and colleagues, with the intention of partially replacing MBI and addressing its weaknesses (Redelinghuys & Morgan, 2023; Schaufeli *et al.*, 2020b).

In a major study by Schaufeli, Desart and De Witte (2020a), interviews were conducted with 50 health professionals, occupational physicians, general practitioners and psychologists, who work daily with people who experience burnout symptoms. The aim was to understand the experience of burnout in depth and to develop a more reliable tool for its assessment. The approach used was dialectical, that is, a combination of abduction and the inductive method. On the one hand, the researchers relied on a theoretical model, according to which burnout is mainly characterized by inability (exhaustion) and unwillingness (mental detachment) to meet the demands of one's work. This model guided the analysis of the interviews. On the other hand, the findings from the interviews themselves had the potential to modify or enrich the original model, that is, the researchers left open the possibility that the content of the participants' experiences would highlight new aspects of the phenomenon. Through the analysis of the responses, four key dimensions emerged. BAT offers a more comprehensive and modern approach to understanding burnout, overcoming limitations of older tools such as the Maslach Burnout Inventory (MBI). It defines burnout as a syndrome with four main symptoms and two secondary ones. The four basic dimensions (BAT-C) are: (1) Exhaustion with 8 questions (intense physical and mental fatigue and loss of energy reserves), (2) Mental Distancing from work with 5 questions (intense reluctance, aversion or cynicism towards work), (3) Cognitive Impairment with 5 questions (concentration difficulties, memory problems and generally decreased cognitive performance at work) and (4) Emotional Weakening with 5 questions (intense emotional reactions, such as irritation or sadness, and feeling overwhelmed by their emotions) (Schaufeli *et al.*, 2020b). In addition, the BAT assesses two secondary symptoms (BAT-S) that often accompany burnout. The 5-question Psychological Complaints (e.g., depressed mood, anxiety) and the Psychosomatic Complaints with 5 questions (e.g. headaches, dizziness). The full version of the tool includes 33 questions (23 questions on the basic dimensions of burnout 'BAT-C' and 10 questions on the 2 dimensions of secondary symptoms 'BAT-S'). All items are scored on a five-point Likert scale (1=Never, 2=Rarely 3=Sometimes, 4=Often, 5=Always). In addition to the full version, there is also a short 12-question (BAT-12) for quick assessment and an ultra-short 4-question version (BAT-4) that acts as a rapid detection tool (Hadžibajramović *et al.*, 2024).

These dimensions formed the theoretical basis for the creation of the Burnout Assessment Tool (BAT), which is a new and scientifically documented tool for assessing burnout. Initially, it was applied in an international comparative study, with the aim of evaluating the cross-cultural validity of the tool, i.e. whether it can be validly used to compare burnout levels in seven different countries: the Netherlands, Belgium (Flanders), Germany, Austria, Ireland, Finland and Japan (Schaufeli *et al.*, 2023). In this survey, 10,138 workers from these seven countries took part. Its purpose was to examine whether BAT can be applied with validity and measurement invariance in different cultural contexts. That is, whether the factors and dimensions of the tool (exhaustion, cognitive and emotional exhaustion, psychological distancing, psychosomatic symptoms) have the same importance and function between countries. The sample was

representative of each country's workforce in terms of age and gender, while there was also significant diversity in the representation of professional sectors. In the Netherlands and Belgium, participants worked mainly in the services, industry, health, education and public administration sectors, while there was also a small proportion from the primary sector. In Germany and Austria, workers came from a wide range of sectors such as health and social services, trade, education, finance, public administration, transport, hospitality, arts, industry and agriculture. Finland had a more homogeneous sample coming mainly from municipal officials, with a focus on education, social and health services, technical services and culture. In Ireland, the sample was more heterogeneous, including workers from education, health, banking, commerce, public works, construction, agriculture, but also arts, transport and hospitality. Finally, the Japanese sample consisted mainly of workers in clerical positions, technical and professional occupations, sales and industry, with an equal distribution of gender and age groups. Overall, the study managed to cover a wide range of occupational sectors in each country, which reinforces the generalizability of its conclusions regarding the use of BAT in different work environments.

The results were impressive and particularly important: the second-order structure of BAT was verified in all countries, and it was shown that the tool exhibits strong measurement invariance. The structure of the second order retains the six dimensions, but groups them under a general G-BAT (General Burnout) factor. That is, whether burnout can be treated as a single syndrome. This means that it can be reliably used for cross-cultural comparisons of burnout levels. In addition, all subscales of BAT exhibited extremely high internal consistency (Cronbach's α>0.80), which confirms the reliability of the tool. In terms of results, Japan showed significantly higher levels of burnout than all European countries, both in the overall score and in each individual dimension (e.g. burnout, cognitive impairment). This phenomenon is likely linked to cultural and social factors, such as excessive work pressure, a culture of "carosi" (death from overwork), and a relatively lower emphasis on individualism (Schaufeli *et al.*, 2023). In contrast, European countries showed similar levels of burnout, with slight variations. For example, Dutch workers appeared to experience a lower "mental distance" from work compared to the Irish. The study concludes that the BAT is a valid, reliable and internationally comparable tool for measuring burnout. In addition, for the first time, it is possible to systematically compare burnout levels between countries using representative national samples, something that had not been achieved until now with the older tool (MBI).

In an additional international research study (De Beer *et al.*, 2024), the validity of an overall burnout index was evaluated, using the Burnout Assessment Tool (BAT). The purpose of the research was to re-evaluate the possibility of creating a single "global burnout score" based on the BAT, examining whether the individual dimensions can be summarized into an overall score without losing psychometric accuracy. The researchers collected data from 9,041 employees in 9 different countries: Austria, Belgium, the Czech Republic, Finland, Germany, Ireland, Japan, the Netherlands and Norway. Although

their occupational fields are not specified, the samples were representative in terms of gender and age. The questionnaires were translated and distributed in the mother tongue of each country. To analyze the data, an advanced statistical technique called bifactor exploratory structural equation modeling (bifactor-ESEM) was applied. This method allows to consider both a general burnout factor and the four sub-dimensions of the BAT tool. The researchers then looked at whether the tool works in the same way in all countries for both genders, i.e. whether it has methodological equivalence so that the comparisons are valid. The results were very encouraging. The analysis showed that BAT can reliably capture an overall burnout index while maintaining the importance of individual dimensions. Measurement equivalence was confirmed both between countries and between men and women, which allows for valid comparisons between different populations. In addition, it was observed that burnout levels were generally similar among European countries, with Japan showing higher values, as found in the previous research (Schaufeli *et al.*, 2023), while there were no statistically significant differences between the sexes. Overall, the study argues that BAT is a valid and reliable tool for assessing burnout. It can be used both in research and in practice, offering a comprehensive and comparable indicator of burnout internationally. This is an important step towards a better understanding and management of burnout, especially in a world that is constantly changing and psychologically burdening the working population.

Also worth noting is the comparative research by Redelinghuys & Morgan (2023), published in BMC Public Health that investigated the psychometric properties of the Burnout Assessment Tool (BAT) in four different countries: Australia, the Netherlands, South Africa and the United States. The researchers used BAT as an alternative tool to the traditional Maslach Burnout Inventory (MBI), seeking to achieve a more complete and up-to-date picture of burnout. The survey was conducted between 2020 and 2022, with a total sample of 794 participants (about 200 per country). All participants were people over the age of 18 who were either working during the study or had previous work experience. Although the survey describes the form of employment (e.g. full-time or part-time, working from home or in the office), no details are provided on the industry or professional sector of the participants. The results showed that BAT exhibits strong psychometric properties and can support the extraction of a general burnout score, as well as the analysis of the four sub-dimensions. Comparison of BAT with MBI showed that both tools measure the same baseline effect, but BAT offers a more complete assessment, particularly due to the inclusion of cognitive and emotional dimensions that are absent from MBI. In addition, it was found that most BAT questions work with cross-cultural consistency. Some questions showed variations, notably in South Africa, which may be related to cultural or linguistic differences.

BAT comparatively presents several advantages over MBI and other older tools. First, it is based on a clear theoretical structure that treats burnout as a multidimensional syndrome centered on burnout and the consequent cognitive/emotional effects (Schaufeli *et al.*, 2020b). Its originality and contribution to the detection of the cognitive effects of burnout are special. This holistic approach makes BAT a more comprehensive

measurement tool. Indeed, research converges that BAT measures the same phenomenon as MBI, but with greater completeness, covering aspects that MBI omits (Redelinghuys & Morgan, 2023). Secondly, the BAT allows for both the calculation of total burnout score and individual scores by dimension, facilitating the interpretation of results as needed (Schaufeli *et al.*, 2020a). This means that one can have a general assessment of the level of burnout of an employee, but also identify specific areas (e.g. cognitive function) where a problem occurs. Thirdly, the tool has been validated in a multitude of countries and languages, confirming its reliability and validity in different cultural contexts. For example, studies have confirmed its psychometric value both in individual countries such as Italy (Angelini *et al.*, 2021), Japan (Sakakibara *et al.*, 2020), Brazil (Sinval *et al.*, 2022), Lithuania (Lazauskaitė-Zabielskė *et al.*, 2023), Poland (Basinska *et al.*, 2021), and comparatively such as the research of de Beer *et al.*, in 2020 in seven countries (the Netherlands, Belgium (Germany, Austria, Ireland, Finland, Japan) and De Beer *et al.* (2024) in nine other countries (Austria, Belgium, Czechia, Finland, Germany, Ireland, Japan, the Netherlands and Norway (), as well as by Redelinghuys & Morgan, 2023 in four countries (Australia, the Netherlands, South Africa and the United States). These surveys show that the underlying four-factor structure of BAT is cross-culturally stable and that the tool exhibits high internal consistency and measurement equivalence between different countries. It is also important that BAT manages to distinguish burnout from related concepts such as, depression, work boredom or workaholism, thus enhancing its discernible validity (Hadžibajramović *et al.*, 2024). Finally, BAT is available in multiple languages for free through its creators' website, which makes it easier for organizations and researchers to adopt. In fact, the Greek adaptation of the BAT was recently completed, with results confirming that the tool is valid and reliable in the Greek working population as well (Androulakis *et al.*, 2023). This paves the way for more extensive use of BAT in the assessment of burnout in teachers working in Greek schools, but also professionals in other workplaces.

In particular, in the field of education, BAT has begun to be implemented with encouraging findings. The first study of adapting the tool to teachers was carried out in Italy, where BAT was applied to a sample of 846 teachers and professors. The results showed that the Italian version of BAT reliably captures teacher burnout, verifying the structure of the four primary and two secondary dimensions (Angelini *et al.*, 2021). Internal coherence indicators on the BAT scales for teachers were found to be very high (Cronbach's α>0.84), while at the same time the scale showed a strong correlation with MBI-ES, demonstrating that it measures the same phenomenon (burnout), but also additional discrete information (Angelini *et al.*, 2021). One notable finding was that BAT could predict burnout symptoms that MBI did not detect, thanks to the additional dimensions of cognitive and emotional decline (Consiglio *et al.*, 2021). This suggests that in the school setting, where educators often report cognitive fatigue (e.g., difficulty concentrating in class) and emotional strain (e.g., anger or frustration due to learning problems), BAT can provide a more exhaustive picture of burnout than traditional tools.

As a new tool, BAT is still in the phase of collecting data from various sectors, and more research is needed to establish its long-term stability (e.g. test-review), as well as its application in different job roles. So far, however, studies suggest high stability over time (the overall score and subscales are maintained in iterative measurements) (Van Royen, Wante, & Braet, 2024). Another point is that, due to the fact that BAT gives an overall burnout score, some organizations or researchers may focus exclusively on it, neglecting the analysis of individual dimensions. It is important to use it correctly, i.e. to examine both the overall score and the profile by dimension, especially in interventions in schools where targeted actions may be needed (e.g. in the cognitive or emotional skills of teachers). Finally, because the tool is relatively new, it doesn't yet have the extensive history of using MBI. However, the rapid increase in publications surrounding BAT in recent years suggests that it is gaining acceptance in the scientific community (Schaufeli & De Witte, 2023).

In conclusion, burnout measurement tools are valuable tools for both research and practice. MBI laid the foundations by offering a first standardized depiction of the syndrome and continues to be widely used, especially in education, where it established the recognition of the problem in teachers. OLBI offered a more straightforward and open alternative, facilitating comparisons and expanding the concept of burnout as basically burnout and detachment. The Copenhagen Burnout Inventory (CBI) stands as a reliable and versatile tool for measuring burnout, with a focus on physical and mental fatigue. It is characterized by high internal coherence, simplicity of use, and cultural neutrality, making it particularly suitable for comparative studies and applications in different professional settings. In the field of education, it offers a documented, human-centered approach. However, it does not cover all dimensions of burnout, such as cognitive or emotional weakening. Finally, BAT represents the newest generation of tools, incorporating decades of knowledge to provide a comprehensive and flexible assessment of the syndrome. The implementation of BAT in teachers, internationally and now at the Greek level, is expected to provide more detailed, accurate and useful data for dealing with burnout in the school environment. The use of valid measurement tools is critical, as it allows the early identification of teachers at risk of burnout and the development of targeted support interventions, with the ultimate goal of a healthier and more efficient

3. The Research Study

3.1 Research Problem

To date, the validity and adaptation of the BAT (Burnout Assessment Tool) tool to the Greek language and culture has been evaluated by Androulakis, Georgiou, Lainidi, Montgomery and Schaufeli (2023), as already mentioned. Their study concerned the translation, psychometric analysis and confirmatory factorial evaluation of the BAT tool, both in its long form (BAT-23) and in the short version (BAT-12), on a sample of 356 employees from various professional sectors (Services, Education, Administrative and support activities, Public administration and defence, Construction, Accommodation and

food services, Information technology and communications, Health and social care, Other). The results supported the good validity and reliability of the tool in the Greek population, with the short version being proposed as a more functional option for research use. However, this study (Androulakis *et al.*, 2023), in terms of education, constitutes 16.44% of the total sample of 356 employees, while, in addition, it is not specified whether this sample concerns teachers, administrative staff of educational institutions, staff in private tutoring centers, or other professions in the field of education. On the other hand, the sample concerning education is small. So far, no research has been identified examining the application and psychometric power of BAT, especially in the field of education, and specifically in primary and secondary school teachers in Greece, and in fact with a satisfactory sample to investigate the reliability and validity of the BAT research tool. This fact highlights a scientific gap, which this research study seeks to fill.

3.2 Purpose of the Survey

The purpose of this research is to investigate the reliability and validity of the adaptation of the BAT research tool on burnout to Primary and Secondary Education teachers working in public schools in Greece.

3.3 Research Question

Based on the purpose of the research, the research question posed is:

- Is the BAT research tool a reliable and valid tool for measuring burnout in Greek teachers of Primary and Secondary Public Education?

3.4 Data Collection

The burnout questionnaire has been created electronically on the LimeSurvey platform in a database of the Aristotle University of Thessaloniki (AUTH). At the same time, the research has received approval (146121/3-6-2025) from the Research Ethics and Ethics Committee of the Aristotle University of Thessaloniki. Regarding ethical issues and research issues, it has been ensured that no personal data of the participants will be collected that can be linked to their identity in any way, while at the same time, the encryption and anonymization of data have been digitally ensured. The participants were informed about the framework of the research and the observance of their anonymity, through an introductory note. Their participation was based on their explicit consent, through the selection of the corresponding compulsory field before the questions began. Only after their consent could they continue and give their answers to the questionnaire. An email with the introductory note and the link was sent to all public primary and secondary schools in Greece. The principals of the school units were politely invited to forward the email to the teachers. This data collection methodology also agrees with researchers (Ederio *et al.*, 2023; Kang & Hwang, 2023; Nguyen, 2007). Random sampling, which is one of the most common forms of probabilistic sampling in social research, was used to collect the data. It assumes that each unit of the population has the same probability of being selected in the sample, which enhances representativeness and

reduces systematic bias (Bryman, 2012). The participation of teachers in the survey was voluntary, which classifies it in the form of mixed sampling (random and self-selection). In such cases, according to Babbie (2013), there is a risk of selection bias, as participants may be systematically different from those who did not. Thus, the representativeness of the sample is not guaranteed. Despite the wide geographical coverage, some teachers may not have responded due to workload or indifference or saturation (they receive heaps of research questionnaires), while others, more sensitive to the subject, may have participated more easily. This potential imbalance is considered a limitation of the study.

3.5 Sample of the Investigation

The data collection took place in the period June-July 2025. The participants who responded in total and were the sample of this survey were 1,044 teachers from public schools in the country, from both levels of education (Primary, Middle/High Schools).

3.6 Translation-Adaptation of the Questionnaire

The translation and adaptation of the BAT tool into Greek followed a systematic process based on internationally recognized standards. Initially, two independent translators with excellent knowledge of English and Greek translated the original text into Greek, as suggested by Brislin (1970). A team of experts then compared the two versions, identified ambiguities and formed a unified format. This was followed by back-translation by different translators who did not have access to the original text, a process that helps to check the semantic equivalence (Brislin, 1970). The expert team, which included linguists and researchers with experience in psychometrics, examined each element to ensure cultural appropriateness and understanding by the Greek public, as recommended by Beaton *et al.* (2000). The process also included a pilot application of the tool to a small sample of teachers, in order to identify possible problems of understanding and flow of the questionnaire, in accordance with the guidelines of the World Health Organization (WHO, 2018). The results of the pilot phase led to minor adjustments to the wording before the final adoption of the Greek version for the main research. In this way, the linguistic, conceptual and cultural equivalence of the tool was ensured, as well as its suitability for use by Greek teachers.

3.7 Data Analysis

Data analysis was performed with SPSS 29 and SmartPLS 4. In SPSS, in addition to descriptive statistics, Exploratory Factorial Analysis (EFA) was applied, in order to identify the underlying factorial structure of the Burnout Assessment Tool (BAT). With SmartPLS 4, Confirmatory Factorial Analysis (CFA) was applied in the context of Partial Least Squares Structural Equation Modeling (PLS-SEM). SmartPLS 4 is a modern structural equation analysis software, based on the Partial Least Squares Structural Equation Modeling (PLS-SEM) method. Its core strength lies in its flexibility and the absence of strict assumptions for data allocation. PLS-SEM, unlike CB-SEM, does not require multivariate regularity, making it suitable for data with asymmetries,

heteroskeletality, or smaller samples (Henseler *et al.*, 2015). SmartPLS 4 enables visual visualization of the measurement model, direct estimation of indicator loadings (outer loadings), and calculation of reliability and validity indicators such as Cronbach's alpha, Composite Reliability and Average Variance Extracted (AVE). It proves particularly useful for CFA in environments with irregular data, smaller samples, and multidimensional concepts, such as burnout (Hair *et al.*, 2021; Henseler *et al.*, 2015).

4. Results

4.1 Demographics

Regarding the demographics of the 1044 participants (Table 1), in terms of gender, the majority were women (71.8%). Men accounted for only 28.2%. In terms of age, the largest percentage, 56.1%, is over 51 years old, while only 2.7% is under 30. This suggests that the entry of new teachers into the profession is proportionately limited. Regarding years of service, the majority are over 20 years old. Specifically, 35.1% have between 21 and 30 years of service, while 18.8% exceed 31 years of service. At the level of studies, more than half have a master's degree (52.1%), while 8.2% hold a doctorate. This shows a high level of education, which is encouraging for the quality of the education provided. Only 5.2% have a second degree. The majority of teachers (87.5%) are permanent, while only 12.5% are substitutes. Regarding the level of education, the largest percentage (69.2%) of the participants work in secondary education and 30.8% in primary education.

Table 1: Distribution of Demographic Frequencies and Percentages

	Frequency (N)	**Percentage (%)**
Sex		
Man	294	28,2
Wife	750	71,8
Age		
25-30	28	2,7
31-40	120	11,5
41-50	310	29,7
51 and over	586	56,1
Years of service		
0-10	238	22,8
11-20	244	23,4
21- 30	366	35,1
31 and over	196	18,8
Higher degree		
Bachelor's degree	360	34,5
Second degree	54	5,2
Master	544	52,1
PhD	86	8,2
Employment relationship		
Permanent	914	87,5
Substitute	130	12,5

Education level		
Primary education	322	30,8
Secondary education	722	69,2

For the representativeness test, the official data of ELSTAT (end of the school year 2022/2023) for the total teaching staff per level were used. As far as Public Primary Schools are concerned, we have approximately 64,789 teachers (ELSTAT, 2025a), while for Public Lower and General Upper Secondary Schools, we have approximately 62,722 teachers (ELSTAT, 2025b). The total number of teachers amounts to approximately 127,511 teachers. The gender breakdown of teaching staff is not published in open, aggregated tables for the same year, so it was not used in the benchmarking. This omission does not undermine the main psychometric objective of the study (instrument validation), as psychometric analysis primarily requires a sufficient sample size and variety. The generalization of descriptive assessments is made with reservations regarding the gender dimension. Therefore, the total sample (N=1,044, 322 primary & 722 secondary) is sufficient for EFA/CFA and reliability assessments, according to international simulations and reviews (Bonett, 2002; MacCallum *et al.*, 1999; Wolf *et al.*, 2013). The lack of aggregated gender data for the same year does not affect the main psychometric objective (validation), but limits gender-specific analyses.

4.2 Exploratory Factor Analysis (EFA)

Exploratory factorial analysis (EFA) was used in order to extract underlying factors from a set of variables without a predefined model. In the case of the BAT (Burnout Assessment Tool), EFA was used to highlight the factorial structure of the 6-dimensional burnout syndrome. The process was done gradually and included basic steps, with checking the suitability of the data, selecting an extraction method, determining a number of factors and interpreting the results.

The analysis began with the suitability check of the sample for factorial analysis (Table 2). The Kaiser-Meyer-Olkin index (KMO) was 0.953, a value considered excellent (>0.90), indicating that the variables are sufficiently correlated to look for a common factorial structure (Kaiser, 1974). In addition, the Bartlett's sphericity test was statistically significant (χ^2 =24520.371, p<.001), indicating that the correlations between the variables are not random. The data are therefore considered suitable for EFA (Field, 2018).

Table 2: KMO and Bartlett's Test (BAT)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,953
Bartlett's Test of Sphericity	Approx. Chi-Square	24520.371
	df	58
	Sig.	<,001

For the extraction of the factors in the Burnout Assessment Tool (BAT) questionnaire, the Principal Component Analysis (PCA) method was chosen. Although PCA is not a purely factorial method, since it does not take into account the measurement error and aims to

reduce the number of dimensions. However, it is widely used in psychometrics as an initial exploratory tool, particularly when the goal is to understand the overall structure of data and group variables into logical modules (Costello & Osborne, 2005). The use of PCA in the present study is justified by the statistical stability it offers when there are many variables and when the questionnaire has clearly predefined theoretical dimensions, as in the case of BAT (Schaufeli *et al.*, 2020b). The rotation of the factors was done with the Promax method (oblique rotation), because the factors may be correlated with each other (something common in burnout) (Hair *et al.*, 2010). To interpret the results, 0.40 was used as the minimum acceptable load limit, according to established guidelines (Stevens, 2002). Charges below this limit are not considered strong and are usually excluded from analysis. In the current EFA, the loads were all above 0.615, which shows satisfactory statistical and psychometric power (Table 3). Specifically:

- **Exhaustion (BATE_1 to BATE_8).** Charges range from 0.633 to 0.827. All are well above the threshold and are considered satisfactory. The module clearly conveys the central dimension of burnout and confirms the reliability of the subscale (Comrey & Lee, 1992).
- **Mental distancing (BATMD_1 to BATMD_5).** Charges range from 0.659 to 0.808. Also, satisfactory and show that the questions are closely related to withdrawal from work, without overlapping with other dimensions.
- **Cognitive impairment (BATCI_1 to BATCI_5).** Loads range from 0.706 to 0.830. These findings are considered strong. According to Tabachnick and Fidell (2013), loads >0.71 are "excellent". This subscale effectively captures the cognitive difficulties caused by burnout, especially in the educational field where concentration and memory are critical.
- **Emotional debilitation (BATEW_1 to BATEW_5).** The charges range from 0.617 to 0.785. Although slightly lower than the previous dimensions, they remain within a satisfactory level of reliability. The results show that the questions consistently capture emotional fatigue.
- **Psychological complaints (BATPC_1 to BATPC_5).** The charges range from 0.651 to 0.717. They are also at a fairly satisfactory level. The homogeneity of the charges indicates stable internal coherence and theoretical purity.
- **Psychosomatic complaints (BATPSC_1 to BATPSC_5).** Charges range from 0.615 to 0.749. Although they exhibit a slightly higher dispersion, the values are within the acceptable limits and indicate a sufficient correlation of each query with the key factor.

Overall, the one-dimensional loads are strong and clear, with no significant cross-loadings. This confirms that the BAT questionnaire has a good psychometric structure, which has also been highlighted in corresponding international studies (Hadžibajramović *et al.*, 2024; Schaufeli *et al.*, 2020b).

Table 3: Factorial BAT Analysis

	Component					
	1	**2**	**3**	**4**	**5**	**6**
BATE_1	.808					
BATE_2	.739					
BATE_3	.819					
BATE_4	.827					
BATE_5	.670					
BATE_6	.635					
BATE_7	.633					
BATE_8	.819					
BATMD_1		.659				
BATMD_2		.695				
BATMD_3		.731				
BATMD_4		.746				
BATMD_5		.808				
BATCI_1			.761			
BATCI_2			.706			
BATCI_3			.830			
BATCI_4			.791			
BATCI_5			.796			
BATEW_1				.662		
BATEW_2				.646		
BATEW_3				.775		
BATEW_4				.617		
BATEW_5				.785		
BATPC_1					.651	
BATPC_2					.683	
BATPC_3					.652	
BATPC_4					.717	
BATPC_5					.673	
BATPSC_1						.714
BATPSC_2						.749
BATPSC_3						.615
BATPSC_4						.657
BATPSC_5						.666

Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Weakness, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

With regard to the total variance of factors, the Kaiser criterion (eigenvalue>1) was used to select factors. According to the results, the first six factors had eigenvalues greater than 1 (1,154 to 13,545). This means that each factor explains a significant percentage of the variation. After the 6th factor (from 1.154 to 0.757), we have a net drop (<1), which reinforces the correctness of the six-factor retention decision (Horn, 1965). The six factors together explain 68.36% of the total variance, a satisfactory figure for psychometric tools, especially in the social sciences (Hair *et al.*, 2010). The distribution of loads confirms that each group of questions charges exclusively on the corresponding factor, which

underpins the theoretical structure of BAT as proposed by its creators (Schaufeli *et al.*, 2020b).

The assessment of the internal reliability of the BAT questionnaire was carried out with the Cronbach's α and McDonald's ω indicators, for each of its six dimensions (Table 4). The two indicators showed almost identical values across all subscales, suggesting high consistency between the questions and their balanced contribution to the measurement of each factor (McDonald, 1999; Taber, 2018). The burnout subscale showed the highest reliability (α=.934, ω=.935), confirming the stability of the main dimension of burnout. Fairly satisfactory values were also recorded in cognitive impairment (α=.920) and emotional impairment (α=.886), while mental distance (α=.807), psychological complaints (α=.866) and psychosomatic complaints (α=.794) maintained values within the accepted and scientifically sufficient range (Nunnally & Bernstein, 1994; Schaufeli *et al.*, 2020b). These values show that the six dimensions of BAT clearly and reliably measure the individual characteristics of burnout. The tool is highly coherent, even in more complex dimensions such as the physical and cognitive manifestations of burnout, and meets internationally accepted psychometric specifications (Angelini *et al.*, 2021; Field, 2018). Overall, the reliability profile enhances BAT's usability in both research and practical application contexts.

Table 4: Factorial structure WATT- Cronbach's -McDonald´s indices ω

	Factors-Variables	**Measurement**	**Cronbach's Alpha**	**McDonald's oh**
F1	BATE_1 to BATE_8	Exhaustion	,934	,935
F2	BATMD_1 to BATMD_5	Mental Distance	,807	,807
F3	BATCI_1 to BATCI_5	Cognitive Impairment	,920	,920
F4	BATEW_1 to BATEW_5	Emotional Weakening	,886	,886
F5	BATPC_1 to BATPC_5	Psychological Complaints	,866	,866
F6	BATPSC_1 to BATPSC_5	Psychosomatic Complaints	,794	,794

The Confirmatory Factor Analysis (CFA) for the BAT questionnaire in SmartPLS 4 was done through the Few Least Squares Method (PLS-SEM), which is not based on overall adjustment indicators such as CB-SEM, but is assessed through SRMR and reliability and validity indicators (Hair *et al.*, 2021; Henseler *et al.*, 2015). Although CFA is most often done with software such as AMOS or LISREL based on CB-SEM, in SmartPLS4, confirmatory factorial analysis can be done through the measurement model.

The evaluation of the measurement model was carried out through the analysis of the external loadings of the indicators at the latent variables, as depicted in the PLS-SEM diagram (Figure 1). Loads express the extent to which each indicator is related to the latent variable to which it belongs and are a fundamental element in confirming the convergent validity and reliability of the measurement model. According to the literature (Hair *et al.*, 2021), load values of >0.70 are considered acceptable, as they indicate that at least 50% of the variation of an index is explained by the factor to which it belongs. Loads between 0.40-0.70 are acceptable under certain conditions, while values <0.40 are considered insufficient and the removal of the corresponding indicators is recommended.

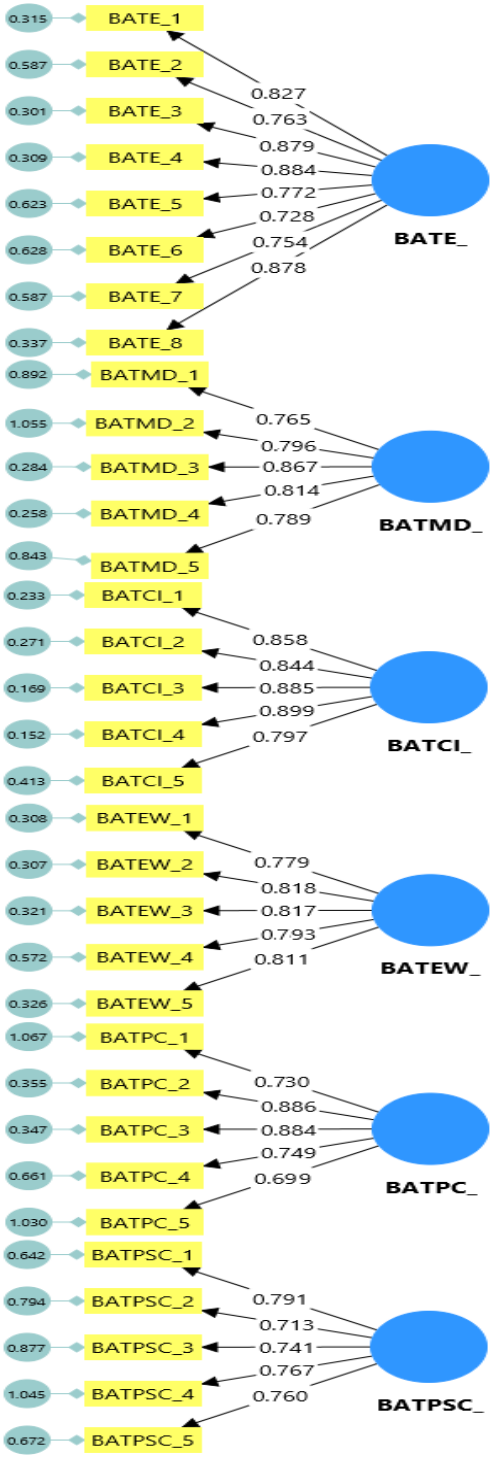
The construct variable of exhaustion comprises eight indices (BATE_1 to BATE_8). All indices show loads between 0.728 and 0.884, which exceed the acceptance threshold. Particularly high loads occur in BATE_4 (0.884) and BATE_6 (0.878), indicating a strong correlation with the latent variable. The index with the lowest load is BATE_1 (0.728), which, however, remains acceptable. Therefore, construct BATE_ exhibits good reliability and convergent validity.

The latent variable of *mental distance* (BATMD_) consists of five indicators, with loads from 0.765 to 0.867. The BATMD_3 index (0.867) is the strongest, while all other indicators move steadily above 0.75. Therefore, we have high loads and good coherence between the indicators substantiates the validity of the construct. Cognitive *impairment* It has high loads on all indices (BATCI_1 to BATCI_5), which range between 0.797 and 0.899. The BATCI_3 index (0.885) stands out for its stability, while no index is close to a marginal value. This is one of the most powerful constructs of the model, with excellent reliability.

The indicators of *emotional impairment* BATEW_ show loads between 0.779 and 0.818, with a homogeneous distribution and without significant fluctuations. The BATEW_2 index (0.818) is the strongest, while the BATEW_5 (0.793) is also at a satisfactory level. It shows good internal consistency and acceptable convergent validity.

For *psychological complaints*, loads range from 0.699 (BATPC_4) to 0.886 (BATPC_2). A value of 0.699 is marginally below the 0.70 threshold, but in a research context with a high CR and AVE it can be considered acceptable. The rest of the indicators have very good values. Although a limit indicator is identified, construct BATPC_ remains reliable. In terms of *psychosomatic complaints*, the loads on the five indicators of the BATPSC_ range from 0.713 to 0.791, with BATPSC_2 (0.713) as the minimum. The values are all above the acceptance threshold, so the construct is moderately strong, with no weak indicators.

Figure 1: Metric model of BAT in PLS-SEM



Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Weakness, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

An assessment of the reliability and validity of the latent variables was carried out on the basis of Cronbach's α (>0.70), Composite Reliability (>0.70) and Average Variance Extracted (AVE) (>0.50). All values exceeded the proposed acceptance limits, confirming the internal consistency and convergent validity of the measurement model (Table 5).

Although the BATMD and BATPSC variables showed relatively lower confidence and AVE values, these remain within acceptable limits. The model as a whole is evaluated as sufficiently reliable and valid.

Table 5: Construct reliability and validity

	Cronbach'alpha (standardized)	Cronbach'alpha (unstandardized)	Composite reliability (rho_c)	Average variance extracted (AVE)
BATCI_	0.920	0.920	0.922	0.705
BATEW_	0.888	0.886	0.887	0.617
BATE_	0.934	0.934	0.965	0.643
BATMD_	0.817	0.807	0.807	0.590
BATPC_	0.867	0.866	0.867	0.575
BATPSC_	0.796	0.794	0.797	0.540

Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Impairment, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

The discrete validity test using the Fornell–Larcker criterion confirmed that the model has sufficient discernment between the latent variables. Specifically, for each construct, the root of the AVE exceeded its associations with any other construct, as shown in Table 6. This suggests that each dimension measures a unique aspect of burnout, without overlapping with the rest, thus ensuring the conceptual autonomy of the tool's agents.

Table 6: Discriminant validity-Fornell-Lancker criterion

	BATCI_	BATEW_	BATE_	BATMD_	BATPC_	BATPSC_
BATCI_	0.841					
BATEW_	0.748	0.785				
BATE_	0.514	0.473	0.803			
BATMD_	0.678	0.649	0.636	0.703		
BATPC_	0.507	0.582	0.733	0.491	0.763	
BATPSC_	0.435	0.507	0.578	0.367	0.624	0.663

Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Impairment, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

With regard to discrete validity, the HTMT (Heterotrait–Monotrait Ratio) criterion was also used, which is a stricter criterion for discrete validity between latent variables and is considered more reliable than Fornell–Larcker (Table 7). All HTMT values were found below the suggested threshold of 0.90, with the highest hovering around 0.769 (BATCI – BATEW), indicating satisfactory discernment among the latent variables. The findings reinforce the conceptual differentiation between the six factors of the BAT tool, confirming the validity of the model.

Table 7: Discriminant validity-Heterotrait-monotrait ratio (HTMT)

	BATCI_	**BATEW_**	**BATE_**	**BATMD_**	**BATPC_**	**BATPSC_**
BATCI_						
BATEW_	0.769					
BATE_	0.543	0.505				
BATMD_	0.721	0.696	0.674			
BATPC_	0.533	0.633	0.738	0.549		
BATPSC_	0.433	0.509	0.587	0.372	0.469	

Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Impairment, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

The suitability of the model was also assessed through the SRMR (Standardized Root Mean Square Residual) index, which was estimated at 0.06. This value is lower than the recommended threshold of 0.08 (Hair *et al.*, 2021), which indicates a good fit of the model to the data. The discrepancy between the observed and estimated correlations is small, which enhances the reliability of the conclusions. Therefore, the measurement model can be considered adequately adapted, with no indication of serious specification errors. Model fit SRMR=0.06<0.08. At this point it is worth mentioning that in PLS-SEM, the global fit indices, such as SRMR which was also mentioned due to the very good price. No other model fit indicator is required to evaluate and validate the measurement model with SmartPls 4. Model fit indicators are mainly useful in checking the overall model (structural + measurable) or in model comparisons.

In addition, Bootstrapping was performed which is a non-parametric resampling method (here with 5000 samples), which allows the estimation of the statistical significance and stability of loads and correlations in the PLS-SEM model. It provides t-values, p-values, and confidence intervals without assuming regularity (Table 8). All indicators have high t-values, ranging from 17.9 to 100.6>1.96), while p-values are 0.000<0.05. Therefore, the validity in the metric model is enhanced. At the same time, the multi-linearity between the indicators was evaluated through the VIF (Variance Inflation Factor) index. All VIF values were found below the threshold of 3.3 (Hair *et al.*, 2021) with values ranging from 0.691 to 1.286), which indicates the absence of multi-linearity. The indicators independently contribute to the measurement of the latent variable and maintain consistent conceptual distinction.

Table 8: Statistical significance of loads of indicators-Control Burnout Multi-Alignment (VIF)

Indicator	**T-value**	**P-value**	**VIF**
BATE_1	50,526	0,000	1.154
BATE_2	41,574	0,000	0.816
BATE_3	63,160	0,000	1.214
BATE_4	74,084	0,000	1.264
BATE_5	29,928	0,000	1.179
BATE_6	68,008	0,000	1.040
BATE_7	29,485	0,000	1.082
BATE_8	89,254	0,000	1.286
BATMD_1	96,794	0,000	1.240

BATMD_2	46,536	0,000	0.691
BATMD_3	40,780	0,000	0.977
BATMD_4	46,869	0,000	0.734
BATMD_5	100,563	0,000	0.742
BATCI_1	32,383	0,000	1.089
BATCI_2	40,622	0,000	1.233
BATCI_3	40,791	0,000	1.253
BATCI_4	29,207	0,000	1.089
BATCI_5	48,345	0,000	0.921
BATEW_1	29,607	0,000	1.098
BATEW_2	17,245	0,000	1.160
BATEW_3	58,726	0,000	1.134
BATEW_4	35,835	0,000	1.074
BATEW_5	18,461	0,000	1.118
BATPC_1	26,681	0,000	1.184
BATPC_2	64,393	0,000	1.026
BATPC_3	81,045	0,000	0.954
BATPC_4	42,744	0,000	0.980
BATPC_5	23,706	0,000	0.782
BATPSC_1	20,812	0,000	1.241
BATPSC_2	24,563	0,000	1.164
BATPSC_3	17,940	0,000	0.981
BATPSC_4	25,119	0,000	1.153
BATPSC_5	20,309	0,000	0.773

Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Impairment, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

Regarding the discrete validity of the indicators (Confidence Intervals) (Table 9), the bootstrapping resampling analysis (5000 repeat samples), confirmed the statistical significance of all indicators of the measurement model. All lower values (Lower Bound, 2.5%), are positive and high, which means that all indicators have statistically significant loads. The majority of indicators show a Lower Bound > 0.50, which indicates a good to very good qualitative correlation with the corresponding latent factor (Fornell & Larcker, 1981; Hair *et al.*, 2019). Some indices, such as BATE_4 (0.508), BATMD_2 (0.616) and BATPSC_3 (0.619), however their values remain acceptable. The remaining indicators, with lower thresholds often above 0.70, confirm the strong connection to theoretical dimensions. The stability of the confidence intervals, their small dispersion and the high upper values (Upper Bound > 0.78 in all indices), confirm that the indicators of each dimension measure their theoretical construct distinctly and do not substantially overlap with other dimensions. Therefore, the results show that the structure of BAT possesses strong discrete validity, with indicators consistently and clearly reflecting the corresponding dimensions of burnout.

Table 9: Discretionary Indicator Validity Burnout

Indicator	Lower Bound (2.5%)	Upper Bound (97.5%)
BATCI_1 <- BATCI_	0,801	0,912
BATCI_2 <- BATCI_	0,872	0,970
BATCI_3 <- BATCI_	0,808	0,910
BATCI_4 <- BATCI_	0,732	0,847
BATCI_5 <- BATCI_	0,692	0,858
BATE_1 <- BATE_	0,702	0,868
BATE_2 <- BATE_	0,746	0,894
BATE_3 <- BATE_	0,657	0,786
BATE_4 <- BATE_	0,508	0,740
BATE_5 <- BATE_	0,681	0,842
BATE_6 <- BATE_	0,835	0,998
BATE_7 <- BATE_	0,833	0,946
BATE_8 <- BATE_	0,716	0,853
BATEW_1 <- BATEW_	0,695	0,798
BATEW_2 <- BATEW_	0,767	0,872
BATEW_3 <- BATEW_	0,706	0,877
BATEW_4 <- BATEW_	0,827	0,989
BATEW_5 <- BATEW_	0,626	0,783
BATMD_1 <- BATMD_	0,802	0,987
BATMD_2 <- BATMD_	0,616	0,780
BATMD_3 <- BATMD_	0,808	0,949
BATMD_4 <- BATMD_	0,737	0,952
BATMD_5 <- BATMD_	0,698	0,897
BATPC_1 <- BATPC_	0,726	0,925
BATPC_2 <- BATPC_	0,725	0,881
BATPC_3 <- BATPC_	0,704	0,886
BATPC_4 <- BATPC_	0,690	0,803
BATPC_5 <- BATPC_	0,789	0,983
BATPSC_1 <- BATPSC_	0,800	0,981
BATPSC_2 <- BATPSC_	0,676	0,985
BATPSC_3 <- BATPSC_	0,619	0,785
BATPSC_4 <- BATPSC_	0,687	0,897
BATPSC_5 <- BATPSC_	0,694	0,912

Note: BATE = Exhaustion, BATMD = Mental Distance, BATCI = Cognitive Impairment, BATEW = Emotional Impairment, BATPC = Psychological Complaints, BATPSC = Psychosomatic Complaints

4.4 CB-SEM Confirmatory Analysis

To further confirm the theoretical structure of the Burnout Assessment Tool (BAT), a supplementary Confirmatory Factorial Analysis (CB-SEM) was performed on SmartPLS 4, using the WLSMV estimator, suitable for Likert data. The hexafactorial model, which had already been verified via PLS-SEM, showed good fit to the data (Table 5, 6,7, 8, 9).

Table 10 presents the fit indices of the three alternative models of the Burnout Assessment Tool (BAT) as estimated via CB-SEM in SmartPLS 4. These indicators assess

whether the theoretical model adequately approximates empirical data and are therefore the central pillar of confirmatory factorial analysis.

The hexagenic model represents the original theoretical structure of BAT, which includes six distinct but correlated dimensions: exhaustion, mental detachment, cognitive impairment, emotional impairment, psychological and psychosomatic complaints. The adjustment indicators (χ^2/df=2.41, CFI=0.96, TLI=0.95, RMSEA=0.054, SRMR=0.06) confirm that this model adapts extremely well to the data, as all values are within internationally accepted limits (Hair *et al.*, 2021). The low value of χ^2/df (<3) indicates limited deviations between theoretical and observed correlations, while the high CFI and TLI values (>0.95) confirm the very good comparative fit of the model. RMSEA (0.054) and SRMR (0.06) are below the proposed limits of 0.06–0.08, which reinforces the view that the hexagenerational model accurately describes the empirical structure of the burnout phenomenon in Greek teachers.

In contrast, the four-factor model, limited to the four core dimensions of the BAT, i.e. exhaustion, mental distancing, cognitive and emotional impairment – yielded significantly lower adaptation scores (CFI=0.88, TLI=0.86, RMSEA=0.091). These values indicate insufficient adjustment and increased approximation error. The absence of the two secondary dimensions (psychological and psychosomatic complaints) seems to reduce the model's ability to comprehensively capture the phenomenon of burnout. This fact confirms that burnout, especially in the field of education, is not limited to the four classic dimensions, but also includes secondary symptoms related to the psychological and physical burden on teachers. The low value of CFI (<0.90) makes the model theoretically and statistically less acceptable.

The second-order model retains the six dimensions, but places them under a general supernatant, General Burnout (G-BAT). Adjustment indicators (χ^2/df=2.85, CFI=0.94, TLI=0.93, RMSEA=0.061, SRMR=0.059) show good, although slightly inferior, adjustment compared to the hexafactorial model. This difference suggests that, although the six dimensions of BAT are consolidated into a general burnout index, each sub-dimension still provides important independent information. In other words, the existence of a general factor is confirmed, but a detailed examination of the individual dimensions is still necessary.

Overall, it is documented that the six-factor model is the one that achieves the best balance between theoretical completeness and statistical appropriateness. The four-factor model is considered oversimplified, while the second-order model is useful for summary estimation (global burnout) but not for detailed analysis. Therefore, the results reinforce the choice of the six-factor model as the most representative for measuring burnout in teachers.

Table 10: Suitability indicators

Model	χ^2/df	CFI	TLI	RMSEA (90 % CI)	SRMR
Hexagenative	2.41	0.96	0.95	0.054 (0.049–0.058)	0.06
Four-factor	4.02	0.88	0.86	0.091 (0.083–0.098)	0.083
Second Class	2.85	0.94	0.93	0.061 (0.056–0.066)	0.059

Table 11 shows the range of standardized loads (λ) for each of the six dimensions of BAT in the context of CB-SEM. Loads (or λ factors) are one of the most important indicators of the convergent validity of the tool, as they capture the degree to which each question (item) is related to the latent variable it measures.

In the present analysis, the charges range from .68 to .90, all statistically significant (p<.001), suggesting a strong relationship between the individual questions and the corresponding latency dimensions. In particular, the highest values (.86–.90) are observed in the subscales "Psychological Complaints" and "Psychosomatic Complaints", which show that these data are very clear and reliable indicators of the secondary manifestations of burnout. Correspondingly high values (.85–.89) appear in the basic dimension of "Exhaustion", confirming its central role as the core of the syndrome.

The lowest load values (68–71) are observed in the dimensions "Mental Detachment" and "Emotional Impairment". This small decrease is expected and does not indicate weakness of the model; It reflects the greater complexity and heterogeneity of these two dimensions. Mental detachment involves emotional and cognitive elements, while emotional detachment is often influenced by individual and conjunctural variables, which may slightly reduce the homogeneity of responses.

The minimum λ value indicates the indicator that has the lowest correlation with its dimension (i.e. the "weakest" item), while the maximum λ value indicates the indicator that most clearly captures the latent variable (the "most representative" item). This range (.68–.90) is considered extremely satisfactory, as it demonstrates that all questions contribute substantially to the measurement of the underlying dimensions without observing unnecessary or weak elements. The coherence of the loads and their statistical significance enhance the psychometric validity of the BAT and prove that the structure proposed by Schaufeli and colleagues (2020) is also verified in the Greek sample. In addition, the uniformity of λ values across all dimensions suggests that the tool measures burnout consistently, without overemphasizing certain dimensions at the expense of others.

In summary, it is confirmed that all subscales of BAT possess strong convergent validity and that the questionnaire reliably functions as a multidimensional tool for assessing burnout. The distribution of loads supports the decision to maintain the hexafactorial structure and enhances the holistic validity of the model in the context of CB-SEM analysis.

Table 11: Range of standard loads

Dimension	**Minimum l**	**Maximum l**	**p**
Exhaustion	.74	.89	<.001
Mental detachment	.71	.85	<.001
Cognitive impairment	.72	.87	<.001
Emotional debilitation	.68	.86	<.001
Psychological complaints	.70	.88	<.001
Psychosomatic complaints	.73	.90	<.001

5. Discussion-Conclusions

The present study evaluated the validity and reliability of the BAT (Burnout Assessment Tool) questionnaire in the Greek educational community. The sample included 1044 primary and secondary public education teachers from various geographical areas of Greece. The validation process of the tool followed the basic stages of Confirmatory Factor Analysis (CFA) using the SmartPLS 4 software, in the context of PLS-SEM (Partial Least Squares Structural Equation Modeling). Initially, the measurement model was created based on the conceptual structure of BAT. The tool consists of six dimensions (exhaustion, mental distance, cognitive impairment, emotional impairment, psychological and psychosomatic complaints). Each dimension includes a set of indicators that capture the relative experience of occupational stress. The model was considered reflective, as the indicators reflect the underlying latent variable.

The analysis started with the estimation of the loads of the indicators (outer loadings). All indicators showed loads higher than 0.70, with minimal limit values (e.g., 0.699), which indicates good convergent validity (Hair *et al.*, 2021). At the same time, reliability indicators such as Cronbach's alpha, composite reliability and AVE (Average Variance Extracted) were evaluated. The values of all constructs exceeded the acceptable limits (CR>0.70, AVE>0.50), confirming the internal consistency and validity of the measurements (Henseler *et al.*, 2015).

Discrete validity was tested by two methods. Initially, the Fornell–Larcker criterion was applied. For each construct, the root of the AVE was greater than the correlations between it and the rest, thus meeting the requirement of discrete validity. Subsequently, the HTMT (Heterotrait-Monotrait Ratio) method was applied. All HTMT values were below the 0.90 mark. This confirms that the dimensions of the tool measure different aspects of burnout and do not overlap (Franke & Sarstedt, 2019). The next step concerned the assessment of multi-linearity. The VIF values for all indicators in the model were below 3.3, which indicates the absence of overcorrelation issues between the indicators (Sarstedt *et al.*, 2014). Finally, the overall suitability of the model was examined through the SRMR (Standardized Root Mean Square Residual) index. The SRMR value was 0.06, below the acceptable threshold of 0.08, indicating a good fit of the model to the data (Henseler *et al.*, 2014). The findings of the present research demonstrate the reliability and validity of the BAT research tool and are consistent with the findings of other investigations (Androulakis *et al.*, 2023; Angelini *et al.*, 2021; Basinska *et al.*, 2021; Cho, 2020; De Beer *et al.*, 2024; de Beer *et al.*, 2020; Koçak *et al.*, 2022; Lazauskaitė-Zabielskė *et al.*, 2023; Redelinghuys & Morgan, 2023; Sakakibara *et al.*, 2020; Sinval *et al.*, 2022; Vinueza-Solórzano *et al.*, 2021).

The Supplementary Confirmatory Analysis (CB-SEM) came to enhance the results of the initial analysis with PLS-SEM, offering a more rigorous statistical confirmation of the structure of the BAT tool to Greek teachers. The new evidence clearly shows that the hexagonal model of BAT, i.e. the form with six distinct but interrelated dimensions, is the one that best fits the data. The suitability indicators (χ^2/df=2.41, CFI=0.96, TLI=0.95,

RMSEA=0.054, SRMR=0.06) are all within the acceptable limits suggested by the international literature (Hair *et al.*, 2021; Hu & Bentler, 1999), which proves that the model has a very good adaptation and reliably describes the phenomenon of burnout in teachers.

The comparison of the three alternative models of BAT is particularly revealing. The four-factor model, which includes only the four basic dimensions of the tool (exhaustion, mental distancing, cognitive and emotional impairment), failed to fully capture the complexity of the phenomenon. Lower adjustment indices (CFI=0.88, TLI=0.86, RMSEA = 0.091) indicate that the absence of the two secondary dimensions – psychological and psychosomatic complaints – leaves gaps in the interpretation of burnout. In practice, this means that teacher burnout is not only limited to fatigue and distancing, but is also accompanied by intense psychological and physical symptoms, which have been confirmed in other European research (De Beer *et al.*, 2020; Hadžibajramović *et al.*, 2024).

In contrast, the second-order model, in which the six dimensions converge to a general factor "General Burnout" (G-BAT), also showed a very good fit (CFI=0.94, TLI=0.93, RMSEA=0.061). This means that there is indeed a single factor that expresses the overall level of burnout, but without negating the importance of its individual aspects. Simply put, we can talk about a common "core" of burnout, which manifests itself in different ways – physically, emotionally, cognitively and psychologically. Similar results have been observed in international BAT validation studies, such as those of Schaufeli *et al.* (2020a) and De Beer *et al.* (2024), which document that this particular structure remains stable in different cultural contexts.

The values of the charges (λ) presented further enhance the validity of the model. The loads of all questions in their respective dimensions range from .68 to .90 and are all statistically significant ($p < .001$). This shows that each question contributes substantially to the measurement of the dimension to which it belongs. The higher values in the dimensions of psychological and psychosomatic complaints confirm that these aspects of burnout are particularly stable and discernible in Greek teachers, while the slightly lower values in the dimensions of mental and emotional impairment are attributed to the greater complexity of these experiences, which are often influenced by personal and contextual factors (Angelini *et al.*, 2021; Sinval *et al.*, 2022).

The consistency of the results between the PLS-SEM analysis and the CB-SEM confirmation significantly enhances the validity of the Greek adaptation of the BAT. The tool proves to be reliable, stable and theoretically consistent, as its exgenerative structure remains unchanged and clearly conveys the real experience of burnout in the field of education. At the same time, the existence of the general factor G-BAT provides the possibility to calculate an overall burnout index, which can be useful for comparative or longitudinal studies.

Overall, the results show that BAT is a valid and reliable tool for measuring burnout in Greek teachers. Confirmation of its hexagenic structure via CB-SEM gives the study additional validity and allows the tool to be used for both research purposes and

practical applications, such as the early detection of teachers at risk of burnout. BAT seems to combine theoretical completeness with practical utility, offering a reliable means of understanding a problem that affects not only the teachers themselves but also the overall quality of the educational process (Schaufeli & De Witte, 2023).

6. Restrictions-Suggestions

The main limitations of the study are mainly related to the sample and the way the data is collected. Participation was voluntary and based on self-selection, which can affect representativeness, since those who are more interested in the topic may have participated more easily, a limitation, of course, that is found in all quantitative measurement tools. No repeat measurement testing was performed, so we don't know if the results remain consistent over time. Also, BAT was not compared with other established tools, such as MBI or CBI, in the same participants, in order to check the comparative validity. Based on the above limitations, further research is proposed to assess the validity and reliability of the BAT research tool. Research may be extended to higher education or other areas of education.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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