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Research article

Analysing influencing factors and correlation paths of learning burnout among secondary vocational students in the context of social media: An integrated ISM–MICMAC approach

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ABSTRACT

By analysing the factors influencing secondary vocational students' learning burnout in the context of social media, this study unearthed the underlying causes of learning burnout. It also determined the correlation paths among the factors influencing learning burnout, providing references for educational and pedagogical improvement. This contributes to preventing secondary vocational students' learning burnout and enhancing learning efficiency in secondary vocational schools. Combined with previous research results and a theoretical basis, this study identifies 10 influencing factors employing the Delphi method, and uses Interpretative Structural Modelling (ISM) and Matrice d' Impacts Croisés Multiplication Appliqués à un Classement (MICMAC) to elucidate the relationship between influencing factors of learning burnout among secondary vocational students in the context of social media. This study also constructs a corresponding mechanism model and subsequently proposes prevention and improvement strategies. The results show that the overdevelopment of social media, as driving factors, has the greatest impact on secondary vocational students' learning burnout. Simultaneously, it takes the lead in addressing cognitive bias among students, decreased self-control, and low learning efficiency, factors that contribute to learning burnout. This is particularly beneficial in alleviating the degree of learning burnout among secondary vocational students in the context of social media and improves overall learning outcomes for these students. The hierarchical structure and correlation paths identified in this study offer robust invaluable guidance for developing a scientific program to address the problem of learning burnout among this demographic. This includes implementing related educational practises, thereby reducing the unpredictability of the practical applications.

1. Introduction

As big data advances and social media platforms continue to innovate, the reach of social media is constantly expanding. In the era of new media, social media exhibits traits such as mobility, portability and intelligence, enabling users to share information and express personal views anytime and anywhere within the network environment. However, with the rapid development of media

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technology, the demands imposed by social media have escalated, particularly for secondary vocational students. These students are at a critical stage of value formation, and their growth is more susceptible to the influence of social media. Many secondary vocational students use social media excessively, resulting in addiction to it, and they exhibit a tendency to cling to their phones, while neglecting their studies. For example, they prefer to play games and browse Tiktok and Weibo on their mobile phones instead of completing course assignments. If the abuse of social media by secondary vocational students is not properly controlled, it will negatively affect their learning efficiency, leading to more serious learning burnout.

Learning burnout reflects secondary vocational students' negative psychological reaction of when confronted with the challenges of learning, and is affected by internal and external factors. It is reflected in being short of confidence when facing learning problems, and produces negative psychological effects when learning and completing school. Learning burnout is more common among secondary vocational students and mainly manifested as poor learning attitude and low learning motivation. In addition, secondary vocational students' weak learning foundation also makes it difficult for them to resist the "temptation" of social media. With the deepening of such an undesirable phenomenon, secondary vocational students possess a more negative attitude towards learning, which is reflected in indifference and weariness towards learning. Moreover, they are excessively addicted to social media and become the "slave" of it, which leads to serious learning burnout and low education quality. The growing prevalence of learning burnout among secondary vocational students contradicts the policy objectives of promoting vocational and technical education while cultivating skilled talent, thereby undermining the enduring progression of vocational education [1]. Consequently, the Ministry of Education has introduced the Action Plan for Improving the Quality and Excellence of Vocational Education (2020-2023), aiming to address the challenges of "insufficient attractiveness and low teaching quality" in secondary vocational schools. This strategy prioritizes expediting the system construction of vocational education, deepening systemic and institutional reforms, and enhancing its content and quality. An integral part of solution is to effectively prevent learning burnout among secondary vocational students, thereby improving their learning efficiency.

Both domestic and foreign research has been devoted to solving practical problems, such as students' insufficient learning engagement and poor teaching effects. Scholars also emphasise the problem of students' learning burnout. Existing research has mainly focused on the negative impact of learning burnout [2–6], the determining its influencing factors [2,7–12], and their correlation paths [13–15]. Previous study subjects have included college students [7,16–20], high school students [6,21], middle school students [2–5,15,21,22] and elementary school students [23,24]. In the age of big data and the rapid development of digitalisation, networking, and intelligent integration, scholars from both domestic and international arenas have focused their research on learning burnout within the social media environment (the results from Citespace support the view, see the Fig. A.1 and Fig. A.2 in the appendix for details), which specifically manifests as addiction to mobile phone and the internet, scholars have gradually shifted their research focuses to mobile phone-based social media, such as investigating the negative effects brought by mobile phone addiction [25–30]. Both qualitative and quantitative methods have been utilized to examine the association between mobile phone dependence, and study-weariness [19,21–23,31–37]. Through these studies, it was found that social media is penetrating the lives and studies of secondary vocational students, leading to serious learning burnout. To solve this problem, after analysing the causes of learning burnout among students of all ages, scholars have identified its influencing factors [11,12,32,33,37–41]. They attempted to restrain learning burnout by controlling specific influencing factors and confirmed that this can reduce the occurrence of learning burnout [12,24,32,33,38,41,42], and achieving certain effects in its management. However, across existing studies, the influencing factors of learning burnout were obtained from scholars' individual circumstances, which are discrete and not systematic. Therefore, the root causes of learning burnout and the impact of multiple influencing factors on it remains undetermined. Concurrently, research has confirmed that among the groups affected by social media, junior high school students accounted for the largest proportion at 25.2% [22]. However, there are few studies on secondary vocational students, who are all junior high school graduates. As our country remains committed to addressing practical challenges, such as inadequate teaching outcomes among secondary vocational students, an increasing number of scholars are focusing on the study of learning burnout among this demographic. The investigation shows that social media penetrates the lives and studies of secondary vocational students. Simultaneously, its breadth is continuing to expand. Ultimately, this will aggravate the degree secondary vocational students' learning burnout and learning weariness, which is contrary to the country's original intention to develop vocational education. Therefore, there is a need to construct a comprehensive framework for the influencing factors of learning burnout in the context of social media, with vocational school students as the research subjects. This framework can clarify the deep-seated causes of learning burnout and the correlation paths between the influencing factors. It is also helpful in examining the problem of learning burnout from a more holistic perspective to find better solutions.

Through a summary of the previous research on learning burnout among secondary vocational students in the context of social media, scholars have frequently discussed the causes, influencing factors and evaluation methods of learning burnout and have made certain progress. However, the deep-rooted causes of secondary vocational students' learning burnout in the context of social media and the correlation between its influencing factors have not been studied; therefore, an effective way to solve this problem has not yet been obtained so far. Based on previous studies, the objectives of this research can be delineated as follows:

- Extract the important factors affecting secondary vocational students' learning burnout in the context of social media through literature analysis and theDelphi method;
- Apply ISM for exploring the interrelationships between the influencing factors and establish a clear hierarchical structure;
- Validate the reasonableness of the hierarchical division through Cross-matrix multiplication analysis;
- The driving power and dependence power of each influencing factor are calculated, and a "driving power-dependence power" quadrant chart is plotted;

- Determine classification and structural relationships among the influencing factors by ISM-MICMAC;
- Provide a reference for secondary vocational schools dealing with secondary vocational students' learning burnout.

2. Literature review

The fast-paced evolution of social media has offered people convenience, but also poses potential harm. Secondary vocational students are deeply influenced by social media during their learning process, and many tend to overindulge in its use and ignore their schoolwork, which leads to lower academic performance and learning burnout. The term "learning burnout" has extended from research on job burnout, and the current research in this area has gradually matured. This study is based on a collation of the existing research, summarizing learning burnout among secondary vocational students in the context of social media, discusses its causes and influencing factors, while examining approaches to addressing secondary vocational students' learning burnout.

2.1. Research on factors contributing to learning burnout among secondary vocational students in the context of social media

Scholars have found that the main cause of secondary vocational students' learning burnout is their addiction to social media. Sun et al. investigated 2095 Chinese secondary school students and discovered a notable and positive correlation between adolescent social media addiction and learning burnout [43]. Social media addiction is mainly associated with internet addiction [44] and smartphone addiction [45,46]. During the period of maintaining social distance, there has been a sharp increase in the usage of electronic devices. According to Meng et al., the worldwide combined prevalence rates were 26.99% for smartphone addiction and 14.22% for internet addiction [47]. Because of these objective conditions, student education is increasingly dependent on social media. While some secondary vocational students enjoy the convenience for learning facilitated by the rapid development of social media, others overuse it and neglect their studies, which causes learning burnout. In addition, the popularity of social media also interferes with the judgment of secondary vocational students, making it difficult for them to resist the temptation of it, thus affecting their learning enthusiasm. Ji posited that social overload is the main cause of learning burnout among secondary vocational students. As a result of excessive social media usage, this demographic experience social anxiety and must use social media to maintain existing relationships. In this process, a contradiction exists between limited energy and social overload, which results in low learning engagement and burnout [48]. Zhang et al. considered that the functional and social overload of social media are the main causes of learning burnout among secondary vocational students, and proposed that they should have a clear cognition of this element of social media. Zhang stressed that secondary vocational school students should use social media in moderation; otherwise, it exacerbates their learning burnout due to social overload [49]. Dhir et al. proposed that the reason why secondary vocational students suffer from learning burnout is that when they used social media, they are inundated with a large amount of information, making them lose their information judgment and blindly pursue the stimulation facilitated by information explosion [50]. In addition, the selective anxiety proposed by Liu et al. is identified as one of the potential contributors to learning burnout among secondary vocational students [51].

2.2. Research on the influencing factors of learning burnout among secondary vocational students in the context of social media

Amid widespread social media usage, social media's platform environment and secondary vocational students' personal factors affect the generation of emotional exhaustion and negative learning actions. Jiang further verified the negative impact of low spirit on the learning process of secondary vocational students, stating that depression is closely related to low personal achievement and has the greatest impact on learning burnout [52]. Rehman et al. focused on the impact of learning motivation on learning burnout, believing that the excessive use of social media by secondary vocational students reduces their learning motivation. Correspondingly, the lower the motivation and interest in learning, the more serious the learning burnout [53]. Akanni et al. found no connection between individual intelligence and learning burnout, and noted that if secondary vocational students over-rely on the convenience facilitated by social media, learning burnout will be more serious regardless of how high their IQ is, as it reduces their enthusiasm for learning [54]. Chen et al. believed that high learning engagement and positive attitudes towards learning can decrease the negative effect of learning burnout among secondary vocational students to some extent, and the reasonable use of social media can also stimulate their enthusiasm for learning, strengthen their sense of self-efficacy, and achieve an ideal learning effect [55,56]. Xiang et al. argued that it is necessary to cultivate appropriate learning motivation and increase students' participation in learning. This can reduce their learning burnout while also contributing to shaping their personal growth. Students' individual growth initiative can indirectly reduce learning burnout by regulating learning motivation [57]. Lian et al. found that excessive addiction to social media among secondary vocational students can lead to fatigue, apathy, anxiety and other negative behaviours, which has seriously affected them physically and mentally, leading to the deeper learning burnout [58]. Rufino et al. noted that schools must support to minimise the consequences of burnout due to the outbreak of COVID-19, which has caused an increase in stress factors during online teaching and learning. This situation exposed students to a heightened risk of learning burnout [59].

2.3. Research on the assessment method of learning burnout among secondary vocational students in the context of social media

Scholars have analysed learning burnout among secondary vocational students using different perspectives and methods. Zhang focused on the relevance between academic procrastination and learning burnout from the perspective of the psychological control source of secondary vocational students, involving 414 students as research subjects. He designed questionnaires to investigate four

aspects: emotional exhaustion, physical exhaustion, low learning efficiency, and the alienation between teachers and students. He subsequently used SPSS26.0 to conduct a quantitative analysis to examine the hypotheses addressed above. It has been determined that with the advancement of social media, continual psychological intervention is essential for secondary vocational students to alleviate the occurrence of learning burnout [60]. Chang conducted a thorough examination of the diminished enthusiasm for learning and limited practical opportunities among secondary vocational school students, viewing it through the lens of positive psychology, and developed corresponding intervention strategies combined with the educational intervention of positive psychology. Finally, Chang proposed that the collaborative mechanism of education should be optimised from the perspective of positive psychology to create conditions for effectively solving the problem of learning burnout [61]. Chen conducted a questionnaire survey among 1200 secondary vocational students and concluded learning burnout occurs not only because of students' personal reasons, but also due to family reasons and problems at school. Based on this, Chen advocated that concrete solutions should consider different degrees of learning burnout among secondary vocational students, to promote their overall development [62].

2.4. Research gaps

By analysing the research status of secondary vocational students' learning burnout in the context of social media, it was found that previous studies have identified some influencing factors. Furthermore, quantitative analysis methods have been used to measure the relationships between negative academic performance and learning burnout, along with theoretical simulations on how to dampen the occurrence of learning burnout by controlling the influencing factors. Building upon this foundation, this paper plans to further research the following aspects.

(1) Identify the factors that influence learning burnout among secondary vocational students within the context of social media. Although some scholars have determined factors influencing learning burnout considering social media, their applicability to secondary vocational students remains to be verified. In addition, these influencing factors are discrete and not systematic, which is not conducive to studying the simultaneous impact of multiple influencing factors on learning burnout. Therefore, it is necessary to adopt the Delphi method to establish a universal framework for the influencing factors of learning burnout among secondary vocational students in the context of social media. This approach is helpful in viewing the problem of learning burnout from a holistic perspective and seeking better solutions.

(2) Clarify the hierarchical structure of influencing factors contributing to learning burnout among secondary vocational students within the context of social media. Drawing from the established framework for learning burnout among secondary vocational students, this study subdivided it into three layers. This segmentation aims to uncover the underlying causes of learning burnout while also understanding the dynamic changes in learning burnout by observing the influencing factors at the direct layer. This approach enables a focus on solving major problems, enhancing the effectiveness of managing learning burnout, and allowing swift countermeasures when problems occur. Simultaneously, the existence of influencing factors in the intermediate layer provides insights into studying the indirect relationships between these factors. This exploration serves to maximise the effectiveness of governing learning burnout. Therefore, it is important to determine the hierarchical structure of the influencing factors affecting learning burnout in secondary vocational students through appropriate methods, which is helpful for deeply analysing and decomposing them.

(3) Analyse the correlation paths among the influencing factors of learning burnout among secondary vocational students within the context of social media. After determining the hierarchical structure of the influencing factors, it is necessary to further classify the functional routes and relationships between the influencing factors at each layer. This classification aims to show the direct and indirect correlation paths. This paper provides a theoretical direction for the effective management of learning burnout, combined with the hierarchical structure and correlation paths, through a joint effort in controlling the influencing factors of the root layer, regulating the influencing factors of the intermediate layer, and observing the influencing factors of the direct layer. This reduces the blindness of educational practises.

3. Research methodology

In this study, the research methodology consists of three stages, as depicted in Fig. 1. Initially, the literature review and Delphi method were utilized to identify influencing factors of learning burnout among secondary vocational students within the social media context, constructing a framework for follow-up study. Subsequently, questionnaire survey and ISM were employed to assess the influencing factors and construct a hierarchical model. Finally, the MICMAC was applied to validate the model, categorize influencing factors by determining their driving and dependence power, and analyze the correlation paths between these factors.

3.1. Stage 1 – identifying influencing factors

A literature review and the Delphi method were both used to identify the influencing factors of learning burnout among our chosen demographic in a social media context. This study conducted a comprehensive review of both domestic and international research on learning burnout among secondary vocational students in the context of social media. Various databases, including the China National Knowledge Infrastructure (CNKI), Science Citation Index Expanded (SCIE), and Social Science Citation Index (SSCI), were used for the literature review. The search was conducted using keywords such as "Social media background", "learning burnout", "Secondary vocational students", and "Secondary vocational students' learning burnout". The method was as follows: (1) The time range for the search spanned 2006 to 2023, with a focus on journal articles. Irrelevant studies were excluded. The initial search resulted in 113 English and 419 Chinese articles. (2) Specific criteria were applied to select a set of 86 exemplary sample articles.

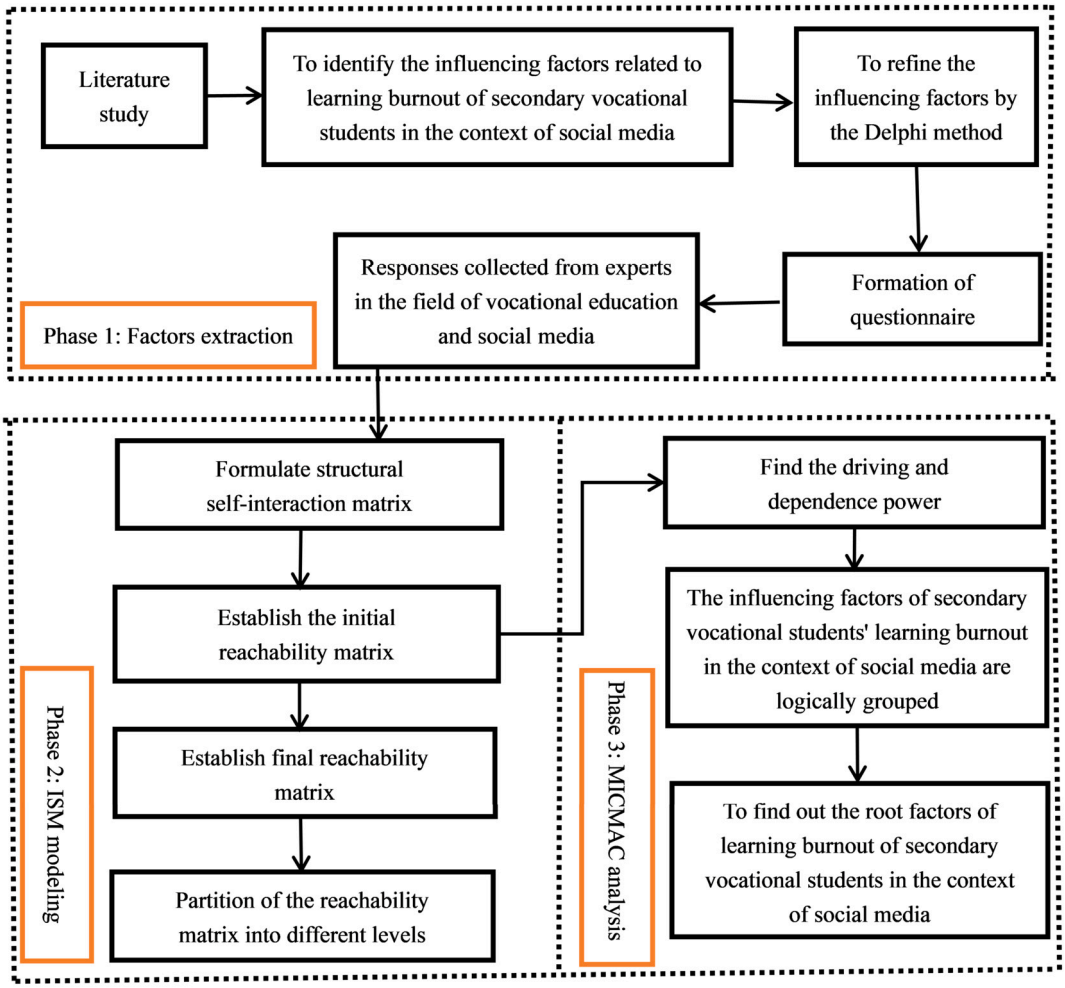

Fig. 1. Research methodology.

These included articles highly relevant to the topic, recently published, and whit high citation counts and authority. The selected sample consisted of 22 English and 64 Chinese articles. (3) The influencing factors that appeared twice or more in the references were extracted to form a preliminary list. Subsequently, two senior educational experts were invited to carry out preliminary evaluation on the initial list's scientific rigour and rationality. Factors with similar meanings were the merged. (4)Influencing factors were refined using the Delphi method. Three social media experts and six vocational education researchers performed preliminary screening and review of the identified factors. The experts had over 10 years' experience in the industry, possessed the title of deputy senior or above, and extensive theoretical teaching and practical experience in secondary vocational education [63]. The screening criteria of the influencing factors were as follows: mean assignment of importance greater than or equal to 3.50, coefficient of variation less than or equal to 0.25, and an expert approval rating (the selectivity of greater than or equal to 4 points) greater than or equal to 75% [64]. Following two rounds of consultation, 10 influencing factors were determined by combining the field research conducted in vocational colleges and the experts' opinions [65]. Table 1 presents the identified influencing factors. Two factors were eliminated based on the motivation and characteristics of secondary vocational students' learning burnout in the context of social media as well as field research conducted in vocational colleges.

3.2. Stage 2 – interpretive structural modelling

Warfield introduced the philosophical foundation of Interpretative Structural Modeling (ISM), which includes its conceptual framework and analytical details [66,67]. ISM proves to be a potent method for discerning multiple subsystems within intricate systems and facilitates the construction of a multi-layered structural model [68]. This approach addresses the shortcomings and challenges encountered in traditional methods like weighted score and structural equation modelling, and provides a better understanding of system behaviour. For example, ISM can be utilized to identify and comprehend the interrelationships and hierarchical structure among various elements within complex systems. [63]. By utilizing ISM, we stratify and grade the influencing factors,

Table 1
Influencing factors of secondary vocational students' learning burnout in the context of social media.

Variable	Influencing Factor	Description	Literature Source
S_1	Over development of social media	In the era of big data, there are many kinds of social media apps with great innovation.	[21] [48] [49] [50] [51] [53] [74] [75] [76]
S_2	Information overload	The information received by an individual or system exceeds the scope of its effective processing and management.	[11] [50] [51] [53] [63] [74] [75] [76]
S_3	Function overload	Social media provides more functions than users need.	[11] [21] [35] [48] [49] [53] [74] [75] [76]
S_4	Social overload	The combination of online socialising with real life interpersonal communication creates a drain on time and energy that secondary vocational students cannot cope with.	[11] [27] [48] [49] [53] [63] [74] [75] [76]
S_5	Selective anxiety of students	When faced with a large amount of information, students tend to be confused when making choices.	[11] [21] [50] [51] [63]
S_6	Proliferation of learning software	With the continuous development of technology, learning software is also increasing and improving.	[11] [49] [51]
S_7	Frequent interpersonal interaction	Secondary vocational students' way of socialising is also changing from offline to online.	[11] [26] [27] [35] [48] [49]
S_8	Cognitive bias of students	Secondary vocational students are not clear about their goals and life orientation.	[9] [10] [11] [12] [15] [16] [28] [29]
S_9	Decreased self-control	While studying, secondary vocational students are easily distracted by games, etc.	[12] [32] [33] [34] [38] [39] [40] [54] [55] [56] [57] [61] [62]
S_{10}	Low learning efficiency	Secondary vocational students can not master efficient learning strategies. They study with double efforts but receive half the achievement.	[32] [33] [37] [38] [41] [57] [58] [60]

which are characterized by numerous variables and complex structural relationships, facilitating a comprehensive investigation into the factors contributing to learning burnout among secondary vocational students.

Step 1. Questionnaire survey. To ensure impartiality in establishing relationships between the influencing factors, a questionnaire was emailed to 106 experts in the fields of vocational education and the media industry between June and September 2022. The sample data were collected through a combination of online survey submissions and offline delivery. The experts' responses collected and averaged to produce the final responses, which were then employed to delineate the contextual relationships between the influencing factors by constructing a Structural Self-Interaction Matrix (SSIM) [69]. Using V, A, X, O to represent the directions of variables (i, j):

V: S_i contributes to achieving S_j;
A: S_j contributes to achieving S_i;
X: S_i and S_j contributes to achieving each other;
O: S_i and S_j are irrelevant.

Step 2. Establish an IRM. The second stage of ISM involves transforming the SSIM into an Initial Reachability Matrix (IRM) by substituting matrix entries with binary digits [70]. This conversion from SSIM to IRM adheres to the following principles:

- When represented by the V symbol, it is advisable to switch the values of i and j to 1, and values of j and i to 0.
- When represented by the A symbol, it is advisable to switch the values of i and j to 1, and values of j and i to 0.
- When represented by the X symbol, it is advisable to switch the values of i and j to 1, and values of j and i to 0.
- When represented by the O symbol, it is advisable to switch the values of i and j to 1, and values of j and i to 0.

Step 3. Construct an FRM. In this step, transform the IRM into the Final Reachability Matrix (FRM). According to the transitivity rule, if there exists a relationship between X and Y, and another between Y and Z, then a relationship should also be inferred between X and Z [69,71,72]. FRM eliminates logical gaps identified after expert scoring by incorporating the "1*" entry into IRM.

Step 4. Hierarchical decomposition of FRM. After decomposing the FRM, several sets are obtained. The set of influencing factors, where the matrix element is 1 in the row corresponding to the influencing factor S_i, is defined as the reachability set,

denoted as $R(S_i)$. The $R(S_i)$, for a specific influencing factor S_i consists of S_i itself and any other factors that S_i contributes to achieving [63]. The set of influencing factors, where the matrix element is 1 in the column corresponding to the influencing factor S_i, is defined as the antecedent set, denoted as $A(S_i)$. The $A(S_i)$, for a specific influencing factor S_i consists of S_i itself and any other factors that contribute to achieving S_i [69]. The intersection $R(S_i) \bigcap A(S_i)$ is denoted by $I(S_i)$. If the $R(S_i)$, and the $I(S_i)$, for a specific influencing factor were found to be identical, then that factor was deemed to be at level 1 and placed at the apex of the ISM hierarchy [70]. After identifying the factors at the initial level, ignore those influencing factors and proceed with the same way to identify influencing factors at subsequent levels. Repeat this iterative process until all elements have been allocated to their respective levels of the ISM hierarchy. Following this, we categorized factors into distinct logical groups using MICMAC, taking into account their interrelations with other factors.

3.3. Stage 3 – application of MICMAC analysis to factor classification

Validating the rationality of the hierarchical decomposition of influencing factors affecting secondary vocational students' learning burnout in the context of social media, the MICMAC analysis was utilised. This method relies on the principle of matrix multiplication to ascertain how variables interact with each other by analyzing the interactive relationship among different subsystems within a complex system [68]. This was achieved by evaluating the dependence power and driving power of each variable, which were obtained from the final reachability matrix. Through MICMAC analysis, four potential outcomes were identified: weak or strong dependence power, as well as weak or strong driving power. These were determined through the following steps.

Step 1. Calculate the driving and dependence power. Driving power refers to the extent to which one factor influences others. As driving power increases, the impact of the influencing factor on other factors also amplifies. Conversely, dependence power signifies the degree to which other factors influence a particular factor. A higher level of dependence indicates a greater reliance of the influencing factor on other factors [72]. Based on the final reachability matrix, the number of influencing factors with matrix elements equal to 1 in the row corresponding to influencing factor S_i represents the magnitude of the driving power, whereas the number of influencing factors with matrix elements equal to 1 in the column signifies the magnitude of the dependence power. These results can be represented using a Cartesian coordinate system, where the x-axis represents dependence power and the y-axis represents driving power.

Step 2. Establish the four quadrants for categorizing influencing factors. The influencing factors were categorized into four quadrants based on their driving and dependence powers [69]. Quadrant names and their detailed descriptions are as follows:

First Quadrant – Linkage Factors. Characteristic: High driving and dependence power. Detailed description: Akin to dependent variables, they are inherently unstable, and any change in them can affect other factors and produce a feedback loop, influencing themselves in return.

Second Quadrant – Driving Factors. Characteristic: Low dependence power but high driving power. Detailed description: Also known as critical factors, changes in these factors can profoundly impact other variables and the entire system.

Third Quadrant – Autonomous Factors. Characteristic: Low driving and dependence power. Detailed description: Exerting a relatively minor influence on the overall system, entities situated in the intermediate layer, they play a crucial role in mediating relationships between factors, affecting those in the preceding layer while being constrained by factors in the subsequent layer [69].

Forth Quadrant – Dependent Factors. Characteristic: Low driving power but high dependence power. Detailed description: They are susceptible to the influence of other factors and reliant on them for problem solving.

Step 3. Create a quadrant diagram illustrating "driving power and dependence power". According to the obtained results, identify the primary factors influencing learning burnout among secondary vocational students within the context of social media.

4. Results

4.1. Interpretive structural modelling

Step 1. Establishing mutual relationships among influencing factors using SSIM. Finally, 92 meaningful responses were collected from 106 questionnaires for further analysis. Regarding gender, 36.96% were men, and 63.04% were women. In terms of educational background, 31.52% held bachelor's degrees, 57.61% held master's degrees, and 10.87% held doctoral degrees. Regarding professional experience, 8.70% had 5-10 years of work experience, while 11-15 years and 16-20 years were represented by 42.39% and 39.13%, respectively. Furthermore, 9.78% possessed over 20 years of work experience. 13 survey respondents were highly professional, 36 of them were sub-advanced, and 43 were medium-grade professionals. Table 2 displays the SSIM, which was formulated based on expert opinions. Using A, V, O, and X represents the correlations among the factors affecting learning burnout among secondary vocational students in the context of social media. Data provided by experts revealed that S_1 (over development of social media) contributed to S_2 (information overload), denoted by "V". Similarly, S_5 (selective anxiety of students) contributed to S_6 (proliferation of learning software), marked by "A". Additionally, S_1 (over development of social media) and S_{10} (low learning efficiency) were deemed unrelated, marked by "O", while S_2 (information overload) and S_3 (function overload) mutually influenced each other, indicated by "X". Finally, (S_1, S_2), (S_1, S_3), (S_1, S_4), (S_1, S_5), (S_1, S_6), (S_1, S_7), (S_2, S_5), (S_2, S_6), (S_2, S_7), (S_2, S_8), (S_3, S_5), (S_3, S_6), (S_3, S_7), (S_3, S_9), (S_4, S_5), (S_4, S_7), (S_4, S_8), (S_5, S_8), (S_6, S_7), (S_6, S_8), (S_7, S_8), (S_7, S_9), (S_7, S_{10}), and (S_8, S_9) were marked "V"; (S_2, S_3), (S_2, S_4), (S_3, S_4), (S_8, S_{10}), and (S_9, S_{10}) were marked "X"; and (S_5, S_6) was marked "A". The rest were labelled "O".

Table 2
Structural self-interaction matrix.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
S_1	—	V	V	V	V	V	V	O	O	O
S_2		—	X	X	V	V	V	V	O	O
S_3			—	X	V	V	V	O	V	O
S_4				—	V	O	V	V	O	O
S_5					—	A	O	V	O	O
S_6						—	V	V	O	O
S_7							—	V	V	V
S_8								—	V	X
S_9									—	X
S_{10}										—

Table 3
Initial reachability matrix.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
S_1	1	1	1	1	1	1	1	0	0	0
S_2	0	1	1	1	1	1	1	1	0	0
S_3	0	1	1	1	1	1	1	0	1	0
S_4	0	1	1	1	1	0	1	1	0	0
S_5	0	0	0	0	1	0	0	1	0	0
S_6	0	0	0	0	1	1	1	1	0	0
S_7	0	0	0	0	0	0	1	1	1	1
S_8	0	0	0	0	0	0	0	1	1	1
S_9	0	0	0	0	0	0	0	0	1	1
S_{10}	0	0	0	0	0	0	0	1	1	1

Table 4
Final reachability matrix.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	Driving power
S_1	1	1	1	1	1	1	1	1*	1*	1*	10
S_2	0	1	1	1	1	1	1	1	1*	1*	9
S_3	0	1	1	1	1	1	1	1*	1	1*	9
S_4	0	1	1	1	1	1*	1	1	1*	1*	9
S_5	0	0	0	0	1	0	0	1	1*	1*	4
S_6	0	0	0	0	1	1	1	1	1*	1*	6
S_7	0	0	0	0	0	0	1	1	1	1	4
S_8	0	0	0	0	0	0	0	1	1	1	3
S_9	0	0	0	0	0	0	0	1*	1	1	3
S_{10}	0	0	0	0	0	0	0	1	1	1	3
Dependence power	1	4	4	4	6	5	6	10	10	10	

Step 2. Converting SSIM to IRM. Due to the extensive volume of data, computer-assisted arrangements and subsequent computations were conducted to convert the symbols utilized in SSIM into numerical values recognizable by the computer. Following the transitivity rule outlined in the Research Methodology section, SSIM was converted into ISM using binary digits, represented by 0 and 1. For instance, if the SSIM indicates a relationship of "V" for (S_1, S_2), the corresponding entry in the IRM is "1", while the reverse relation (S_2, S_1) is represented as "0". Conversely, if the SSIM shows an association of "A" for (S_5, S_6), the IRM entry for (S_5, S_6) would be "0", and for (S_6, S_5) it would be "1". Similarly, if the SSIM entry for (S_1, S_{10}) is "O", the corresponding IRM entry is "0", with the reciprocal entry (S_{10}, S_1) also being "0". If the SSIM denotes "X" for (S_2, S_3), the IRM entry for (S_2, S_3) would be "1", while (S_3, S_2) would also be "1". Table 3 displays the IRM obtained after conversion.

Step 3. Deriving FRM from IRM. IRM depicts the direct relationships among the factors influencing students' learning burnout within the context of social media. However, to discern the indirect relationships, one must apply the transitivity principle outlined in the Methodology section. This entails conducting correlation analysis for factors with a value of "0" in IRM. For instance, the experts concluded that there was no direct relationship between S_1 and S_8. However, since S_1 was linked to S_2 and S_2 was associated with S_8, it follows that a corresponding relationship should exist between S_1 and S_8. Thus, according to the conversion rules, "(S_1, S_8)" was amended to "1*". Finally, IRM was transformed intoFRM using strict logic. Table 4 describes the FRM formed by checking transitivity.

Table 5
Hierarchical decomposition of the FRM.

S_i	$R(S_i)$	$A(S_i)$	$I(S_i)$	Levels
S_1	1,2,3,4,5,6,7,8,9,10	1	1	
S_2	2,3,4,5,6,7,8,9,10	1,2,3,4	2,3,4	
S_3	2,3,4,5,6,7,8,9,10	1,2,3,4	2,3,4	
S_4	2,3,4,5,6,7,8,9,10	1,2,3,4	2,3,4	
S_5	5,8,9,10	1,2,3,4,5,6	5	Level1 = $\{S_8, S_9, S_{10}\}$
S_6	5,6,7,8,9,10	1,2,3,4,6	6	
S_7	7,8,9,10	1,2,3,4,6,7	7	
S_8	8,9,10	1,2,3,4,5,6,7,8,9,10	8,9,10	
S_9	8,9,10	1,2,3,4,5,6,7,8,9,10	8,9,10	
S_{10}	8,9,10	1,2,3,4,5,6,7,8,9,10	8,9,10	
S_1	1,2,3,4,5,6,7	1	1	
S_2	2,3,4,5,6,7	1,2,3,4	2,3,4	
S_3	2,3,4,5,6,7	1,2,3,4	2,3,4	
S_4	2,3,4,5,6,7	1,2,3,4	2,3,4	Level2 = $\{S_5, S_7\}$
S_5	5	1,2,3,4,5,6	6	
S_6	5,6,7	1,2,3,4,6	6	
S_7	7	1,2,3,4,6,7	7	
S_1	1,2,3,4,6	1	1	
S_2	2,3,4,6	1,2,3,4	2,3,4	
S_3	2,3,4,6	1,2,3,4	2,3,4	Level3 = $\{S_6\}$
S_4	2,3,4,6	1,2,3,4	2,3,4	
S_6	6	1,2,3,4,6	6	
S_1	1,2,3,4	1	1	
S_2	2,3,4	1,2,3,4	2,3,4	Level4 = $\{S_2, S_3, S_4\}$
S_3	2,3,4	1,2,3,4	2,3,4	
S_4	2,3,4	1,2,3,4	2,3,4	
S_1	1	1	1	Level5 = $\{S_1\}$

Step 4. Partitioning FRM into distinct levels. During this phase, the hierarchical structure of the factors influencing learning burnout was primarily established by using ISM. Based on the condition of $A(S_i) = R(S_i) \bigcap Q(S_i) = R(S_i)$, the influencing factors were classified at different levels. The hierarchical structure is as follows: Level1 = S_8, S_9, S_{10}, Level2 = S_5, S_7, Level3 = S_6, Level4 = S_2, S_3, S_4, Level5 = S_1. In the social media context, the reachability set $R(S_i)$, antecedent set $A(S_i)$, intersection $I(S_i)$ and level partitions of secondary vocational students' learning burnout are listed in Table 5.

Step 5. Analysing ISM modelling. Following the hierarchical decomposition results, influencing factors exhibiting correlation relationships were intricately interconnected to represent their mutual influence. Then the ISM modelling could be constructed, as depicted in Fig. 2. ISM serves as a visual representation of the influencing factors affecting learning burnout among secondary vocational students under the background of social media, showcasing the hierarchical positioning of each factor. The ISM model in this study is structured into five levels, spanning a total of three layers.

Level1 is the direct layer, signifying the direct factor affecting learning burnout among secondary vocational students. This includes factors such as cognitive bias of students (S_8), decreased self-control (S_9), and low learning efficiency (S_{10}). Level2 and Level3 are the intermediate layers, that play mediating roles in the whole ISM modelling. The elements in these intermediate layers are both influencing and affecting factors, including the selective anxiety of students (S_5), proliferation of learning software (S_6), and frequent interpersonal interaction (S_7). Level4 and Level5 are the root layers, which are the fundamental factors leading to learning burnout among secondary vocational students in the context of social media. These factors include the overdevelopment of social media (S_1), information overload (S_2), function overload (S_3), and social overload (S_4).

The conduction in the ISM modelling starts with the overdevelopment of social media, and reveals the relationship between secondary vocational students' learning input and learning outcomes. The overdevelopment of social media, information overload, social overload, and function overload affect the improvement of learning burnout, whereas self-cognitive bias, decreased self-control and low learning efficiency directly affect the degree of learning burnout among secondary vocational students.

4.2. MICMAC analysis

By calculating the number of influencing factors in a row and column of the reachability matrix with matrix elements "1" and "1*", the value of driving power and dependence power of the influencing factors of learning burnout among secondary vocational students in the context of social media were obtained, as shown in Table 6. These values were used as coordinates to fill in the MICMAC analysis quadrant diagram, dividing it into four quadrants: linkage, driving, autonomous, and dependent, as illustrated in

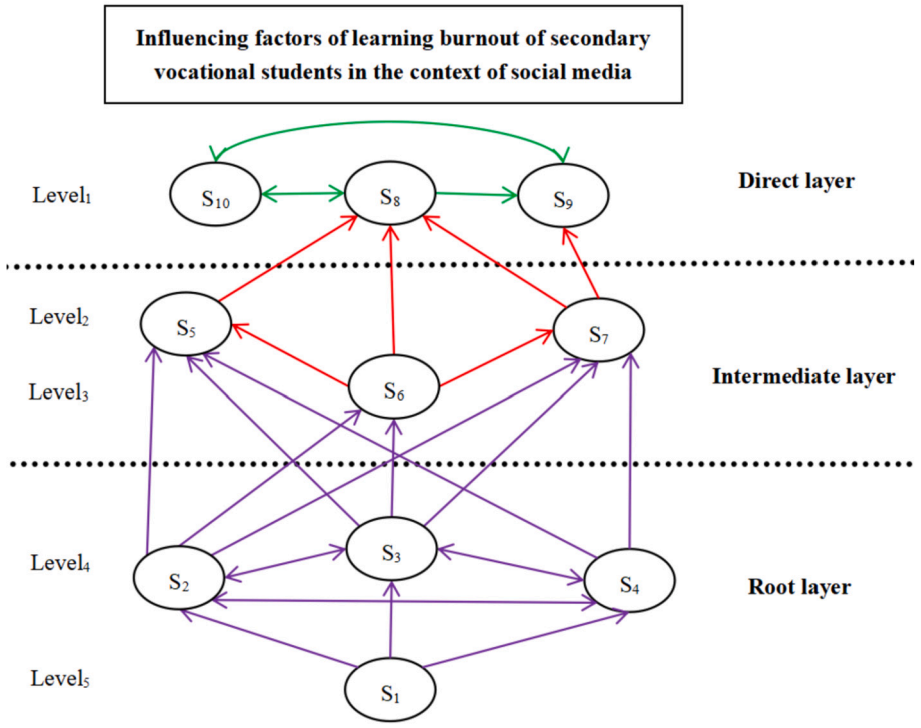

Fig. 2. ISM modelling.

Table 6
Numerical value of driving power and dependence power.

Factors	Driving power	Dependence power
S_1	10	1
S_2	9	4
S_3	9	4
S_4	9	4
S_5	4	6
S_6	6	5
S_7	4	6
S_8	3	10
S_9	3	10
S_{10}	3	10

Fig. 3 [69]. S_8, S_9 and S_{10} were identified as dependent factors, S_5, S_6 and S_7 were identified as autonomous factors, and S_1, S_2, S_3 and S_4 were identified as driving factors.

5. Discussion of findings

To examine the interrelationships among the influencing factors, combining the ISM model with the MICMAC analysis for effective joint validation.

Linkage factors. There were no influencing factors in Quadrant I. This suggests that the factors influencing learning burnout among secondary vocational students in the context of social media demonstrate a high level of independence. The absence of factors in this quadrant indicates good system stability and clear associations among the factors [63].

Driving factors. The influencing factors in Quadrant II are S_1, S_2, S_3, and S_4. These factors exhibit low dependence power but high driving power. They are also called critical factors because any changes in these factors can significantly impact other factors and the entire system. These factors belong to Levels 4 and 5. The driving power of the influencing factors at Level 4 is nine with a dependence power is four, while the driving power of the influencing factors at Level 5 is ten with a dependence power is one.

The rapid expansion of social media has offered people a platform for communication, sharing, and interaction, as well as convenience and endless possibilities. However, this rapid growth has created a significant contradiction between the expansion of social media and the actual needs of users. The proliferation of social media has resulted in information, functional, and social overload [53], which has significantly disrupted the judgment of secondary vocational students regarding its usage. The overwhelming influx

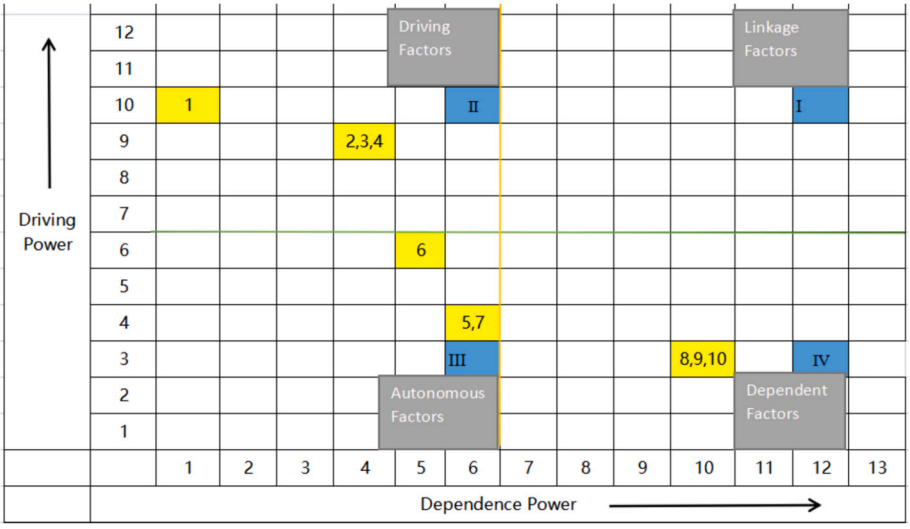

Fig. 3. The "driving power-dependence power" quadrant diagram.

of content burdens the usage of social media by secondary vocational students. Their long-term use of social media causes problems such as inattention and poor sleep quality, ultimately resulting in learning burnout [73,74]. Furthermore, information, functional, and social overload have become significant obstacles to the progress of secondary vocational students' learning [75,76]. The various forms of overload make it increasingly difficult for students to resist the temptations of social media, further exacerbating the issue of learning burnout [49,53]. Additionally, the rapid development of big data has provided a high-level platform for social media' expansion. Various platforms and companies, driven by their own growth, engage in excessive development, allowing people to enjoy the convenience provided by social media in their lives [74,75]. However, this inadvertently contributes to the continuous growth and stimulation of social media, further entangling individuals with the vortex of excessive social media usage [11]. One of the fundamental reasons for the transition of secondary vocational school students from positive emotions to negative emotions, leading to learning burnout, is the excessive development of social media. Furthermore, information, function, and social overload are interconnected, and changes in one of these factors can impact the others. For example, when information overload occurs, social media platforms, in order to attract users, will inevitably classify information and introduce different functions. The abundance of information and diverse functions ultimately lead to function overload, interfering with user's normal lives and triggering learning burnout.If the phenomenon of excessive social media usage can be effectively controlled and if social communication, information dissemination and other internet-based activities develop rationally, it is expected to reduce the dependency of secondary vocational students on social media use [11,21,27]. Therefore, it is crucial to prioritise these four influencing factors, eliminate learning burnout at the root, and indirectly influence other factors through the transmission paths identified in ISM.

Autonomous factors. The influencing factors in Quadrant III are S_5, S_6, and S_7. These factors have weak driving and dependence powers and exert a relatively small impact on the entire system. These factors are located in the middle layer. They can affect the factors in the previous layers while also being restricted by the factors in the next layer [63]. These factors belong to Levels 2 and 3. The driving power of the influencing factors at Level 2 is four and the dependence power is six. The driving power of the influencing factors at Level 3 is six and the dependence power is five.

The occurrence of information, function, and social overload [53] directly trigger the proliferation of learning software, selective anxiety among students, and frequent interpersonal interaction [11,74,75]. Social media systems have reached a relatively mature stage, encompassing various aspects of the lives and studies of secondary vocational students. The abundance of content available on these platforms poses decision-making challenges. As secondary vocational students' discernment ability continues to develop, their judgments may lack objectivity. When faced with difficulties in selecting relevant content for their learning process through social media, they may struggle to identify materials that are beneficial to their learning, resulting in negative psychological factors such as confusion and anxiety [77]. The continuous advancement of internet technology has contributed to the ongoing improvement of social media functions, leading to the emergence of various learning software and excessive internet use that disrupts the normal usage of social media. While the proliferation of learning software provides more choices for learning, students often face difficulties selecting the most suitable options due to limited energy [51,78]. Consequently, software development companies' excessive focus on profit rather than ensuring the suitability of their products for students' learning can lead to the emergence of learning burnout behaviour centred around such software. Furthermore, social media has become the primary platform for daily communication and maintaining interpersonal relationships among secondary vocational students. Consequently, students frequently rely on social media to deepen and sustain existing social connections through activities such as liking posts and engaging in interactive spaces [11,49,79]. The extensive use of social media occupies a significant amount of time, ultimately leading to a decline in students' learning state. The frequency and depth of social media interactions have gradually intensified learning burnout among secondary vocational students. Ensuring that secondary vocational students reduce selective anxiety in the learning process and concentrate on learning will help

them save time, improve their learning efficiency, and reduce the degree of learning burnout [19,26,27]. Therefore, leveraging the mediating effect of the influencing factors in the intermediate layer is conducive to transforming negative emotions into positive emotions and reducing the likelihood of learning burnout.

Dependent factors. The influencing factors in Quadrant IV are S_8, S_9, and S_{10}. These factors tend to have weaker driving power but stronger dependence power; as a result, they are more vulnerable to the influence of other factors and often rely on them to address issues or challenges. These factors belong to Level 1. The driving power of the influencing factors at Level 1 is three and the dependence power is ten.

The proliferation of learning software, aggravation of students' selective anxiety, and frequent interpersonal interaction consume a significant amount of time for secondary vocational students. However, due to limited energy, students can only grasp and use a few social media platforms. Thus, their thoughts and behaviours are highly likely to be influenced by the remarks and content published on these platforms, leading to cognitive biases [12]. The rapid development of social media has created a negative atmosphere that gradually misleads the secondary vocational students' learning [79]. Many students have become impetuous and deeply immersed in the trends set by social media [12,80]. They start believing that studying cannot improve their current situation and feel uncertain about their future prospects. As social media further penetrates their lives, deviations in secondary vocational students' learning concepts intensify, eventually resulting in a severe problem of learning burnout [32,40,81]. The abundance of information on social media, coupled with the lack of clear review and admission mechanisms, presents a significant temptation for students with weak knowledge foundations and poor study habits [61,62,82]. As social media continues to infiltrate, their sense of autonomy erodes [12,83], and their ability to exercise self-control weakens. When self-control reaches a point where it can no longer meet students' learning needs, they tend to reduce or divert their learning efforts, leading to learning burnout [51,57]. Furthermore, the powerful features of social media strongly appeal to secondary vocational students, who often rely on it during the learning process, such as searching for answers or excessively indulging on social media [11,84]. This occupies valuable study time and results in low learning efficiency and unsatisfactory academic performance. Prolonged poor learning outcomes create ongoing mental strain in secondary vocational students, exacerbating their level of learning burnout [85]. For example, in China, the majority of parents hold a negative perception of secondary vocational education, and it is generally believed that only students who do not perform well choose to attend these schools. Secondary vocational students are often synonymous with "poor students". This is precisely because of the cognitive deviation that secondary vocational schools and students generally face, such as poor learning atmosphere and low academic performance [37,41]. For these reasons, secondary vocational students receive half the results with twice the effort in their learning, further deepening their cognitive bias [33,54–56]. They make the mistake of thinking that learning is of little use to them, which leads to a further decline in self-control [37,51]. They are easily seduced and misled by social media [26,27], leading to more serious learning burnout.

Based on the characteristics of the influencing factors in this quadrant, the positive development of any factor in the root and the intermediate layers will directly guide the positive development of key factors. Thus, to improve the learning burnout of secondary vocational students in the context of social media, we can strengthen the positive influence of these direct factors through the positive management of key and fundamental factors. More importantly, specific factors in the direct layer can be detected easily. Investigating and analysing the learning state and emotional performance of secondary vocational students to measure their level of learning burnout can effectively prevent problems regarding learning and improve effectiveness of addressing learning burnout [41,86].

This study utilized the ISM model to establish a hierarchical structure of factors influencing learning burnout among secondary vocational students in the context of social media. Then, by using the MICMAC method, the driving and dependence powers of these factors were computed and categorized into four groups, and the characteristics and roles of these four factors were elucidated, validating the rationality of the ISM hierarchy. The analysis of the interrelations between factors revealed the pathways and mechanisms through which they interact, ultimately determining the relevant pathways for secondary vocational students to avoid learning burnout. The driving power and dependence power calculations helped identify the root causes of learning burnout. Based on the obtained hierarchical structure and correlation paths, learning burnout among secondary vocational students can be effectively solved from the root by observing the dynamic changes in influencing factors at the surface level, developing scientific management plans for these factors at the root level, and simultaneously adjusting them at the middle level through multilevel collaborative efforts. These measures can solve the problem of learning burnout and improve students' learning efficiency. The hierarchical structure and interrelationships among influencing factors derived from this study offer valuable guidance for effectively alleviating learning burnout among secondary vocational students. This provides reference for the follow-up research.

6. Conclusion, limitations and future research agenda

This paper extracts 10 influencing factors of learning burnout among secondary vocational school students in the context of social media through literature review and the Delphi method. The integrated ISM - MICMAC analysis is employed to establish the hierarchical structure and relevant correlation paths among these factors, analysing the principles of interaction among them. The research findings provide theoretical guidance for the prevention of learning burnout among secondary vocational school students. It was observed that the driving factors, "overdevelopment of social media (S_1)", "information overload (S_2)", "function overload (S_3)" and "social overload (S_4)" are at a low position in the ISM hierarchy, suggesting that it holds significant influence on learning burnout, especially when making important decisions and putting plans into action. The autonomous factors "selective anxiety of students (S_5)", "proliferation of learning software (S_6)" and "frequent interpersonal interaction (S_7)" are at a middle position in the ISM hierarchy, indicating that they can indirectly influence learning burnout through variable factors, and can be also influenced by other variable factors. These factors serve as mediators between the root layer factors and the direct layer factors. Furthermore,

the dependent factors "cognitive bias of students (S_8)", "decreased self-control (S_9)", and "low learning efficiency (S_{10})" occupy the highest position in the ISM hierarchy, which implies that they are the direct expression of the learning burnout. Monitoring these factors is crucial for identifying the current state of learning burnout. Once learning burnout is formed detected, it can be effectively addressed by controlling the influencing factors at the root layer, adjusting the influencing factors at the intermediate layer, and observing the influencing factors at the direct layer. This study aims to explore the factors influencing learning burnout among secondary vocational school students in the context of social media. It suggests management strategies based on the hierarchal structure and correlation paths of these factors, which can provide reference for preventing learning burnout among secondary vocational students.

However, this study is subject to certain limitations: (1) The selection of variables in the study was influenced by the subjective perceptions of survey participants and experts, resulting in a slight decrease in the accuracy of ISM modelling and MICMAC analysis. Structural equation modelling (SEM) should be further used to test its effectiveness; (2) This study is based on research conducted in China, and future studies should focus on testing its applicability in different countries to enhance its universality.

In future, schools should prioritise the mental health education of secondary vocational students. Timely guidance and support should be provided to address any psychological obstacles, improving their ideological understanding and moral development. Ensuring that students are in a positive state of mind effectively improve their academic performance. If necessary, teaching content and methods can be adjusted appropriately to alleviate learning burnout among secondary vocational students.

7. Recommendations

Based on this study's findings, the following suggestions are proposed: (1) Enhance the advocacy for responsible social media usage through educational initiatives. Implementing active educational interventions that teach students how to use social media responsibly can guide them in establishing correct values, screen valuable learning information, and have meaningful experiences on social media. By avoiding being overwhelmed by irrelevant information, students can improve their ability to filter information, enhance their information retrieval skills, and develop better reading comprehension abilities. Cooperation with the telecommunications department can be considered, utilising big data applications to track students' social media updates in real time and identify negative trends, enabling timely preventive measures. It may also be beneficial to extract positive and negative practical cases for instructional purposes. (2) Establish a curriculum teaching mechanism that stimulates students' learning interest. Creating a diversified evaluation system to obtain a complete understanding of students' learning situations should not be ignored. Based on students' learning characteristics and needs, adopting online teaching, blended teaching, and other methods that utilise social media can create a relaxed learning atmosphere and provide students with positive suggestions and emotional responses to stimulate their internal driving force. Additionally, the use of humour and encouragement can stimulate learning motivation, leading to increased initiative and reduced negativity in the learning process. To improve the effectiveness of teaching, vivid and interesting teaching methods such as stratified and project-based teaching can also help students master effective learning strategies and promote learning efficiency and autonomous learning. Developing course games can be an effective way to arouse student enthusiasm for independent study. (3) Utilise psychological counselling methods to provide guidance tailored to the degree of learning aversion experienced by secondary vocational students. Building a stable and positive relationship between teachers and students requires teachers with occupational sensitivity to pay attention to student' lives, studies and psychological health. This requires patience and respect. Teachers can help students adjust their study attitudes, overcome challenges, and reduce anxiety though psychological counselling and group dynamics. Moreover, when students experience addiction to social media and consider quitting their studies, teachers can cooperate with parents to establish appropriate limits on social media usage frequency.

Ethical statement

Not applicable.

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CRediT authorship contribution statement

Ping Zhang: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Shuaige Ma:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Data curation, Conceptualization. **Yuenan Zhao:** Writing – original draft, Visualization, Software, Methodology, Investigation. **Jing Ling:** Writing – review & editing. **Ying Sun:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A

Fig. A.1. Research focuses on learning burnout (Chinese literature).

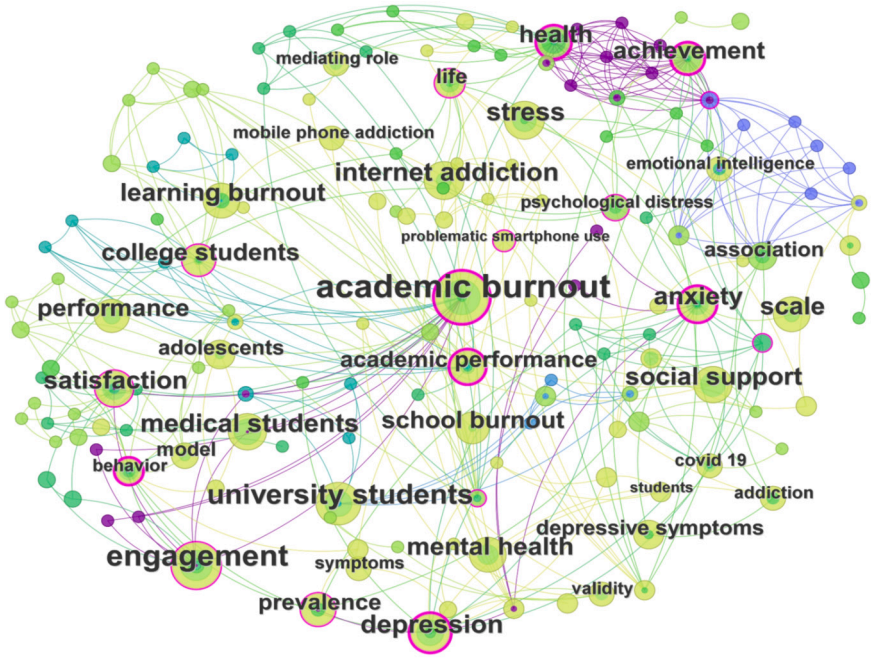

Fig. A.2. Research focuses on learning burnout (Foreign literature).

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