An Empirical Study on the Impacts of Learning Climate on Autonomous Learning Ability: The Mediating Role of Well-being

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Abstract. This paper investigates the influence of students' perceived learning climate on their autonomous learning ability. A valid sample of 980 junior high school students in China was surveyed, using the Campus Atmosphere Perception Scale, Self-learning Ability Scale, and Student Happiness Scale. Multiple regression analysis and the Bootstrap method were employed to test the model. The results demonstrate that a positive learning atmosphere significantly impacts junior high school students' autonomous learning ability. Additionally, happiness plays a mediating role between the learning atmosphere and autonomous learning ability. To promote students' autonomous learning ability, schools should focus on fostering a dialogue-based teacher-student relationship, establishing positive peer relationships, and encouraging students' active participation in school activities. It is essential to enhance students' perception of the campus atmosphere. Furthermore, schools should pay closer attention to students' psychological well-being to cultivate happiness in their daily learning experiences.

Keywords: learning climate, autonomous learning ability, students well-being, junior high school students

1. Introduction

Currently, there is fierce competition for talents in society, and the standard for measuring talent quality goes beyond mere mastery of subject knowledge. It now encompasses attributes such as innovation, practicality, and autonomous learning ability. Consequently, cultivating students' autonomous learning capability has become a vital educational goal, drawing significant attention from educational practitioners and theorists alike (Ferreira et al., 2015). During junior high school, students experience a period of rapid physical and mental development. Their ability to learn independently is influenced by both external social factors and internal personal factors. Within the trajectory of students' growth, schools play a crucial role as an environment where students engage in learning and develop self-sufficiency, making schools the primary external factor affecting students' independent learning (Cassar, 2022; Chen, 2022; Song and Nfu, 2023).

The concept of learning climate predominantly pertains to the adolescent group and refers to the quality of peer communication, teacher-student relationships, and the autonomy felt by adolescents within the school environment (Wang, 2022). A positive school atmosphere not only serves as an effective predictor of teenagers' academic achievements but also correlates with other positive behaviors they exhibit (Overah et al., 2022). According to the theory of human-environment matching, healthy adolescent development depends on positive interpersonal relationships and equitable opportunities for expression and decision-making. If schools fail to provide students with supportive relationships and autonomy, they cannot fully meet the developmental needs of students, leading to various challenges among them (Eccles et al., 1993). Teachers' supportive behavior is linked to students' well-being, while controlling behavior can hinder their happiness.

As junior high school students are still in a stage of developmental growth, their happiness significantly impacts their physical and mental health, as well as their academic progress. Happiness promotes the positive growth of teenagers and helps to resolve the problems and contradictions they face during adolescence, playing a pivotal role in their overall development. Students with high levels of happiness perform better, contributing more to their country by staying in school, exhibiting high autonomy, participating in work, and engaging in social life (Cárdenas et al., 2022). Life satisfaction and positive emotions in happiness are positively correlated with students' academic performance, indicating that higher life satisfaction and positive emotions among junior high school students can enhance their learning. Conversely, negative emotions are negatively correlated with students' academic performance, indicating that negative emotions can hinder students' academic success (Tanu et al., 2022). Studies have shown that learning climate influences junior middle school students' learning happiness, and it has both mediating and moderating effects (Cao et al., 2022).

In summary, this study explores the influence of learning climate on junior high school students' autonomous learning ability and examines the mediating role of students' well-being. By combining learning climate, students' well-being, and autonomous learning ability, this research expands the scope of independent learning exploration, conducts a comprehensive analysis of the cultivation path for junior high school students' autonomous learning capability, and provides valuable insights for fostering outstanding and innovative talents.

1.1. Learning Climate and Autonomous Learning Ability

Learning climate is a crucial environmental variable perceived by members of the campus, which exerts a relatively lasting and stable influence on their behaviors (Hoy and Hannum, 1997). It reflects the overall quality and characteristics of the school environment (Fabbri et al., 2004). Therefore, learning climate stands as one of the most important situational variables in schools, profoundly affecting teenagers' development in all aspects. Successful adolescent development necessitates the presence of "trusting and caring relationships and autonomous self-expression, choice, and decision-making" (Roeser et al., 2000). When a student's school fails to provide opportunities for such

relationships or autonomy, a 'mismatch' occurs between their developmental needs and their environment, leading to challenges in psychological and academic adjustment (Roeser et al., 2000). Researchers focusing on campus climate have identified three key components: faculty support (Colarossi & Eccles, 2003), peer support (Loukas et al., 2006), and opportunities for autonomy (Way et al., 2007). If teachers offer students fewer opportunities to manage their time, control their learning process, and choose learning strategies, students are less likely to develop the ability to learn independently (Zimmerman, 2023). Moreover, teachers' teaching methods and the types of learning tasks they set for students also significantly impact students' autonomous learning process (Maehr and Midgley, 1991). In a qualitative research conducted by Mona et al. (2020) on the role of learning climate in fostering independent learning in primary schools, the findings reveal that successful self-directed learning schools differentiate themselves through a shared vision, ample and focused professional development opportunities, and regular collaboration and communication among teachers. These factors contribute to fostering a collective sense of responsibility for implementing self-directed learning. Building upon this research, the following research hypothesis is proposed: H1 learning climate has a significant positive and significant impact on autonomous learning ability.

1.2. Learning Climate and Students Well-Being

Learning climate and students' well-being have been subjects of theoretical research, which posits that students' well-being is a positive emotional attitude encompassing vital aspects of student development. It serves as a crucial indicator of school education quality and forms the basis for the cultivation of students' virtues, ultimately promoting the development of their creative thinking (Turshen and Sen, 1999). Scholars unanimously agree on the significance of students' well-being, recognizing it as a multidimensional concept that spans various domains (Danker et al., 2019).

As psychological research has embraced the rise of systematic development and ecological perspectives, researchers increasingly acknowledge the role of school environment factors in students' overall development (Hoferichter et al., 2000). Numerous teenagers exhibit only moderate satisfaction with their current school life, with a small proportion experiencing even lower levels of satisfaction (Huebner, 2000). Drane & Valois (2000) conducted a survey involving 5,544 students from grades 9 to 12 and revealed that over 22.8% of middle school students expressed dissatisfaction with their school life, resulting in decreased happiness among this group. The study highlighted the pivotal role of the learning environment in influencing students' well-being. Teacher emotional support emerged as a significant factor in fostering students' mental well-being (Eileen et al., 2012). Additionally, peer competition within schools was found to be associated with lower levels of student well-being (Hoferichter et al., 2000), and experiences of peer victimization and bullying were linked to lower overall well-being. Furthermore, Datu et al. (2022) confirmed the positive relationship between a good learning climate and students' well-being. A positive learning climate was associated with higher levels of positive emotions and lower levels of depressive symptoms. In light of these findings, schools should actively organize and implement various campus activities, cultivate a positive learning climate, enrich students' campus cultural life, and promote their happiness. Based on these observations, the following hypothesis is proposed: H2: learning climate has a significant positive and substantial impact on the happiness of junior middle school students.

1.3. Students Well-Being and Autonomous Learning Ability

In the process of learning, students often set development goals for themselves based on their knowledge base, IQ, and other factors. As they strive towards these goals, they experience a sense of satisfaction. Learning happiness serves as the foundation for independent learning because when students engage in the learning process joyfully, they become more active learners, adopt a positive learning attitude, optimize their learning methods, and develop good learning habits. Simultaneously, autonomous learning ability effectively enhances the happiness of learning. The two concepts are interdependent and inseparable.

In his research on self-regulated learning, Huebner proposed that academic emotions should pay more attention to students' emotional experiences during the learning process, emphasizing that positive emotions can promote happiness. Indeed, life satisfaction and positive emotions in happiness are positively correlated with students' academic performance. This implies that higher life satisfaction and positive emotions among junior high school students can enhance their learning outcomes, while negative emotions are negatively associated with academic performance (Tommaso et al., 2022). The happiness of junior high school students plays a crucial role in determining their autonomous learning ability. Through literature verification and theoretical considerations, this paper presents the following hypothesis: H3: junior high school students' well-being has a significant positive impact on their independent learning capability.

1.4. Learning Climate, Students Well-Being and Autonomous Learning Ability

Learning climate plays a crucial role in adolescents' daily activities and social interactions, significantly influencing students' well-being (Day et al., 2018). The construction of learning climate involves interactions, relationships, norms, shared values, and expectations (Lee et al., 2004). Students' perception of the learning climate or social environment can profoundly impact their happiness (Way et al., 2007). A campus environment that fosters a strong sense of belonging, harmonious peer relationships, and active parent-child involvement tends to enhance students' well-being (Ulmanen et al., 2022). Factors such as the social and cultural environment of the school, the attitudes and behaviors of teachers and classmates, the physical school environment, and the respect for the confidentiality of gender identity have all been found to influence students' well-being (Kelley et al., 2022). The relationship between learning climate and students' well-being has been highlighted in various studies, with particular emphasis on the link between teacher-student relationships and well-being. For instance, Reddy and colleagues found a positive correlation between changes in students' perceived levels of teacher support and changes in their well-being (Reddy et al., 2003). Positive teacher-student relationships have also been associated with a greater sense of security (Ryan et al., 1994; Sainuddin et al., 2022), reduced depression, enhanced self-esteem, and fewer mental health problems (Townsend et al., 2017). Additionally, good peer relationships are linked to happiness, as positive and supportive student relationships predict higher life satisfaction, overall self-esteem, and lower levels of social anxiety and depressive symptoms (Liem and Martin, 2011). Conversely, adolescents experiencing more bullying and peer harm at school, including physical and verbal threats and reputational damage, are more likely to exhibit depressive symptoms and social anxiety (Perren et al., 2010).

Prior research has shown that students' well-being not only significantly affects their physical and mental health but also influences their inclination towards self-learning. A correlation between students' level of autonomous learning and subjective well-being has been identified, indicating that individuals with low happiness often experience negative emotions, leading to a lack of motivation for learning and a reduction in autonomous learning ability. Moreover, the direct relationship between students' well-being and independent learning has been confirmed, with students' well-being being a significant positive predictor of individual autonomous learning ability (Salazar and Meador, 2023). Empirical research further demonstrates a significant positive correlation between students' well-being and independent learning, with higher levels of happiness being associated with a stronger sense of belonging to school (Alnuaimi et al., 2023; Bhatia et al., 2023; Vang & Adrienne, 2022). Subjective well-being is also significantly positively correlated with self-efficacy, which significantly affects students' autonomous learning ability (Wang et al., 2022).

Therefore, learning climate may have an impact on students well-being, which in turn affects junior high school students' autonomous learning ability. We can reasonably predict that students well-being plays a mediating role between learning climate and independent learning of junior high

school students. Accordingly, the research hypothesis is proposed in this study: H4 junior high school students well-being plays a mediating role between learning climate and autonomous learning ability.

2. Materials and Methods

2.1. Participant

The survey targeted junior high school students in Hebei Province, China. The researchers contacted the student management teacher to distribute the electronic questionnaire to junior high school students. The questionnaire took approximately 30 minutes to complete. A total of 1126 questionnaires were distributed, and after excluding invalid responses, 980 valid questionnaires were obtained, resulting in an effective recovery rate of 87%. Among the valid respondents, 453 were boys (46%) and 527 were girls (54%). In terms of grade distribution, 298 students were in the first grade (30%), 399 in the second grade (41%), and 283 in the third grade (29%) (see Table 1 for detailed breakdown). Sample Size Calculation: The sample size was determined based on the formula proposed by Israel (1992): Sample size$=z^2 \times p(1-p)/E^2/[1 +(z^2 \times p(1-p)/e^2N)]$. Considering $z=2.58$, $p=0.5$, $N=3000$, and $e^2=0.0025$, the required sample size should be no less than 545. In this study, the formal sample size of 980 participants exceeded the required minimum, satisfying the sampling standards.

Ethical Considerations: The study adhered to the principles outlined in the Declaration of Helsinki. Prior to participation, all subjects provided voluntary cooperation and signed informed consent. Participants' privacy and preferences were fully respected, and they were informed of their right to refuse participation or withdraw from the study at any time. Moreover, the study received approval from the Ethics Committee of Thailand Krirk University.

Table 1: Background variable characteristics (N=980)

Background Variable	Category	Number of People	Percent
sex	male	453	46%
	female	527	54%
grade	junior high school in grade 1	298	30%
	junior high school in grade 2	399	41%
	junior high school in grade 3	283	29%

3. Measure

3.1. Learning Climate

To assess teenagers' perception of learning climate, the "Campus Atmosphere Perception Scale" compiled by Jia et al. (2009) was used. This scale consists of 25 items categorized into three dimensions: teacher support, classmate support, and opportunities for autonomy. Respondents rate each statement on a 5-point scale: "strongly agree" (scored as 5), "agree" (scored as 4), "not necessarily" (scored as 3), "disagree" (scored as 2), and "strongly disagree" (scored as 1). A higher total score on the scale indicates a better learning climate. The Cronbach's alpha value for the scale in this study was 0.971.

3.2. Students Well-Being

The assessment of students' well-being was based on the scale revealed by Lu (2020), which is rooted in the PISA framework. This scale comprises five dimensions: self-efficacy, school belonging, fear of failure, social relations, and leisure time. The scale consists of 23 items divided into 5 subscales. Responses are provided on a 5-point Likert scale: "strongly disagree" (scored as 1), "disagree" (scored as 2), "not necessarily" (scored as 3), "agree" (scored as 4), and "strongly agree" (scored as 5). The total score reflects the level of happiness among junior students, with higher scores indicating greater happiness. The Cronbach's alpha value for the scale in this study was 0.969.

3.3. Autonomous Learning Ability

In this study, we have adopted the autonomous learning ability scale developed by Shu (2018) to assess the autonomous learning ability of secondary school students. The scale comprises a total of 34 questions, which are divided into 9 dimensions, namely, learning attitude, learning responsibility, motivation and self-efficacy, planning, monitoring and reflection, management of resources, use of learning strategies, evaluation of the learning process, and evaluation of academic performance. To rate their responses on the scale, participants use a Likert scale with a 5-point scoring method. Specifically, responses range from "strongly disagree" (scored as 1 point) to "strongly agree" (scored as 5 points), while "disagree," "not necessarily," and "agree" are assigned scores of 2, 3, and 4 points, respectively. A higher total score on the scale indicates a stronger level of autonomous learning ability. In this particular study, the Cronbach's α value of the scale was found to be 0.977, demonstrating a high level of internal consistency and reliability in the measurements.

3.4. Data analysis

Data management and analysis were conducted using SPSS and AMOS. SPSS was used for preliminary data processing, descriptive statistics, reliability and validity testing, and correlation analysis between variables. AMOS was employed for confirmatory factor analysis and structural equation modeling to explore the mediation effect.

4. Result

4.1. Descriptive Analysis

Table 2 presents the descriptive analysis results, including the mean value (M) and standard deviation (SD) of each variable in the study, as well as the correlation coefficients between the variables. The results indicate that positive learning climate is positively correlated with autonomous learning ability ($\gamma=0.367$, $p<0.01$) and students' well-being ($\gamma=0.463$, $p<0.01$). Furthermore, students' well-being is positively correlated with their autonomous learning ability ($\gamma=0.665$, $p<0.01$). These findings provide preliminary evidence to support our hypothesis.

Table 2: Descriptive analysis result

Variables and dimensions	M	SD	learning climate	Autonomous learning ability	students well-being
learning climate	3.3412	.94853	1		
Autonomous learning ability	3.3818	.92860	.367**	1	
students well-being	3.3935	.95428	.463**	.665**	1

*p<.05; **p<.01

4.2. Convergence Validity

To assess the convergence validity of the variables, we examined standard Factor Loading (SFL), Average Variance Extraction (AVE), and Composite Reliability (CR), as recommended by Hair Jr et al. (2021). The results are presented in Table 3.

Table 3: Convergence validity table

	SFL	t	CR	AVE
Threshold value	>0.50	>1.96	>0.60	>0.50
learning climate	0.618-0.818	18.665-29.608	0.786-0.912	0.528-0.574
Autonomous learning ability	0.501-0.724	17.282-25.083	0.763-0.845	0.506-0.582
students well-being	0.506-0.780	17.842-28.293	0.734-0.857	0.514-0.578

As shown in Table 3, the observed variable SFL for each variable is greater than 0.5, and the t-value reaches a significant level, indicating that each item significantly contributes to its respective

latent variable. Additionally, the AVE value for each variable is over 0.5, suggesting that more than 50% of the variance in the variables is explained by their indicators, indicating good convergent validity. Moreover, the CR values are over 0.6 for each variable, demonstrating good internal consistency reliability. Based on these results, it can be concluded that the variables of learning climate, autonomous learning ability, and students' well-being all exhibit good convergence validity, supporting the reliability and validity of the measurement model. The variables have high correlations within their respective constructs, indicating good internal consistency and convergent validity.

4.3. Test the Differential Validity

The table 4 shows the correlation coefficients (in the diagonal cells) and the AVE square roots for each pair of variables (A-Q). The variables represent different dimensions related to learning climate, autonomous learning ability, and students' well-being. According to the Fornell and Larcker (1981) criterion for differential validity, the AVE square root of each variable should be greater than the correlation coefficient of each variable. Additionally, the AVE square roots should account for at least 75% of the overall comparison number. The correlation coefficients between most variable pairs are statistically significant at the p<0.01 level, suggesting that there are significant relationships between the dimensions. Therefore, no collinearity problem was evident.

Table 4: Differential validity test table

	A	B	C	D	E	F	G	H	I	G	K	L	M	N	O	P	Q
A	.761																
B	.383**	.774															
C	.398**	.418**	.828														
D	.370**	.465**	.421**	.720													
E	.367**	.480**	.633**	.364**	.831												
F	.312**	.446**	.518**	.258**	.445**	.847											
G	.389**	.344**	.498**	.468**	.511**	.369**	.739										
H	.310**	.556**	.507**	.354**	.552**	.505**	.383**	.764									
I	.314**	.529**	.462**	.168**	.566**	.532**	.367**	.345**	.750								
J	.386**	.580**	.526**	.366**	.357**	.532**	.533**	.445**	.187**	.882							
K	.310**	.429**	.432**	.469**	.438**	.476**	.502**	.411**	.501**	.354**	.806						
L	.325**	.306**	.232**	.362**	.361**	.425**	.378**	.462**	.268**	.368**	.351**	.719					
M	.368**	.500**	.187**	.351**	.364**	.432**	.377**	.294**	.320**	.261**	.203**	.311**	.814				
N	.462**	.526**	.516**	.543**	.531**	.187**	.488**	.457**	.542**	.294**	.508**	.561**	.425**	.778			
O	.357**	.137**	.161**	.520**	.364**	.516**	.517**	.522	.470**	.426**	.308**	.433**	.210**	.264**	.836		
P	.420**	.463**	.368**	.537**	.531**	.367**	.516**	.505**	.531**	.148**	.507**	.542**	.351**	.354**	.354**	.749	
Q	.356**	.137**	.518**	.522**	.268**	.363**	.346**	.249**	.433**	.411**	.488**	.505**	.264**	.351	.272**	.461**	.732

Teacher support B. Student support C. Autonomy opportunity D. Learning attitude E. Learn responsibility F. Motivation and self-efficacy G. Planning arrangement H. Monitoring reflection I. Manage resources J. Use learning strategies K. Evaluation and learning process L. Assess academic performance M. self-efficacy N. Fear of failure O. School belonging P. Social relationship Q. Leisure time*p<.05; **p<.01

4.4. Structural Model

The structural model examines the relationship between learning climate, students' well-being, and self-learning ability. The results showed that χ2/df=5.781. However, since χ2/df is easily affected by sample size, when χ2/df is greater than 3, it is necessary to refer to other fit indicators for determination. Other fit indicators, such as RMSEA=0.070 (lower than the standard value of 0.1), SRMR=0.040 (lower than the standard value of 0.8), CFI=0.982, NFI=0.978, GFI=0.927, and TLI=0.942, all suggest that the model is well-fitted (Schumacker and Lomax, 2004). The results are shown in Figure 1.

First, learning climate significantly and positively affects the ability of independent learning ($\beta=0.17$, $p<0.01$), supporting hypothesis H1. Second, learning climate can significantly and positively affect students' well-being ($\beta=0.49$, $p<0.01$), confirming hypothesis H2. Third, students' well-being can significantly and positively affect their autonomous learning ability ($\beta=0.73$, $p<0.01$), supporting hypothesis H3. These findings indicate that learning climate may indirectly affect students' self-learning ability through students' well-being.
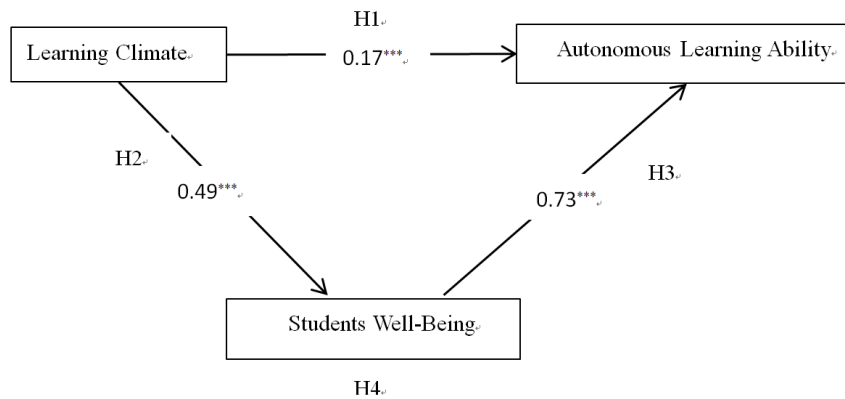

Fig. 1: Research validation model ***p<.001

The table presents the results of testing the mediating effect of students' well-being between learning climate and autonomous learning ability. The bias correction percentile Bootstrap method with 5000 repetitions was used to estimate the confidence intervals at the 95% level.

The indirect effect of learning climate on autonomous learning ability through students' well-being is significant, as the confidence interval does not include 0. This indicates that students' well-being mediates the relationship between learning climate and autonomous learning ability. The direct effect of learning climate on autonomous learning ability remains significant even after considering the mediating effect of students' well-being. This suggests that learning climate also has a direct impact on students' autonomous learning ability, in addition to its indirect effect through happiness. Based on the results in Table 5:

Table 5: Intermediate effect table

Intermediate path	Estimate	95% Confidence Interval Bias-Corrected Percentile Method	
		Lower Bounds	Upper Bounds
Indirect effect (learning climate→ students well-being→ Autonomous learning ability)	(0.49)*(0.73)=0.358	0.278	0.569
Direct effect (learning climate→ Autonomous learning ability)	0.17	0.049	0.304
Total effect	0.528	0.163	1.136

Overall, the results support hypothesis H4, demonstrating that students' well-being acts as a significant mediator between learning climate and autonomous learning ability. This finding highlights the importance of creating a positive and supportive school environment to promote students' well-being, which in turn enhances their ability to engage in autonomous learning. The structural model provides valuable insights into the complex interplay between learning climate, students' well-being, and their capacity for independent learning.

5. Discussion and Conclusion

5.1. Theoretical Implications

The results of the research hypothesis are sorted out, and the results are shown in Table 6.

Table 6: Summary table of results.

Hypothesis	Conclusions
H1: Learning climate has significant positive influence on autonomous learning ability	assumption holds
H2: Learning climate has a significant positive impact on students well-being	
H3: The students well-being has a significant positive influence on their autonomous learning ability	
H4: The students well-being has mediating effect between learning climate and autonomous learning ability	

Building upon prior research, this study proposes a mediating effect model with learning climate as the predictor, students' well-being as the mediating variable, and autonomous learning ability as the outcome variable. Examining learning climate and independent learning in tandem expands the research perspectives on autonomous learning ability and provides valuable insights for the theoretical framework of independent learning.

The research findings align with the theory of human-environment matching, which posits that individual behavior, motivation, and mental health are influenced by how well individual characteristics align with the characteristics of their environment. Unlike other disciplines, environmental education necessitates learners to possess the ability to analyze spatial relationships of ground features, describe environmental phenomena and problems, and analyze contrasts and mechanisms between geographical elements. These requirements perfectly align with the constructivist learning theory (Zhao and Han, 2017).

Autonomous learning entails self-regulation of not only motivation and emotion but also behavior, learning environment, and resources. From the perspective of social cognitive theory, self-regulation in all these aspects results from the interplay of human subjective factors, environmental factors, and behavioral factors.

The results of this study reveal the mediating effect of junior high school students' well-being on the relationship between learning climate and autonomous learning ability, which aligns with findings from other scholars who emphasize the significant impact of students' well-being on their autonomous learning ability (Sverdlik et al., 2022). Considering that junior high school students are still in a stage of physical and mental development, they may easily experience unhappiness and difficulties. Happiness, in turn, has a profound influence on students' physical and mental health, as well as their academic development (Frances et al., 2021). Furthermore, promoting happiness contributes to the positive growth of teenagers and assists in resolving the challenges and contradictions they face during adolescence, which plays a pivotal role in their development (Govorova et al., 2020).

The learning climate can significantly impact students' well-being. Students who experience high teacher support, a supportive student community, and opportunities for autonomy are more likely to feel happy and motivated to engage in independent learning. Moreover, individuals with a high sense of happiness often exhibit better mental health, higher self-esteem, and self-control, and experience fewer negative emotional states such as depression and anxiety (Karlsen et al., 2006). This heightened ability to adapt allows them to flexibly navigate their interactions with the environment. Moreover, fostering a habit of independent learning equips students to cope with life's setbacks and find greater satisfaction in real-life situations (Tharani et al., 2017).

5.2. Practical Implications

Firstly, learning climate significantly contributes to the improvement of junior high school students' autonomous learning ability. Hence, schools should not only focus on infrastructure development but also emphasize the cultivation of a humanistic environment to enhance students' sense of belonging. Building a dialogue-based teacher-student relationship and establishing positive peer relationships can enhance the overall learning climate for junior high school students. In addition, teachers should foster a harmonious class atmosphere, encourage student participation in school activities, and guide them to engage in various practical experiences based on school affairs. By doing so, schools can cultivate socially adept individuals with sustainable development capabilities.

Secondly, the happiness of junior middle school students plays a significant mediating role between learning climate and autonomous learning ability. Therefore, middle schools must prioritize cultivating students' well-being in the education and teaching process. Emotion education courses or activities can serve as a platform for conveying emotional regulation knowledge and skills to junior high school students, guiding them to learn how to regulate their emotions. This not only improves their emotional state but also leads to a greater sense of happiness in their daily learning experiences and boosts their self-confidence.

5.3. Limitations and Future Research

This study has several limitations. Firstly, a cross-sectional study design was used, which, although supported by previous studies, makes it challenging to establish definitive cause-and-effect relationships. In the future, longitudinal studies could be employed to explore the causal relationship between learning climate and autonomous learning ability more effectively.

Secondly, the use of a questionnaire survey as the research method may benefit from complementing qualitative or quasi-experimental designs in future studies. Such approaches would allow for a deeper exploration of the possible factors influencing autonomous learning ability.

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