Assessing the Influence of Landscape Factors in School Gardens on Special Education Teachers' Perceptions, Use, and Restorative Experiences

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ABSTRACT

This study examined how school garden landscape factors shape special education teachers' perceptions, use patterns, and restorative experiences in two public special education schools in Zhejiang Province, China. Although school gardens are increasingly recognised as supportive environments for mental restoration, evidence on teachers, especially those working in special education settings, remains limited. A questionnaire survey was conducted among 114 teachers to assess perceived stress, garden use patterns, evaluations of ten landscape factors, and perceptions of four dimensions of overall garden quality. Descriptive statistics, Pearson correlation analysis, and hierarchical multiple regression were applied. Results showed that 95.61% of teachers reported experiencing work related stress at least sometimes, and 92.98% agreed that natural environments help relieve stress and promote psychological recovery. However, actual garden use remained limited, as only 19.30% visited almost daily and 52.63% typically stayed for 16 to 30 minutes. Teachers mainly used the garden for low intensity and restorative activities such as passing through, sitting quietly, and grounding. Overall garden quality was evaluated relatively low, particularly for psychological restoration and sensory quality, while several individual landscape factors received high ratings. Correlation analysis revealed that vegetation coverage, educational spaces, natural shading, aromatic flowers, and locally adapted plants were positively associated with multiple quality dimensions. In the final regression model, perceived aromatic flowers ($\beta = 0.25$, $p < 0.05$) emerged as the strongest positive predictor of overall garden quality, while visit duration ($\beta = –0.27$, $p < 0.05$) showed a significant negative effect. These findings highlight a mismatch between teachers' restorative needs and current garden performance, and emphasise the importance of sensory rich planting and context responsive design in improving restorative school landscapes for special education teachers.

Keywords: Special education schools, school garden, teachers' perceptions, landscape quality, landscape factors

INTRODUCTION

Despite the growing body of research on restorative environments and school green spaces, several important gaps remain. Existing studies have predominantly focused on students' outcomes or general campus environments, while teachers, particularly those working in special education settings, have received comparatively limited empirical attention (Wang et al., 2023; Cui, 2022; Guardino et al., 2019). Special education teachers often experience elevated occupational stress and prolonged cognitive and emotional demands (Winding et al., 2022), which may shape both their use of school gardens and their evaluations of environmental quality (Lappa et al., 2017; Scartazza et al., 2020). However, how this group perceives and values specific landscape elements within school gardens remains insufficiently understood.

Research on special education school landscapes has frequently treated vegetation as a broad or homogeneous component, emphasizing overall greenness or the presence of natural elements (Bellamy et al., 2022; Hussein, 2017). Such approaches provide limited guidance for landscape design practice, as they do not clarify which specific landscape factors are most salient to users. In particular, the ways in which teachers' perceived importance of landscape characteristics, such as sensory characteristics, natural shading, and private spaces, relate to their evaluations of different dimensions of garden quality have rarely been examined in a systematic manner (Wang et al., 2023).

Additionally, although environmental psychology and restorative environment theories suggest that perceptions of environmental quality are shaped through the interaction of individual characteristics, usage patterns, and environmental attributes, these factors are often examined in isolation (Du et al., 2022; Yang et al., 2023; Dean et al., 2017). Few empirical studies have simultaneously considered teachers' psychological conditions, garden use behaviors, and perceptions of landscape factors within a single analytical framework. As a result, the relative contribution of landscape perceptions to overall garden evaluations, beyond individual stress levels and patterns of garden use, remains unclear.

To address these gaps, this study investigates the associations between special education teachers' garden use patterns, their perceived importance of landscape features, and their evaluations of school garden quality in two public special education schools in Zhejiang Province, China. Specifically, the study examines (1) how teachers use school gardens in terms of visitation frequency, duration, and activity types; (2) how perceived landscape factors are associated with multiple dimensions of perceived garden quality, including accessibility, psychological restoration and multifunctionality, sensory quality, and environmental safety; and (3) the extent to which perceived landscape factors contribute to overall garden quality evaluations beyond individual psychological characteristics and garden use behaviors. By adopting this integrated perspective, the study aims to provide empirically grounded insights that can inform the design and management of restorative school gardens in special education contexts, while maintaining a clear distinction between perceived environmental evaluations and objective landscape conditions.

METHODS

Study sites

The study was conducted in September 2025 at two public special education schools in Zhejiang Province—School A (119.92°E, 28.45°N) and School B (120.15°E, 30.27°N) (see Fig. 1). These two schools were selected due to their relatively large scale and well-developed facilities. Both institutions have student enrollments well above the provincial average for public special education schools, which stands at 154 students (Zhejiang Provincial Department of Education, 2025).

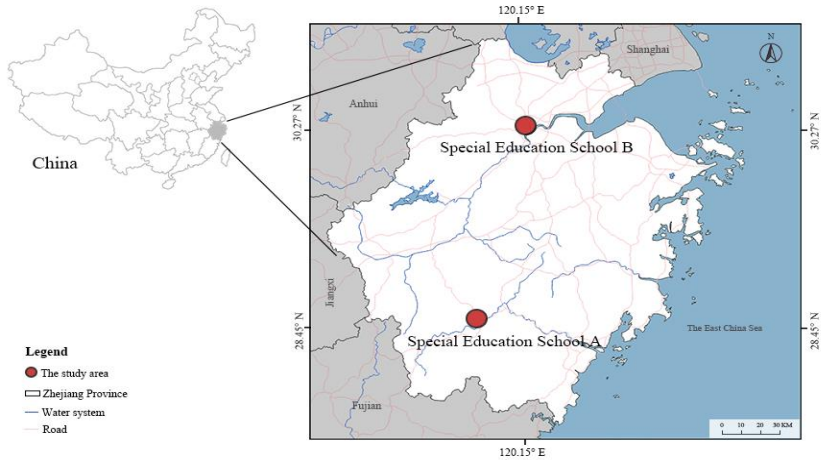

Fig. 1. Location of the selected schools, Zhejiang province, China.

School A currently enrolls approximately 220 students and employs over 80 teaching staff. As a municipally managed special education institution, it occupies 54 mu, with 7,300 square meters of athletic grounds and 14,500 square meters of green space, making it one of the largest and best-equipped special education schools in the province (see Fig. 2). School B serves 225 students, all with moderate to severe intellectual disabilities, and has 81 teaching staff. Covering over 20 acres, it is the largest planned special education school in Zhejiang Province and functions as the provincial resource center for intellectual disability education. The substantial outdoor spaces and institutional scale of both schools enhance their representativeness as landscape research sites, justifying their selection for this study.

Fig. 2. Master plan and status of the school. a Refers to school A, b refers to school B.

Questionnaire design

The questionnaire was designed to address three research objectives. It comprised two sections: the first focused on teachers' usage patterns, including perceived stress, connection to psychological restoration, visit frequency, visit duration, and activity types in the garden. The second assessed perceptions of overall garden quality and landscape features, covering ten landscape factors (e.g., vegetation coverage, plant species, multisensory experience, water features) and four quality dimensions: accessibility, psychological restoration and multifunctionality, environmental sensory quality, and environmental safety. All items were rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The variables were adapted from prior research on green school environments, psychological restoration, satisfaction, and educational value (Allahyar & Kazemi, 2021; Kim, 2022; Alzamil et al., 2023; Salih et al., 2023), with modifications for special education contexts (see Table 1).

Table 1. Variables

Variables	**Sub-category**	**References**
Landscape factors	Vegetation coverage	Wang et al., 2021
	Private spaces	Wang et al., 2023
	Multisensory experience	Duan et al., 2024
	plant species	Salih et al., 2023
	Aromatic flowers	Mani & Woolley, 2024; Song & Wu, 2022
	Natural shading	Tabatabaie et al., 2023
	Locally adapted plants	Kim et al., 2022
	Water features	Cai et al., 2022; Wang et al., 2021
	Seating types	Tao et al., 2023
	Educational spaces	Duan et al., 2024
Overall quality	Accessibility	Yang et al., 2023
	Psychological restoration & multifunctionality	Wang et al., 2021; Kaplan & Kaplan, 1989
	Environmental sensory quality	DeGuzman et al., 2024
	Environmental safety	Zhao et al., 2024; Curtis et al., 2022

Participants

This study was conducted among teachers from two special education schools in Zhejiang Province, with a total teacher population of approximately 160. Of the 122 questionnaires distributed, 114 were returned as valid, yielding a response rate of 93.4%. The sample represented 71.3% of the target population, exceeding the general threshold for sample adequacy in social science research (Krejcie & Morgan, 1970). Prior studies suggest that a coverage rate above 70% ensures strong representativeness and inferential validity (Ochsner, 2021). Given the demanding nature of special education work and the specificity of the target group, the achieved sample size meets the basic criteria for quantitative analysis (Memon et al., 2020), providing a robust foundation for empirical investigation.

Statistical analysis procedures

Given the consistency between the two schools in terms of institutional structure, size, teacher characteristics, and environmental context, and considering the study's focus on overall modeling, data were combined to enhance the reliability and generalizability of the statistical results (Curran & Hussong, 2009). All analyses were conducted using SPSS 27.0. Descriptive statistics were first used to summarize teachers' garden use patterns, including visit frequency, visit duration, and activity types. Mean scores and standard deviations were then calculated for each perceived landscape factor and each dimension of overall garden quality to describe teachers' evaluations of landscape attributes. Pearson correlation analysis was conducted to examine associations between perceived landscape factors and overall garden quality dimensions, with the aim of identifying key features linked to more positive evaluations. Subsequently, multiple linear regression analysis was applied to explore the relative contributions of psychological, behavioral, and landscape variables. A hierarchical regression model was constructed using the mean score of the four overall quality dimensions as the dependent variable. Psychological variables were entered in the first block, behavioral variables in the second block, and perceived landscape factors in the final block. This stepwise approach enabled the assessment of incremental explanatory power and the independent effects of each variable group while controlling for previously entered predictors (Johannesson et al., 2024).

RESULTS

Reliability and validity testing

Internal consistency and structural validity were confirmed for both the overall garden quality and landscape factor scales. Cronbach's α values were 0.837 and 0.812, respectively, exceeding the 0.70 threshold for acceptable reliability (Nunnally & Bernstein, 1994). KMO values of 0.797 and 0.832 also surpassed the recommended minimum (Kaiser, 1974), indicating strong psychometric suitability for further statistical analysis.

Usage patterns of school garden

Table 2 presents survey findings from 114 special education teachers regarding stress levels, perceived psychological restoration, and school garden usage patterns. A substantial majority (95.61%) reported experiencing work-related stress "sometimes," "often," or "always," indicating a high psychological burden across the sample. Concurrently, 92.98% either "agreed" or "strongly agreed" that natural environments help alleviate stress and promote mental recovery, reflecting widespread recognition of the restorative potential of landscape settings. Despite this positive perception, actual engagement with the school garden was limited: only 19.30% reported visiting the garden "almost daily," while 56.14% used it just once or twice a week. Furthermore, garden visits were typically brief, with only 14.91% of respondents staying longer than 30 minutes, most reported visits lasting less than half an hour.

Table 2. Respondents' garden usage (N=114).

Variables	Sub-category	References
	Vegetation coverage	Wang et al., 2021

Landscape factors	Private spaces	Wang et al., 2023
	Multisensory experience	Duan et al., 2024
	plant species	Salih et al., 2023
	Aromatic flowers	Mani & Woolley, 2024; Song & Wu, 2022
	Natural shading	Tabatabaie et al., 2023
	Locally adapted plants	Kim et al., 2022
	Water features	Cai et al., 2022; Wang et al., 2021
	Seating types	Tao et al., 2023
	Educational spaces	Duan et al., 2024
Overall quality	Accessibility	Yang et al., 2023
	Psychological restoration & multifunctionality	Wang et al., 2021; Kaplan & Kaplan, 1989
	Environmental sensory quality	DeGuzman et al., 2024
	Environmental safety	Zhao et al., 2024; Curtis et al., 2022

As shown in Fig. 3, teachers most engaged in low-intensity, solitary activities within the school garden. The most frequently reported behaviors were “passing through” (66.67%) and “sitting quietly” (61.40%), followed by “grounding/earthing” (64.04%), “using the phone” (52.63%), and “walking around” (51.75%). These patterns suggest that the garden primarily serves as a space for relaxation and individualized, restorative experiences. In contrast, participation in “socializing” (39.47%), “teaching classes” (10.53%), and “work meetings” (11.40%) was notably lower, indicating that teachers are less inclined to use the garden as an extension of their professional roles. Activities such as “playing with equipment” (18.42%) and “eating or drinking” (19.30%) were also infrequent, and no respondents reported engaging in other types of activities. Overall, the data reveal a clear behavioral preference for low-intervention, recovery-oriented use of the garden.

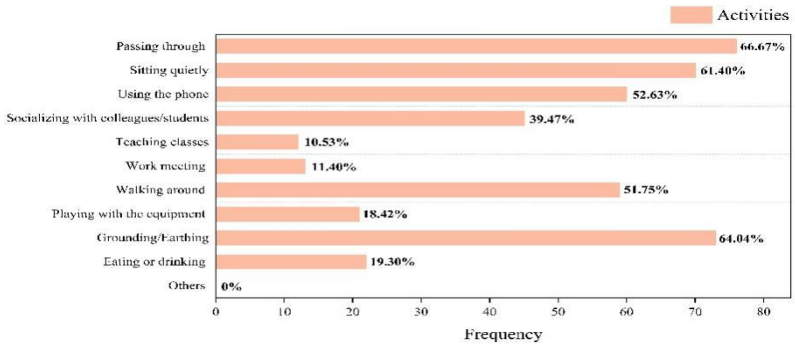

Fig. 3. Activities participated by respondents. Note that multiple answers were allowed.

Evaluation of overall quality and landscape factors

Analysis of special education teachers’ evaluations of overall garden quality and landscape factors revealed clear divergences in perception (Fig. 4). Overall garden quality was rated relatively low. Median scores for accessibility and environmental safety were both 3.00, with interquartile ranges (IQRs) of 2.00 and 1.00, respectively, indicating moderate variability around neutral evaluations. Psychological restoration and multifunctionality, as well as environmental sensory quality, received lower ratings, with median scores ranging from 2.00 to 3.00 and mean values below 3 (M = 2.81 and 2.75). The relatively high standard deviations (SD =

1.10 and 1.04) indicate dispersed responses. Both sensory quality and environmental safety showed high-end outliers, suggesting that a small proportion of teachers reported more favourable perceptions.

By contrast, landscape factors were rated substantially higher. Locally adapted plants and vegetation coverage received the highest median scores (4.50), accompanied by relatively low standard deviations (SD = 0.95 and 1.04), indicating strong consensus among respondents. Plant species diversity, multisensory experiences, and seating types were also rated highly, with mean scores exceeding 4.00 and moderate interquartile ranges. In comparison, aromatic flowers and water features received moderately high mean scores (M = 3.82 and 3.93) but exhibited wider interquartile ranges (IQR = 2.00) and several low-end outliers, reflecting greater variability in teachers' evaluations.

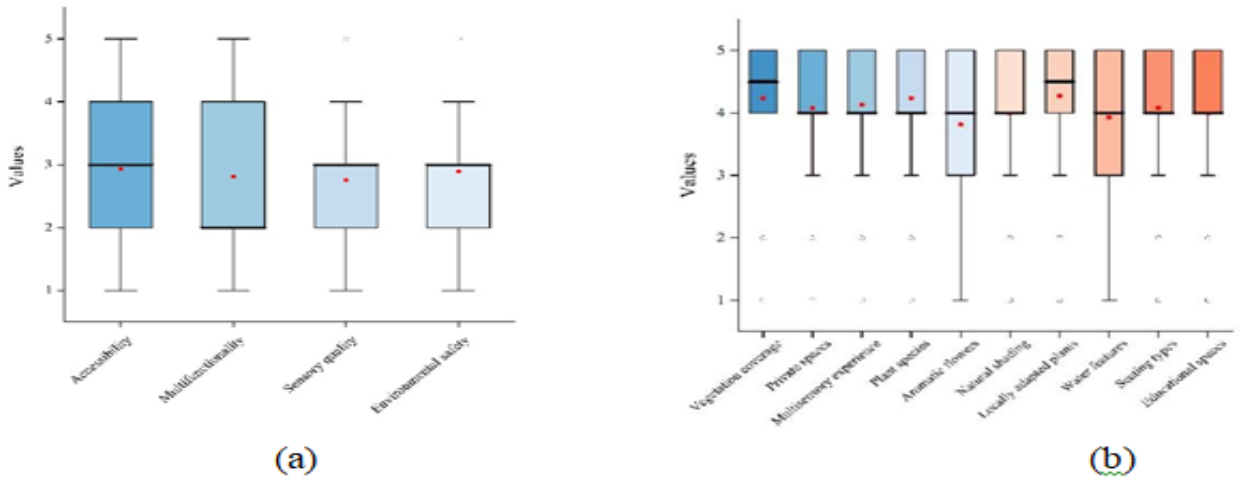

Fig. 4. Boxplots illustrate teachers' ratings. a Refers to the evaluation of overall garden quality dimensions, b refers to their agreement with the value of ten landscape factors in school gardens.

Note: Each box represents the interquartile range (IQR), the bold horizontal line indicates the median, red dots denote the mean, and open circles indicate outliers.

Correlation between overall garden quality and landscape factors

To investigate the relationship between special education teachers' perceptions of overall garden quality and specific landscape factors, Pearson correlation analysis was conducted following normality checks (absolute skewness < 3, kurtosis < 10 for all variables; see Fig. 5). The analysis examined associations between ten landscape factors and four core dimensions of perceived garden quality.

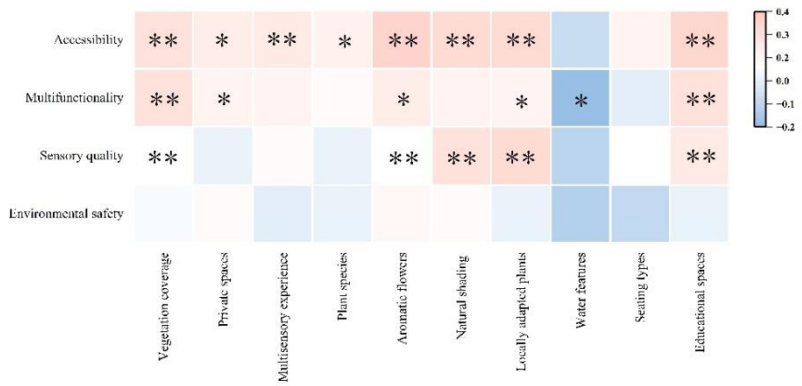

Fig. 5. Heatmap showing the correlation between overall garden quality and landscape factors.

For accessibility, seven landscape factors showed significant positive correlations. Educational spaces ($r = 0.34$, $p < 0.01$), locally adapted plants ($r = 0.32$, $p < 0.01$), natural shading ($r = 0.32$, $p < 0.01$), and vegetation coverage ($r = 0.28$, $p < 0.01$) exhibited the strongest associations. Aromatic flowers, multisensory experience, and private spaces were also positively correlated with accessibility, though with lower correlation coefficients. Within the psychological restoration and multifunctionality dimension, vegetation coverage ($r = 0.29$, $p < 0.01$) and educational spaces ($r = 0.28$, $p < 0.01$) showed the highest correlations. Aromatic flowers and locally adapted plants were also significantly associated, although with weaker effect sizes ($p < 0.05$). Environmental sensory quality showed the broadest pattern of associations, with six landscape factors reaching statistical significance. Aromatic flowers and vegetation coverage demonstrated the strongest correlations ($r = 0.42$, $p < 0.01$). Locally adapted plants, natural shading, and educational spaces also exhibited moderate positive correlations.

By contrast, environmental safety showed weak or non-significant associations with most landscape factors. Vegetation coverage showed a marginal positive correlation ($r = 0.08$), while water features and seating types were negatively correlated but not statistically significant. Notably, water features showed a significant negative correlation with psychological restoration and multifunctionality ($r = -0.22$, $p < 0.05$).

Liner regression analysis and driving factors of overall garden quality

After calculating the mean score across the four dimensions representing overall garden quality ($M = 2.85$), multiple linear regression analysis was conducted using overall quality as the dependent variable. Psychological variables (perceived stress level, agreement on psychological restoration), behavioral variables (visit frequency, visit duration), and perceived ten landscape factors were entered sequentially to assess the independent contribution of each level to perceived overall quality. Prior to regression, multicollinearity diagnostics confirmed that all predictors had tolerance values above 0.2 and variance inflation factors (VIFs) below 5, indicating no serious collinearity and supporting the stability and interpretability of the regression coefficients.

Fig. 6 illustrates the cumulative (R^2) and incremental (ΔR^2) explanatory power of the hierarchical regression model. After controlling for psychological variables in Model 1, the addition of behavioral indicators in Model 2 yielded a modest increase in explained variance ($\Delta R^2 = 0.05$), with visit duration emerging as the only significant predictor—a negative driver ($\beta = -0.28$; see Table 3). Upon introducing perceived landscape variables in Model 3, the model's explanatory power increased substantially ($\Delta R^2 = 0.21$, $p < 0.01$). In this final model, visit duration remained a significant negative predictor ($\beta = -0.27$), while stress level ($\beta = 0.22$) and aromatic flowers ($\beta = 0.25$) emerged as significant positive drivers. These findings suggest that teachers who reported higher stress levels and placed greater value on aromatic plants were more satisfied with the overall garden environment. In contrast, longer durations spent in the garden were associated with lower overall quality ratings, indicating a possible mismatch between expectations and actual experience.

Table 3. Multiple liner regressions' coefficients (response variable: Overall garden quality).

Driving factors	**Model 1**	**Model 2**	**Model 3**
Stress level	0.13	0.19	0.22*
Recovery agreement	-0.17	-0.09	0.01
Visit frequency	/	0.08	0.07
Visit duration	/	-0.28*	-0.27*
Vegetation coverage	/	/	0.22
Private spaces	/	/	0.04
Multisensory experience	/	/	-0.11
Plant species	/	/	-0.03

Aromatic flowers	/	/	0.25*
Natural shading	/	/	0.00
Locally adapted plants	/	/	0.12
Water features	/	/	-0.11
Seating types	/	/	-0.15
Educational spaces	/	/	0.13
R^2	0.03	0.08	0.29
ΔR^2	0.03	0.05	0.21
F	1.85	2.34	2.89**

*. $p < 0.05$, **. $p < 0.01$.

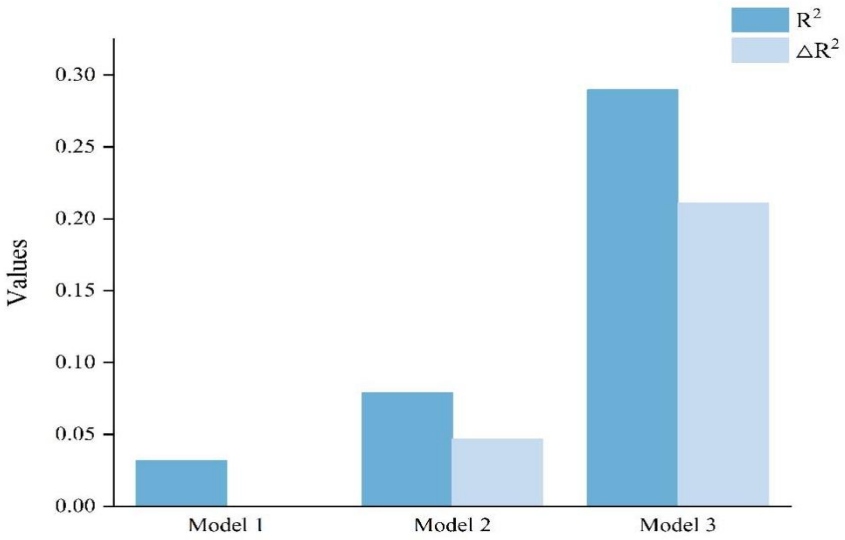

Fig. 6. Cumulative explanatory power (R^2) and incremental explanatory power (ΔR^2) of hierarchical regression models.

DISCUSSION

Stress, restorative awareness, and limited garden use

This study reveals a clear discrepancy between special education teachers' perceived need for restorative environments and their actual use of school gardens. Most teachers reported frequent stress and strongly recognised the restorative value of natural environments, consistent with previous studies (Li & Sullivan, 2016; van den Berg et al., 2017; Bernardo et al., 2021). However, garden engagement remained limited, with infrequent visits, short stays, and predominantly passive activities. Similar perception–behaviour gaps have been reported among educators, suggesting that school green spaces have yet to function as routine restorative settings for teachers (Ernst, 2013; Kelz et al., 2015; Patchen et al., 2022).

Overall garden quality and plant-related perceptions

Teachers rated overall garden quality relatively low, particularly regarding psychological restoration and environmental sensory quality. This finding reflects broader critiques of campus greening in Chinese special education schools, where vegetation provision often prioritises quantity over experiential and functional

performance (Wang, 2020; Liu, 2024). In contrast, individual plant-related features, such as locally adapted species, vegetation coverage, and plant diversity, were rated positively. This discrepancy suggests that while specific plant attributes are valued, their restorative potential has not been effectively integrated into the broader spatial organisation of school gardens (Marcus & Sachs, 2014; Kim, 2022).

Landscape features, restoration, and perceived safety

Most landscape factors were significantly associated with perceived accessibility, psychological restoration and multifunctionality, and environmental sensory quality, reinforcing the importance of landscape design in restorative experiences (Kaplan & Kaplan, 1989; Ulrich, 1984). By contrast, no landscape feature was significantly related to perceived environmental safety, indicating that teachers primarily evaluate safety through non-vegetative elements such as visibility, lighting, and spatial layout (van Rijswijk & Haans, 2017). This distinction highlights the need to address restorative quality and safety through complementary, rather than interchangeable, design strategies.

Water features and context-dependent responses

Contrary to much of the restorative landscape literature, water features showed no positive association with overall garden quality and were negatively related to psychological restoration and multifunctionality. Similar findings have been reported in institutional settings, where water elements may be perceived as safety risks or sources of distraction (Rafi, 2019; Cai et al., 2022; Tabatabaie et al., 2023). In special education contexts, such concerns may outweigh potential restorative benefits, underscoring the importance of context-sensitive design rather than assuming universal effects of water features (Dobbie & Brown, 2014; Jacobs & Buijs, 2011).

Predictors of perceived garden quality

Regression analysis identified perceived importance of aromatic flowers, visit duration, and stress level as significant predictors of overall garden quality. The negative association with visit duration suggests that longer stays may heighten awareness of environmental limitations or lead to sensory fatigue, thereby reducing satisfaction (Akoumianaki-Ioannidou et al., 2016). Conversely, higher stress levels were positively associated with garden quality evaluations, indicating that teachers under greater psychological strain may be more responsive to restorative landscape qualities (Song et al., 2024). Among landscape factors, aromatic flowers emerged as the strongest positive predictor, supporting evidence of their role in emotional relaxation and comfort (Jiang et al., 2021; Song & Wu, 2022).

Design implications

Overall, the findings suggest that current school gardens only partially meet special education teachers' restorative and functional needs (Nazir & Pedretti, 2016; Hosek & Spaulding, 2020). Multisensory planting, particularly aromatic species, appears critical for enhancing restorative experiences, while prolonged use of underperforming spaces may increase dissatisfaction. The results also indicate that safety perceptions depend more on spatial layout and infrastructure than on vegetation alone. An integrated design approach is therefore required, combining restorative planting features with careful attention to accessibility, visibility, and facility management, to better support teacher well-being in special education school environments.

CONCLUSION

This study examined special education teachers' use of school gardens and their perceptions of plant-related features and overall garden quality in two schools in Zhejiang Province, China. The findings reveal a clear mismatch between teachers' strong recognition of the restorative value of natural environments and their limited engagement with school gardens, alongside relatively low evaluations of psychological restoration and sensory quality. While individual plant-related features, particularly aromatic and multisensory elements, were positively associated with perceived garden quality, environmental safety appeared to depend primarily on spatial and infrastructural factors rather than vegetation. Longer visit durations were linked to lower quality evaluations, suggesting heightened awareness of environmental limitations, whereas higher stress levels were associated with greater sensitivity to restorative landscape qualities. Overall, the results indicate that the restorative potential of

school gardens in special education settings depends on the integrated design of sensory-rich planting, functional spatial organisation, and supportive infrastructure, offering practical insights for the development of more effective restorative school landscapes.

However, the broader applicability of these findings is limited by the study context. As the research focused on only two schools in Zhejiang Province, the results may reflect local environmental, institutional, and cultural conditions. Caution is therefore needed when extending these conclusions to other regions or educational settings. Future studies should include a broader sample across multiple provinces and different school types to examine whether the observed patterns remain consistent under varied contextual conditions. Such research would strengthen the generalisability of the findings and support the development of more broadly applicable restorative landscape design guidelines for schools.

Ethics Statement / IRB: The Ethical approval for this study was given by the Ethics Committee for Research Involving Human Subjects (JKEUPM) granted approval for this study on 24 September 2025 (Ref: JKEUPM-2025-504). Written informed consent was obtained from each participant before the commencement of the survey.

Declaration of Interest Statement

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.

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