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RESEARCH ARTICLE

Shadow Education and Self-Learning Management among Junior High School Students in Guangxi, China

Jingjing Li[1,2], Peng-fei Chen[1,*] and Honglan Yang[1,3]

[1] *Chinese International College, Dhurakij Pundit University, Bangkok, 10210, Thailand*

[2] *School of Accounting, Guangxi University Of Foreign Languages, Nanning, 530222, China*

[3] *College of Agriculture and Biology, Guangxi Minzu Normal University, Chongzuo, 532200, China*

*** Corresponding author:** Peng-fei Chen, peng-fei.che@dpu.ac.th

ABSTRACT

Self-learning management constitutes a fundamental prerequisite for lifelong learning. It plays a key role in fostering sustainable personal development. At the critical educational juncture of junior high school, strengthening students' capacity for self-learning management holds particular importance. Drawing on Self-Determination Theory, this study surveyed 780 junior high school students in Guangxi, China. A questionnaire approach was adopted to examine the relationship between shadow education and three dimensions of self-learning management: autonomous learning, time management, and emotion regulation. The findings indicate that shadow education exerts a significant positive effect on students' autonomous learning, time management, and emotion regulation. In other words, shadow education can enhance students' overall self-learning management competence.

Keywords: Junior high school student; Shadow education; Autonomous learning; Time management; Emotion regulation; Self-Determination Theory

1. Introduction

The essence of education lies in cultivating students' adaptability and improving their learning capacity and self-management skills[1–3]. These abilities enable students to achieve their expected growth and to engage in lifelong learning[4–8]. Lifelong learning is an evolving field. As one of the ultimate objectives of education, it is a focal issue within educational research[9]. China's curriculum reform in basic education has positioned the promotion of students' self-learning management as a central objective of school education[10,11]. The broader national vision of building a "learning society" and a "learning-oriented nation" emphasizes a learner-centered paradigm. This paradigm advocates autonomous learning[12]. It encourages individuals to develop the capacity for autonomous learning, self-evaluation, and self-motivation[13,14]. In this context, self-learning management is regarded as an essential prerequisite for lifelong learning[15,16].

Self-learning management refers to the process by which learners act on the basis of self-understanding and internalized learning goals. They actively employ self-regulation strategies to set tasks, plan, and allocate appropriate learning resources and tools[17]. This process entails self-planning, self-practice, self-monitoring,

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self-evaluation, and self-adjustment. These strategies enable learners to exercise proactive control over elements such as time and emotions[18]. Conceptually, self-learning management encompasses three key dimensions: autonomous learning, time management, and emotion regulation[19]. As a multidimensional construct, it provides strategies and procedures to guide students' learning behaviors. It teaches students how to regulate their emotions, set goals, and manage their time. In doing so, it fosters strong self-motivation[20]. These strategies help students to persist in completing tasks while maintaining focus in the classroom. They ultimately lead to stronger academic outcomes[19]. A greater capacity for self-learning management significantly facilitates the development of lifelong learning competencies[21].

In China, shadow education denotes after-school tutoring or supplementary instruction[22]. It includes academic-oriented and interest-oriented extracurricular tutoring and training. It may also involve guidance in students' values, skills, and personal development. Such supplementary education is characterized by its market-driven and private nature.

In July 2021, the Chinese government issued the Opinions on Further Reducing the Burden of Homework and Off-Campus Tutoring for Students in Compulsory Education (the "Double Reduction" policy)[23]. This policy prohibited off-campus institutions from offering subject-based training during weekends, statutory holidays, and school vacations. It halted the approval of new subject-based training institutions for compulsory education. It required existing subject-based institutions to register as non-profit organizations. Meanwhile, it shifted online subject-based training to a licensing system. These measures highlighted the public welfare orientation of off-campus training[24]. Following its implementation, students who previously participated in subject-based tutoring have generally moved in one of three directions: discontinuing off-campus tutoring altogether, transitioning to non-subject-based training, or turning to enrichment activities such as art, sports, and other quality-oriented programs[25-27].

Shadow education impacts students' autonomous learning, time management, and emotion regulation. Using data from the China Education Panel Survey (CEPS), Zheng et al. (2020) discovered that shadow education significantly enhances students' self-confidence and self-efficacy. It improves their time management skills. It also provides a degree of "psychological comfort," helping students manage emotions and stress[28]. These findings underscore the necessity of investigating the relationship between shadow education and self-learning management[25,28].

Junior high school students are relatively young and cognitively immature. They lack experience in independent living and tend to exhibit dependency[29]. Their diligence in learning generally reflects a natural, unmotivated state. They have limited awareness of the importance of learning and underdeveloped self-management skills. Compared with other educational stages, junior high school represents a particularly critical period for personal development. Cultivating self-learning management during this formative stage is especially salient for adolescents. They are undergoing profound physical and psychological changes[30,31]. By developing robust self-learning management skills, students can fully realize their learning potential in both academic and personal domains. These skills enable them to gain a competitive edge in the future[32].

Relative to China's eastern regions, Guangxi lags in socioeconomic development. This region suffers from a shortage of educational resources[33,34]. Students' self-learning management levels exert far-reaching effects at both the individual and regional levels[35]. For individuals, insufficient self-learning management may lead to diminished motivation and goal orientation, hindering lifelong learning and personal development[18]. At the regional level, such deficiencies can impede talent cultivation and exacerbate inequities in educational resource allocation. Consequently, they limit economic development and hinder both educational and socioeconomic progress[36].

Against this backdrop, this research focuses on junior high school students in Guangxi. It examines the impact of shadow education on self-learning management—specifically in terms of autonomous learning, time management, and emotion regulation. The findings have practical significance for improving students' academic performance and overall competencies. This research contributes to enhancing junior high school students' self-learning management abilities, enabling them to better adapt to future learning and development. Meanwhile, it offers theoretical insights into the field of self-learning management and implications for policy and practice in other underdeveloped regions.

2. Research model and hypotheses

2.1. Research model

Self-Determination Theory posits that individuals possess an innate tendency to internalize and integrate values and norms. However, such internalization requires facilitative external conditions instead of occurring automatically[37]. The extent to which individuals internalize cultural expectations, values, and norms largely depends on whether their basic psychological needs are satisfied during relevant activities[38]. When autonomy, competence, and relatedness are supported, individuals are more likely to transform external values into personally endorsed ones. This process strengthens their sense of self-determination.

Self-Determination Theory thus provides a critical theoretical foundation for educational practice. By meeting students' basic psychological needs, education can regulate and internalize learning motivation. This process ultimately leads to positive learning outcomes[37]. Based on Self-Determination Theory, this research examines the influence of shadow education on junior high school students in Guangxi. It focuses on three dimensions of self-learning management: autonomous learning (autonomy), time management (competence), and emotion regulation (relatedness). The research model is presented in Figure 1.

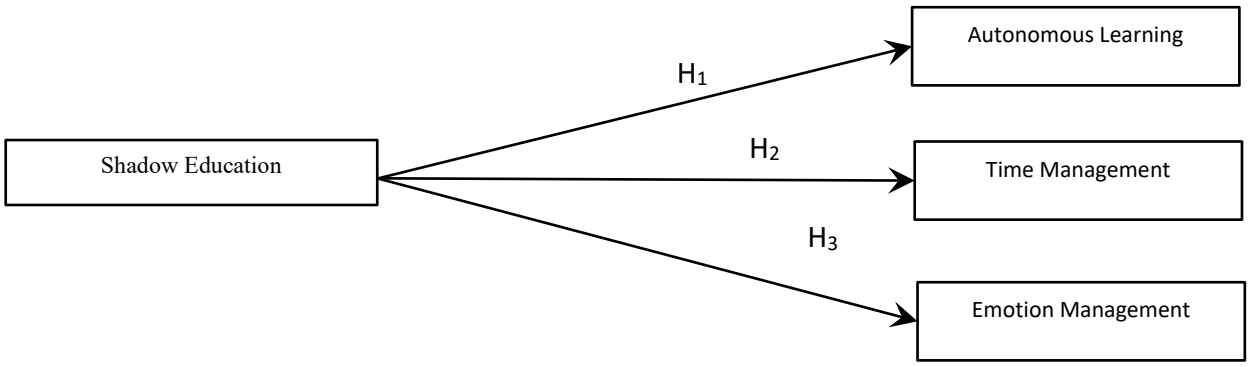

Figure 1. The Research Model

2.2. Relationship between shadow education and autonomous learning

Shadow education can reinforce both students' cognitive and non-cognitive abilities[39,40]. When students have a stronger desire to improve their learning habits, they are more likely to participate in shadow education. This suggests that autonomous learning motivation plays a mediating role in this process[41]. Using CEPS data, Zheng et al. (2020) demonstrated that shadow education significantly improves students' self-confidence and self-efficacy. These improvements further foster autonomous learning[28]. Shadow education increases students' access to educational resources and opportunities. Moreover, it enables them to refine their learning approaches over time. As academic performance improves, students become more motivated to continue optimizing their learning methods[42]. Based on this, the following hypothesis is proposed:

H1: Shadow education has a significant positive effect on junior high school students' autonomous learning in Guangxi, China.

2.3. Relationship between shadow education and time management

Students who participate in shadow education often exhibit stronger aspirations for academic achievement or skill acquisition[43]. Strengthening students' time management ability has been shown to significantly enhance academic performance[44]. Because learning time is limited, effective time management is essential for maximizing outcomes. Shadow education typically takes place outside of regular school hours. Consequently, students must adopt effective time management strategies to balance learning with other activities. These strategies include developing realistic study plans, allocating learning time scientifically, and reducing time waste[45]. Lualhati (2019) found that Filipino secondary school students engaged in shadow education demonstrated positive cognitive, affective, and behavioral attitudes. They achieved significant improvements in time management[46]. Jeon (2022), using regression analysis of Korean youth panel data, reported that shadow education helps students reduce unnecessary time wastage and improve overall time-use efficiency. Based on these findings[47]. The following hypothesis is posited:

H2: Shadow education has a significant positive effect on junior high school students' time management in Guangxi, China.

2.4. Relationship between shadow education and emotion regulation

Shadow education plays a pivotal role in students' emotion regulation. It is particularly effective in fostering positive emotions and enhancing students' ability to manage affective states. Lualhati (2019) found that Filipino secondary school students participating in shadow education demonstrated significantly positive cognitive, affective, and behavioral attitudes[46]. By providing experiences associated with comfort and relaxation, shadow education helps students manage emotions more effectively. Otto and Karbach (2019) reported that shadow education fulfills parental educational expectations and ameliorates parent–child interactions. This, in turn, strengthens students' emotional well-being and psychological stability[48].

Moreover, shadow education serves as a crucial bridge between academic performance and emotion regulation. It helps students shift from feelings of academic inferiority to enhanced confidence and self-esteem. This shift further consolidates their capacity for emotional regulation[49]. Bray (2013) and Zheng et al. (2020) emphasized that improvements in academic performance through shadow education increase students' self-respect and sense of accomplishment. These improvements further bolster their confidence in the future[50]. Additionally, shadow education alleviates anxiety induced by peer pressure. It offers psychological support and reassurance, which is a key reason why many students actively engage in such programs[51]. Positive emotional states enhance students' confidence. Meanwhile, they function as strong predictors of future achievement[52]. Based on these findings, the following hypothesis is put forward:

H3: Shadow education has a significant positive effect on junior high school students' emotion regulation in Guangxi, China.

3. Research design

3.1. Participants and sampling

This study employed a convenience sampling method. An online questionnaire survey was conducted via the Wenjuanxing platform, targeting junior high school students from 14 cities in Guangxi between March 23, 2024, and April 23, 2024. A total of 800 responses were collected. After excluding 20 invalid responses with excessively short completion times, 780 valid questionnaires were retained, yielding a valid

response rate of 97.5%. Among the participants, 294 were male (37.692%) and 486 were female (62.228%). By grade level, 295 students were in Grade 7 (37.724%), 235 in Grade 8 (30.013%), and 250 in Grade 9 (32.888%).

3.2. Measurement

The survey questionnaire consisted of four scales: shadow education, autonomous learning, time management, and emotion regulation. Items measuring shadow education were adapted from the China Education Panel Survey (CEPS) questionnaire. To ensure content validity, five experts reviewed the items for completeness, comprehensibility, and accuracy of expression. Reliability and validity were further tested through item analysis, factor analysis, and reliability analysis. The scales for autonomous learning, time management, and emotion regulation were adapted from well-established and validated instruments developed in international research.

3.3.1. Shadow education scale

To assess the extent of participation in shadow education among these students, this study adapted the scale from the China Education Panel Survey (CEPS). The scale comprises four dimensions: (a) weekly participation in tutoring classes, (b) participation in academic tutoring classes during the past year, (c) participation in interest-oriented tutoring classes during the past year, and (d) participation in tutoring classes during winter and summer vacations in the past year. The four dimensions contain 4, 6, 5, and 3 items, respectively, totaling 18 items. Responses were measured using a five-point Likert scale: 1 = "Never," 2 = "Occasionally (once per week)," 3 = "Sometimes (twice per week)," 4 = "Often (three times per week)," and 5 = "Always (four or more times per week)." Higher scores indicate greater degrees of participation in shadow education.

3.3.2. Autonomous learning scale

To evaluate students' autonomous learning ability, this study employed the Autonomous Learning Scale developed by Cheng et al. (2010)[53]. The scale consists of four dimensions: learning motivation, planning and implementation, self-monitoring, and interpersonal communication. It comprises 20 items in total. Learning motivation and planning and implementation each contain six items, while self-monitoring and interpersonal communication include four items each. Responses were recorded on a five-point Likert scale: 1 = "Strongly disagree," 2 = "Disagree," 3 = "Neutral," 4 = "Agree," and 5 = "Strongly agree." Total scores range from 20 to 100. Higher scores reflect stronger autonomous learning ability.

3.3.3. Time management scale

Students' time management ability was measured using the Time Management Scale developed by Britton and Tesser (1991)[54]. The scale contains three dimensions: short-term planning, time attitudes, and long-term planning. It includes a total of 18 items. Of these, six items measure short-term planning, eight items measure time attitudes, and four items measure long-term planning. Five items (Items 8, 10, 11, 13, and 16) are reverse-scored. Responses were collected using a five-point Likert scale: 1 = "Never," 2 = "Rarely," 3 = "Sometimes," 4 = "Often," and 5 = "Always." Higher scores indicate better time management.

3.3.4. Emotion regulation scale

To assess emotion regulation ability, this study adopted the Emotion Regulation Scale developed by Wong and Law (2002)[55]. The scale comprises four dimensions: self-emotion appraisal, others' emotion appraisal, use of emotion, and regulation of emotion. Each dimension contains four items, totaling 16 items. Responses were measured on a five-point Likert scale: 1 = "Strongly disagree," 2 = "Disagree," 3 =

"Neutral," 4 = "Agree," and 5 = "Strongly agree." Higher scores represent stronger emotion regulation ability among junior high school students.

4. Results

4.1. Model fit analysis / confirmatory factor analysis

This study employed confirmatory factor analysis to assess the model fit of the four scales. The analysis focused on three categories of indices: absolute goodness-of-fit indicators (GFI, RMR, SRMR), incremental fit indicators (RFI, CFI, NFI, IFI, TLI), and parsimonious fit indicators (PNFI, PGFI)[56]. The results are detailed in Table 1. All indices meet the recommended thresholds, and each model demonstrates satisfactory fit.

Table 1. Assessment of Goodness-of-Fit Indicators

Statistics	Evaluation Item	Fit Criterion	Result				Model Fit Outcome
			Shadow Education	Autonomous Learning	Time Management	Emotion Regulation	
Absolute Goodness-of-Fit Indicator	GFI	＞.900	.915	.910	.930	.921	Fit
	RMR	＜.080	.028	.024	.052	.033	Fit
	SRMR	＜.080	.033	.029	.045	.040	Fit
Incremental Goodness-of-Fit Indicator	RFI	＞.900	.933	.936	.930	.934	Fit
	CFI	＞.900	.956	.956	.952	.955	Fit
	NFI	＞.900	.947	.945	.943	.946	Fit
	IFI	＞.900	.956	.956	.952	.955	Fit
	TLI	＞.900	.944	.949	.941	.945	Fit
Parsimonious Goodness-of-Fit Indicator	PNFI	＞.500	.743	.815	.767	.772	Fit
	PGFI	＞.500	.750	.825	.774	.780	Fit

4.2. Reliability and validity analysis

To examine the internal consistency and construct validity of the measurement scales, reliability and validity analyses were conducted using the questionnaire data. The results are presented in Table 2. For the scales of shadow education, autonomous learning, time management, and emotion regulation, the Cronbach's alpha coefficients for all subdimensions—except for long-term planning—exceeded the threshold of 0.700. This indicates good stability and internal consistency. The composite reliability (CR) values ranged from 0.626 to 0.950, all above the recommended threshold of 0.600. The average variance extraction (AVE) values ranged from 0.382 to 0.761. All dimensions—except long-term planning—exceeded 0.500. These results suggest that the four constructs demonstrate acceptable reliability and good construct validity[57].

Table 2. Results of Reliability and Validity

Dimension	Item	Cronbach's α (＞0.700)	CR (＞.600)	AVE (＞.500)
Shadow Education	Weekly participation in tutoring classes	.870	.883	.654
	Participation in academic-oriented tutoring classes in the past year	.936	.945	.741

Dimension	Item	Cronbach's α (> 0.700)	CR (>.600)	AVE (>.500)
	Participation in interest- or specialty-oriented tutoring classes in the past year	.919	.920	.698
	Participation in tutoring classes during winter and summer vacations in the past year	.816	.824	.611
Autonomous Learning	Learning motivation	.902	.907	.621
	Planning and implementation	.931	.932	.695
	Self-monitoring	.910	.910	.717
	Interpersonal communication	.883	.884	.656
Time Management	Short-term planning	.950	.950	.761
	Time attitude	.854	.857	.549
	Long-term planning	.641	.626	.382
Emotion Management	Self-emotion appraisal	.898	.900	.692
	Others' emotion appraisal	.887	.888	.665
	Emotion utilization	.879	.883	.655
	Emotion regulation	.924	.924	.752

Table 2. (*Continued*)

4.3. Discriminant validity analysis

This study employed AVE and the correlation coefficient method to assess discriminant validity. Discriminant validity is established when the square root of the AVE for a latent variable is greater than its correlations with other latent variables[58]. As shown in Table 3, the diagonal elements represent the square roots of the AVEs. These values range from 0.618 to 0.867. The correlation coefficients are between 0.026 and 0.840. For every pair of constructs, the square root of their AVEs exceeded the corresponding correlation coefficient. This meets the criteria proposed by Capron (1999). These results indicate that all constructs exhibit satisfactory discriminant validity.

Table 3. Discriminant Validity Analysis

variable	y1	y2	y3	y4	z1	z2	z3	z4	s1	s2	s3	q1	q2	q3	q4
y1	**.808**[a]														
y2	.776***	**.861**[a]													
y3	.709***	.795***	**.835**[a]												
y4	.709***	.749***	.768***	**.782**[a]											
z1	.140***	.072*	.095**	.134***	**.788**[a]										
z2	.136***	.074*	.079*	.116**	.829***	**.834**[a]									
z3	.146***	.064	.097**	.132***	.776***	.840***	**.847**[a]								
z4	.097**	.031	.041	.087*	.705***	.744***	.781***	**.810**[a]							
s1	.277***	.228***	.245***	.282***	.518***	.578***	.563***	.504***	**.872**[a]						
s2	.173***	.119**	.144***	.197***	.652***	.691***	.669***	.635***	.705***	**.741**[a]					
s3	.190***	.162***	.157***	.168***	.391***	.413***	.409***	.392***	.522***	.548***	**.618**[a]				
q1	.098**	.042	.034	.086*	.626***	.591***	.578***	.602***	.363***	.590***	.366***	**.832**[a]			

variable	y1	y2	y3	y4	z1	z2	z3	z4	s1	s2	s3	q1	q2	q3	q4
q2	.079*	.028	.026	.099**	.535***	.524***	.570***	.586***	.387***	.505***	.375***	.677***	**.815[a]**		
q3	.090*	.033	.046	.098**	.688***	.672***	.672***	.635***	.475***	.621***	.344***	.691***	.646***	**.809[a]**	
q4	.103**	.061	.061	.092*	.603***	.628***	.610***	.569***	.477***	.557***	.315***	.580***	.548***	.690***	**.867[a]**

Table 3. (*Continued*)

Note 1: y represents shadow education, with y1–y4 being its four dimensions; z represents autonomous learning, with z1–z4 denoting its four dimensions; s signifies time management, with s1–s3 as its three dimensions; and q represents emotion regulation, with q1–q4 denoting its four dimensions.

Note 2: Diagonal values are the square roots of the AVEs for each construct, which should be greater than the off-diagonal correlations.

*Note 3: *p < 0.050; **p < 0.010; ***p < 0.001.*

4.4. Correlation analysis

Pearson correlation analysis was conducted to examine the relationships among shadow education, autonomous learning, time management, and emotion regulation. The results are presented in Table 4. Shadow education is positively and significantly correlated with autonomous learning ($r = 0.112$, $p < 0.010$). It moderately and significantly correlated with time management ($r = 0.257$, $p < 0.001$). Additionally, it weakly to moderately but significantly correlated with emotion regulation ($r = 0.082$, $p < 0.050$). Autonomous learning is strongly and significantly correlated with both time management ($r = 0.694$, $p < 0.001$) and emotion regulation ($r = 0.775$, $p < 0.001$). Furthermore, time management and emotion regulation are also strongly and significantly correlated ($r = 0.619$, $p < 0.001$).

Table 4. Summary of Correlation Analysis among Variables

Variable	1	2	3	4
Shadow Education	1			
Autonomous Learning	.112**	1		
Time Management	.257***	.694***	1	
Emotion Management	.082*	.775***	.619***	1

*Note : *p < 0.050; **p < 0.010; ***p < 0.001.*

4.5. Multiple regression analysis

To examine the relationships between the variables, multiple regression analyses were conducted using SPSS. The linear relationships in the models were appropriate, as indicated by significant F values and p values across all models.

When autonomous learning was the dependent variable and shadow education the independent variable, the model was significant ($F = 9.965$, $p < 0.010$). Shadow education explained 1.3% of the variance in autonomous learning ($R^2 = 0.013$), exerting a significant positive effect.

When time management was the dependent variable and shadow education the independent variable, the model was also significant ($F = 55.159$, $p < 0.001$). Shadow education explained 6.6% of the variance in time management ($R^2 = 0.066$), showing a significant positive effect.

When emotion regulation was the dependent variable and shadow education the independent variable, the model remained significant ($F = 5.203$, $p < 0.050$). Shadow education explained 0.7% of the variance in emotion regulation ($R^2 = 0.007$), indicating a significant positive effect.

As shown in Table 5, the findings provide empirical support for all three hypotheses.

Table 5. Summary of Multiple Regression Analyses

Variable	Autonomous Learning	Time Management	Emotion Management
	Beta	Beta	Beta
Gender	.004	.038	.006
Grade	.096**	.052	.120**
Shadow Education	.112**	.257***	.082*
F	9.965**	55.159***	5.203*
R^2	.013	.066	.007
Adj R^2	.011	.065	.005

*Note 1: *p < 0.050; **p < 0.010; ***p < 0.001.*

Note 2: Gender and grade were treated as dummy variables, with male students and Grade 7 serving as the reference groups, and female students, Grade 8, and Grade 9 as the experimental groups.

Note 3: Compiled by the authors.

5. Discussion

This study explored the effects of shadow education on autonomous learning, time management, and emotion regulation among junior high school students in Guangxi. Three hypotheses were proposed and supported by empirical findings.

5.1. Positive effect of shadow education on autonomous learning

The results indicate that shadow education is associated with higher levels of autonomous learning, validating H1. This aligns with previous research by Song and Xue (2020) and Zhang (2023)[59,60]. Shadow education enhances students' academic performance and strengthens their ability to cope with future learning tasks. Students engaged in shadow education exhibited significant improvements in self-confidence and self-efficacy. These improvements, in turn, positively influenced their autonomous learning capabilities[61].

Shadow education promotes comprehensive student development by providing abundant academic resources and support[60]. In addition to strengthening cognitive skills, shadow education fosters non-cognitive abilities, such as problem-solving, creativity, and teamwork. These benefits further enhance students' autonomous learning capacity. The results of this study reinforce the positive role of shadow education in cultivating effective learning habits and strategies.

According to Self-Determination Theory, motivation plays a crucial role in students' learning processes. Students in this study displayed relatively high levels of autonomous learning[38,62]. They possess the ability to learn independently. Moreover, they can effectively plan their learning processes, set realistic goals, and maintain high expectations for learning outcomes. This finding aligns with Widjaja and Chen (2017), who reported that students with higher learning motivation are more likely to engage proactively in learning[63].

5.2. Positive effect of shadow education on time management

The findings indicate that shadow education leads to improved time management, supporting H2. This is consistent with the study by Lualhati (2019)[46]. Students participating in shadow education were more likely to develop detailed study plans. They prioritized learning tasks more effectively. Shadow education,

by offering structured learning activities and organized schedules, assisted students in managing their study time. Improvements included more efficient allocation of time, enhanced task control, and a stronger sense of responsibility. Additionally, increased time management ability was associated with better academic performance. This, in turn, reinforced students' self-confidence.

These results agree with findings by Cayubit et al. (2014) and Romero Pérez and Sánchez Lissen (2022). Shadow education improves students' time management capacity and fosters broader developmental benefits[49,64]. Students become better adept at monitoring and adjusting learning goals, progress, and outcomes. This establishes a positive cycle that ultimately enhances satisfaction in both academic and personal domains.

5.3. Positive effect of shadow education on emotion regulation

The findings indicate that shadow education is positively associated with enhanced emotion regulation among junior high school students, thereby substantiating H3. This is in line with Lualhati (2019)[46]. The benefits of shadow education extend beyond academic performance to encompass emotional well-being. Students engaged in such programs demonstrated stronger emotion regulation competence, particularly in stress management and maintaining positive affect.

Further analysis revealed that shadow education improves emotion regulation by boosting students' self-confidence and sense of academic accomplishment. This finding aligns with Zheng et al. (2020), who noted that students with higher levels of emotional well-being tend to exhibit superior emotion regulation[28]. Shadow education fosters academic success while enhancing self-esteem and confidence. This process mitigates anxiety and depressive symptoms, which are associated with academic pressure. Students' feelings of inferiority are transformed into a sense of efficacy and self-respect. Consequently, their emotion regulation capabilities are significantly strengthened.

Additionally, shadow education was found to positively influence parent–child relationships and fulfill parental educational expectations. This observation is consistent with Otto and Karbach (2019), underscoring the crucial role of shadow education in promoting students' emotional health and overall well-being[48].

6. Conclusion and recommendations

6.1. Conclusion

Based on Self-Determination Theory, this study examined the effects of shadow education on autonomous learning, time management, and emotion regulation among junior high school students in Guangxi, China. Structural model analysis revealed significant and positive effects of shadow education on the three dimensions of self-learning management.

These findings highlight the role of shadow education in addressing learners' individualized and diverse educational needs. They also underscore its contribution to promoting educational innovation. Shadow education is closely linked to students' autonomous learning, time management, and emotion regulation. It fosters autonomy, competence, and relatedness, enhancing students' autonomous learning abilities[65].

Based on these findings, several implications emerge. Schools should leverage shadow education to better accommodate students' individualized learning needs and enhance instructional quality. Parents should pay closer attention to their children's psychological needs. They should encourage children to explore and develop their interests and talents, thereby enhancing psychological resilience. Students should emphasize sustainable personal development and develop habits of lifelong learning[66-69].

6.2. Contributions

Theoretically, this study reveals the positive associations between shadow education and junior high school students' autonomous learning, time management, and emotion regulation within the Guangxi context[70]. It deepens the application of Self-Determination Theory in educational settings. Meanwhile, it enriches quantitative research on shadow education in underdeveloped regions, providing empirical support for constructing inclusive education theories.

At the practical level, the multidimensional assessment scale developed in this study offers practical tools for educators and parents. For teachers, it enables precise diagnosis of students' learning abilities and the design of differentiated instructional strategies. For parents, it facilitates collaborative planning of personalized learning plans, thereby promoting effective school–family educational synergy. Additionally, as a standardized measurement instrument, it allows for cross-regional validation of factors influencing student development. This, in turn, informs the optimization of shadow education governance and localized practices in fostering lifelong learning skills. Overall, the study injects new momentum into the transformation of regional education ecosystems[71,72].

6.3. Limitations and future research directions

Despite its systematic quantitative approaches, this study has several limitations. First, while the quantitative design ensured empirical rigor and objectivity, it constrained the exploration of latent factors. These factors include students' psychological motivations, cultural cognition, and family interaction patterns, thereby limiting explanatory depth. Second, although the study covered 780 junior high school students across 14 cities in Guangxi, constraints on school types, grade levels, and gender distribution may have introduced sample bias. This reduces the comprehensiveness of the findings. Third, critical background variables—such as household economic capital, parental education levels, and parenting beliefs—were not controlled for. These factors may play a moderating role in shaping shadow education participation and self-regulation in contexts of educational inequality in Guangxi. These omissions restrict the generalizability of the results.

Future research can advance this line of inquiry in several ways. First, integrating qualitative approaches—such as in-depth interviews and focus groups—would complement quantitative findings. This would offer richer insights into the causal mechanisms and contextual drivers (e.g., parental decision-making psychology, cultural value conflicts) underlying the relationship between shadow education and autonomous learning. Second, adopting stratified random sampling strategies and expanding coverage to better represent urban–rural gradients, school types, and grade levels would enhance ecological validity. Third, incorporating family-level variables (economic resources, parental education, and parenting beliefs) would allow the construction of an interactive "family–individual–policy" model. This model could clarify how these factors mediate the effects of shadow education on self-regulation under regional educational inequality. Such efforts would provide a stronger empirical foundation for policy interventions tailored to diverse educational contexts.

Author contributions

All authors contributed to the article and approved the submitted version.

Ethics statement

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

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Conflict of interest

The authors declare no conflict of interest

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