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ORIGINAL RESEARCH

How Classroom Environment Influences Academic Enjoyment in Mathematics Among Chinese Middle School Students: Moderated Mediation Effect of Academic Self-Concept and Academic Achievement

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Purpose: Substantial literature has documented the influence of classroom environment on academic enjoyment. However, little is known about the mediating and moderating mechanisms underlying this relationship. Based on the control-value theory and the individual-context interaction model, a moderated mediation model was constructed in this study to further examine whether academic self-concept mediated the relation between classroom environment and enjoyment in mathematics and whether this mediating effect was moderated by academic achievement.

Methods: We recruited 750 Chinese middle school students and they completed the classroom environment, academic self-concept, and academic enjoyment questionnaires.

Results: After controlling for gender and grade, the results of structural equation modeling showed that academic self-concept partially mediated the association between classroom environment and enjoyment in mathematics. The mediating path from classroom environment to academic self-concept was moderated by academic achievement. Classroom environment positively predicted academic self-concept for the higher achieving students. However, the effect of classroom environment on academic self-concept was not significant for the lower achieving students.

Conclusion: These findings highlight that classroom environment has a more salient impact on academic self-concept and enjoyment for higher achieving students than for lower achieving students. The study results provide guidelines for educators regarding effective interventions for fostering positive academic emotions.

Keywords: academic enjoyment, classroom environment, academic self-concept, academic achievement

Introduction

Academic emotions are defined as a wide range of emotions tied directly to achievement-related activities or achievement outcomes.[1,2] To date, research on academic emotions has typically focused on emotions relating to achievement outcomes such as test anxiety.[3–5] Other emotions relating to achievement activities have received much less attention. Academic enjoyment is one of activity-related and pleasure emotions most frequently reported by middle school students.[6–10] The experienced enjoyment regarding different academic situations can differ as well.[11] The present study focus on the class-related enjoyment, which is operationally defined as the activity-related pleasant emotion that

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students experience during class attendance.[12] The experience of enjoyment plays a pivotal role in middle school students' cognitive processes and performance in the academic domain as well as their psychological health.[13–15] Given the clear relevance of enjoyment for education, clarifying the antecedents of enjoyment may be of specific importance for fostering students' achievement-related emotional life and learning.

The present study aimed to explore how middle school students' perceptions of the classroom environment were related to their academic enjoyment in math class. The perceived classroom environment can be conceptualized as students' subjective perceptions of the entire learning setting.[16,17] In line with the causal relationship outlined in Pekrun's social-cognitive model,[18] numerous studies have clearly demonstrated that the following aspects of a student's learning environment are significantly related to the development of enjoyment: (a) quality of instruction (including teacher enthusiasm, elaborative instruction, and order and organization in class), (b) induction of values (eg, peer regard of the subject), (c) feedback and consequences of achievement (indicating perceived teacher punishment or positive reinforcement of achievement), and (d) expectations and goal structures. Specifically, some research found a positive correlation between students' perceptions of order and organization in class and their enjoyment.[19,20] Participating in an orderly, quiet, and polite instructional environment may be enjoyable for students. Such enjoyment may be generalized to related activities of learning and achieving. Additionally, numerous studies examined students' perceptions of other aspects of the learning environment and enjoyment experienced in class. The findings suggest that individually perceived positive reinforcement of achievement,[14] teacher enthusiasm,[21–23] and elaborative instruction were positively related to individual reports of enjoyment.[24] Moreover, the previous studies also revealed that individual levels of enjoyment in mathematics were positively related to individually perceived peer esteem of mathematics as well as to individual perceptions of cooperation among classmates.[25,26]

However, there are some limitations to the existing research. First, although the direct link between classroom environment and enjoyment has received empirical support, research examining the underlying mechanism remains limited. In addition, the social-cognitive model further states that the social relatedness aspect of the learning environment may be particularly relevant to the development of academic emotions.[27,28] Interacting with teachers and classmates in the classroom are daily routines in a middle school student's life. These teacher–student and student–student relationships may induce positive activity-related emotions during the learning process.[13,29–31] Nevertheless, empirical evidence for the relationship between the social relatedness aspect of the classroom environment and academic enjoyment is still lacking.

In sum, the present study aimed to examine the following four facets of classroom environment to further explore the underlying influence mechanisms between the classroom environment and academic enjoyment of mathematics among Chinese middle school students: (1) teacher–student relationships, operationally defined as the student perceived positive affect and emotional support between teacher and the classmates in the classroom;[32,33] (2) student–student relationships, operationally defined as the student perceived care, support, and union among classmates in classroom;[32,34–36] (3) cooperative goal structure, operationally defined as student' perception of mutual assistance and sharing of resources among classmates in academic subjects in classroom;[32,37] and (4) order and organization, operationally defined as the student' perception of the degree to which students subscribe to class rules, and the consistency and effectiveness of classroom disciplines.[32,38]

Academic Self-Concept as a Mediator

The control-value theory of academic emotions offers a comprehensive theoretical framework involving analyzing the environmental and individual antecedents of academic emotions experienced in achievement and academic contexts.[6] Specifically, this theory distinguishes distal and proximal individual antecedents from environmental antecedents.[6] Based on this theory, any type of academic emotions initially induced by control- or value-related cognitions.[11] Control-related cognitions and value-related cognitions are proposed as proximal individual antecedents that mediate the relations between the learning environment and academic emotions.[11,28] It implies that environment perceptions do not trigger an emotion directly, but have to be appraised cognitively before being able to do so.[1,2,11] Specific to academic enjoyment, it may be assumed to depend on a higher level of perceived competence to meet task challenges.[13,39,40] Various positive aspects of classroom environment that convey strong messages concerning students' inherent competence beliefs are

likely related to their enjoyment experience. One important type of competence-related control appraisal is academic self-concept. The academic self-concept has been defined in a variety of ways since its inception, but most researchers have defined the academic self-concept as the self-perception of a student's competencies in an academic subject such as math.[41–44] It implies that a student's perceived classroom environment influences his or her academic self-concept initially, which in turn is assumed to be an antecedent of enjoyment.

Empirically, many studies have consistently demonstrated that academic self-concept has positive effects on enjoyment.[45–47] The findings of existing research have suggested that a student is expected to experience enjoyment during learning if he or she feels competent to meet the academic demands. If a student feels incompetent, studying is not enjoyable. Additionally, some scattered findings have further suggested that several aspects of classroom environment are significantly relevant to academic self-concept. Specifically, the type of relationship that teachers foster with the students in their classroom affects the development of students' academic self-concept such that a supportive teacher–student relationship can predict significant increases in students' reported academic self-concept.[48–51] In addition, other research found that student's academic self-concept was related to interactive experiences with peers during classroom activities.[51] A feeling of support and acceptance from classmates can lead adolescents to evaluate themselves positively, resulting in a higher academic self-concept.[18] Moreover, cooperative goal structure in the classroom implies positive contingencies; that is to say, individual success is dependent on others' success or the success of a group.[18] Therefore, a classroom environment that supports mutual assistance might lead to relatively more opportunities for experiencing success and a sense of control in an achievement activity. Thus, cooperatively organized learning may result in more positive academic self-concept.[52] Finally, Lazarides et al implied that student's academic self-concept was related to perceived order and organization in the classroom.[48] Students possessed higher academic self-concept when they considered the instructional process to be orderly, quiet, and polite, with expectations of obtaining assistance during learning.

As emphasized above, although the direct examination of the mediational assumption implied by control-value theory remains limited, these scattered empirical findings provide consistent support for a mediating role of academic self-concept between classroom environment and academic enjoyment.

Academic Achievement as a Moderator

Another important issue is whether the effect of classroom environment on academic self-concept is applicable to all students in the same way. In other words, are higher achieving and lower achieving students' academic self-concept within the same classroom equally affected by learning environment characteristics?

Numerous academic self-concept studies have highlighted its relations with learning environment and academic achievement.[53–55] For example, it has been reported that the supportive classroom environment and better achievement outcomes lead to a better academic self-concept, respectively.[11,54–56] However, the previous studies have mainly focused on the unique roles of the classroom environment factors and academic achievement to academic self-concept but their joint role remains unclear. Relying on the core prediction of the individual-context interaction model, it is not possible to understand how environment factors function without knowledge of individual factors functioning.[57,58] In fact, actual psychological characteristics are a function of a continuous process of interaction between the student and the learning environment.[57,58] Thus, the combined impact of classroom environment and academic achievement on students' academic self-concept is more than the additive effect but is an interaction effect. Hence, it is reasonable to speculate that higher achieving and lower achieving students' perceptions of their classroom environment would affect their academic self-concepts differently.

Furthermore, the existing empirical results indicate that the positive link between classroom environment and academic self-concept is stronger for lower achieving than for higher achieving students. Specifically, some research has shown that the positive evaluation and support of students' task performance and effort by teachers is more effective in improving lower achieving students' academic self-concept.[59,60] Compared with higher achieving students, lower achieving students tend to have more negative cognitions and evaluations of their own academic competences, thus demanding more positive external reinforcers. Hence, supportive teacher–student relationships give lower achieving students, who may perceive themselves as less competent than others, stronger feelings of competency. Moreover, positive student–student relationships enable peers of varying academic abilities to assist each other in learning activities.

In particular, lower achieving students will benefit more from these kinds of social interactions during learning because they are more likely to receive the academic support they need from more competent peers.[61,62] Therefore, more supportive student–student interactions would predict more significant increases in lower achieving students' reports of academic self-concept. In addition, considering that higher achieving students are generally more competent to perform tasks on their own, a cooperative goal structure in the classroom provides more chance of being successful for lower achieving students.[62] It is plausible that a cooperative goal structure in the classroom may have a more positive impact on lower achieving students' academic self-concept. Finally, higher achieving students prefer math classes that are more open, autonomous, and even unbounded.[63–65] Allowing higher achieving students to make choices in their learning results in a greater sense of control and personal involvement in the educational process. However, for lower achieving students, participating in a structured and orderly classroom allows them to stay focused so as to better comprehend the learning materials and provide a stronger sense of control.

The evidence presented above, paired with the scattered empirical findings, suggests that the relationship between classroom environment and academic self-concept is likely to be stronger for lower achieving students.

The Current Study

Based on the above, the present study extended research in this field by examining the influence mechanism between classroom environment and enjoyment in mathematics through a hypothesized moderated mediation model (see Figure 1). We anticipated that (a) classroom environment would positively predict students' enjoyment in mathematics via the mediation effect of academic self-concept (H1), and (b) academic achievement would moderate the impact of classroom environment on students' academic self-concept (H2). Specifically, the positive link between classroom environment and academic self-concept would be stronger for lower achieving students than for higher achieving students.

Methods

Participants

A total of 750 Chinese middle school students (females = 48.90%; M_{age} = 12.68 years, SD = 0.67) attending Grade 7 (n = 327) or Grade 8 (n = 423) were randomly recruited from two ordinary middle schools in Beijing city to participate in the survey. Participants were recruited from a total of 29 regular and heterogeneous classes. Data were collected during the second part of the academic year.

Measures

Classroom Environment

Four dimensions of the Chinese version of the classroom environment questionnaire were selected to assess students' perceptions of the classroom environment.[32] The teacher-student relationship subscale assessed the degree of the participants perceived the relationship between classmates and their teacher (8 items, ie, "Students like the math teacher"). The student-student relationship subscale measured the degree of the participants perceived the relationship among classmates (8 items, ie, "In math class, Students support and encourage each other"). The competitive goal structure subscale assessed the perceived

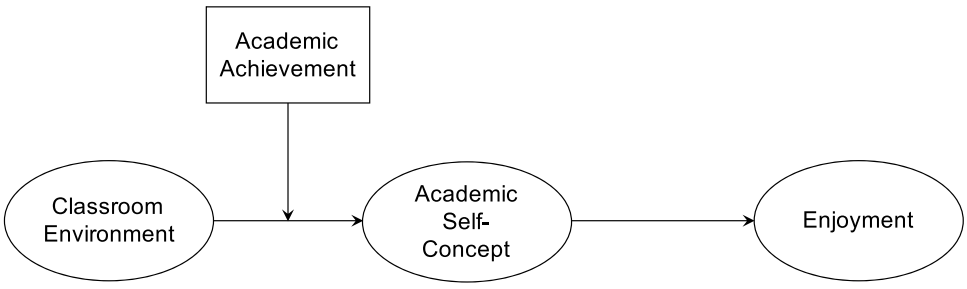

Figure 1 The proposed moderated mediation model.

competition atmosphere among classmates in class (7 items, ie, "Competition between students is intense in math class"). The order and discipline subscale measured student' perception of the degree to which students subscribe to classroom rules, the consistency and effectiveness of classroom disciplines (8 items, ie, "Students abide by discipline in math class"). The My Class Questionnaire has been widely applied to the Chinese adolescents and it has shown good reliability and validity.[32,34,36,66] To confirm the domain-specific context, each item was confirmed for the mathematics situation. A 5-point Likert scale was provided, ranging from 1 (*not at all true*) to 5 (*very true*). Scoring of items in the competitive goal structure subscale was reversed. The scores for the four subscales were summed to create a total score, with higher scores indicating higher levels of classroom environment. In this study, the Cronbach's α coefficients for the teacher–student relationship subscale, the student–student relationship subscale, the competitive goal structure subscale, and the order and discipline subscale were 0.889, 0.779, 0.701, and 0.858, respectively, and the CR (composite reliability) were 0.890, 0.785, 0.662, and 0.865, respectively, indicating good reliability. Correspondingly, the average variance extracted (teacher-student relationship scale: AVE = 0.503; student-student scale: AVE = 0.493; competitive goal structure scale: AVE = 0.471; discipline and order scale: AVE = 0.562) indicated that the questionnaires had good validity. The lowest AVE value was 0.471 for competitive goal structure subscale, which exceeded the largest squared correlation between any pair of constructs (0.349, between "teacher-student relationship" and "student-student relationship"). Thus, shared variance between factors was lower than the AVE's of the individual factors, which confirmed discriminant validity. The results of CFA indicated that construct validity of model was acceptable (χ^2/df = 3.723, $p < 0.05$, CFI = 0.903, TLI = 0.890, RMSEA = 0.060).

Academic Self-Concept

Items from the Chinese version of the Self-Description Questionnaire–II (SDQ-II),[67] was used to evaluate students' academic self-concept in the domain of mathematics. In line with the previous studies,[68] three items focused on cognitive as opposed to affective components of students' academic self-concept were drawn in order to avoid redundancy between academic self-concept scale and academic enjoyment scale (the discussion of the distinction between cognitive-evaluative and affective components of academic self-concepts could be found in Leung's research).[69] It included items such as, "Mathematics is one of my favorite subjects". Each item was answered using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The questionnaire presented satisfactory reliability and validity (Cronbach's α = 0.942, CR = 0.947, AVE = 0.665). The results of CFA indicated that construct validity of model was acceptable (χ^2/df = 4.395, $p < 0.05$, CFI = 0.987, TLI = 0.979, RMSEA = 0.067).

Academic Achievement

Students' academic achievement data were collected using their average math examination performance on multiple standardized tests within each academic year. This enhanced the reliability of multi-point testing scores in comparison to testing scores on a single exam.[70] Examination scores were converted to *z* scores ($M = 0$, $SD = 1$ for all 29 classes) such that higher numeric values indicated relatively higher achievement in class, which is consistent with a previous study.[71] Combined with the teacher-based evaluation, this average math examination performance represented the students' performances in mathematics within each academic year. The last standardized tests had been administered to the students about three weeks prior to the assessment of academic self-concept and enjoyment, implying that there was a clear temporal ordering of the assessment of prior achievement, on the one hand, and academic self-concept and enjoyment, on the other. This meant that students knew their test scores before they participated in questionnaires about their academic self-concept and enjoyment.

Academic Enjoyment

The academic enjoyment scale was drawn from the Chinese versions of the Achievement Emotions Questionnaire–Mathematics (AEQ-M) to assess the academic enjoyment participants experienced when studying mathematics.[72] It consisted of 9 items, which are appropriate for students of grades 5 to 10, pertaining to emotional experiences related to attending mathematics classes, studying and doing homework assignments in mathematics, and taking math tests and exams. We only selected 4 items pertaining to attending mathematics classes (class-related situation) in this study (ie, "I enjoy my math class"). Participants responded on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Higher numeric scores indicated higher levels of enjoyment. The results of the reliability and validity of this scale

in the present study were satisfactory (Cronbach's α = 0.882, CR = 0.883, AVE = 0.566). The results of CFA indicated that construct validity of model was acceptable (χ^2/df = 3.482, $p < 0.05$, CFI = 0.990, TLI = 0.984, RMSEA = 0.058).

Procedure and Data Analysis

Our study was conducted in accordance with the declaration of Helsinki. We obtained approval from the Academic Ethics Committee of the Faculty of Psychology at Beijing Normal University and the principals of the participating schools. Written informed consents were obtained from school principals, teachers, and parents of all students. All participants were informed of their rights to withdraw from the study at any time. Participation was voluntary, and the questionnaires were administered shortly after the scores were published by external, trained testing staff. The investigation was conducted in the students' classrooms during regular math class time. The research assistants distributed and collected the questionnaires according to the seating order. Participants were asked to complete the measures assessing the perception of classroom environment, academic self-concept, and enjoyment. Additionally, some demographic data were collected, including age, gender, and grade. It took approximately 30 minutes for the students to complete all the instruments. To match math grades to each student and link math grades to their responses on the questionnaires, research assistants asked math teachers to provide students' test scores according to the seating order registration form. After the packages were completed, the participants were told that school psychologists or teachers were available to provide any psychological/counseling services that they might need.

First, we conducted a confirmatory factor analysis (CFA) to ensure that reliability and validity of the model was acceptable. Then, descriptive analyses and partial correlations were calculated for the main measures by IBM SPSS software (version 21.0). The pattern of missing data was first evaluated. The results showed that the missing rates of all variables were less than 10%. Therefore, we used the listwise method to handle the missing data in the following structural equation model.[73] Furthermore, a structural equation modeling analysis was conducted in order to explore the hypothesized model by AMOS 20.0. According to Hoyle's suggestion,[74] a model fit was considered acceptable when χ^2/df was smaller than 5; IFI, CFI, and TLI were larger than 0.90; and RMSEA was smaller than 0.08. Meanwhile, a bootstrap estimation procedure with 5000 bootstrap samples was performed to test the significance of the paths.

Results

Preliminary Analyses

The descriptive statistics and partial correlation coefficients are presented in Table 1. We controlled for gender and grade, which have been shown to be related to academic self-concept as well as to enjoyment.[75] Results of partial correlations indicated that students' perceptions of teacher–student relationships, student–student relationships, perceived cooperative goal structure among peers (reversed score of items in the competitive goal structure subscale), and order and organization were positively correlated with academic self-concept and enjoyment, respectively. Academic self-concept was positively correlated with academic achievement and enjoyment. In addition, academic achievement was positively correlated with enjoyment.

Table 1 Descriptive Statistics and Partial Correlations for All Variables

Variables	1	2	3	4	5	6	7
1 Teacher-student relationship	-						
2 Student-student relationship	0.591***	-					
3 Cooperative goal structure	0.246***	0.328***	-				
4 Order and organization	0.348***	0.352***	−0.016	-			
5 Standard score of math achievement	0.098**	0.117***	0.028	0.059	-		
6 Academic self-concept	0.232***	0.202***	0.146***	0.116**	0.459***	-	
7 Enjoyment	0.511***	0.418***	0.211***	0.256***	0.258***	0.604***	-
M	4.256	4.112	3.477	4.040	0	2.949	3.611
SD	0.714	0.693	0.803	0.884	0.985	1.022	0.863

Notes: ** $p < 0.01$. *** $p < 0.001$.

The Mediating Effect of Academic Self-Concept

The mediation model represented in Figure 2 was found to be an acceptable fit to the data: $\chi^2/df = 3.525$, $p < 0.001$; CFI = 0.952, TLI = 0.944, IFI = 0.952, and RMSEA = 0.058. The gender and grade variables were controlled. The results showed that gender and grade had positive effects on academic self-concept but no effects on enjoyment. As we hypothesized, classroom environment positively predicted academic self-concept ($\beta = 0.281$, $t = 5.760$, $p < 0.001$, 95% confidence interval CI [0.221, 0.350]), and academic self-concept positively predicted enjoyment ($\beta = 0.537$, $t = 9.969$, $p < 0.001$, 95% CI [0.487, 0.590]). Moreover, the direct effect of classroom environment on enjoyment was also significant ($\beta = 0.468$, $t = 7.136$, $p < 0.001$, 95% CI [0.406, 0.523]). Bootstrap analysis indicated that the indirect effect of classroom environment on enjoyment via academic self-concept was significantly different from zero (95% CI [0.120, 0.191]). In addition, from the data in Figure 2 suggest that classroom environment and control variables (including gender and grade) together explained 16.6% variance on academic self-concept. Furthermore, the total variance of enjoyment accounted for by the mediation model was 63.8%.

The Moderating Mediation Effect of Academic Achievement

The moderated mediation model presented in Figure 3 was found to be an acceptable fit for the data: $\chi^2/df = 3.362$, $p < 0.001$; IFI = 0.946, TLI = 0.938, CFI = 0.946, and RMSEA = 0.056. The gender and grade variables were controlled. The results showed that gender and grade had positive effects on academic self-concept but no effects on enjoyment. Bootstrapping analyses indicated that the indirect effect of classroom environment on enjoyment through academic self-concept was moderated by academic achievement. As we hypothesized, the main effects of classroom environment ($\beta = 0.224$, $t = 5.531$, $p < 0.001$, 95% CI [0.180, 0.305]) and academic achievement ($\beta = 0.439$, $t = 12.270$, $p < 0.001$, 95% CI [0.362, 0.464]) on academic self-concept were significant. Moreover, the interaction effect between classroom environment and academic achievement on academic self-concept was significant ($\beta = 0.061$, $t = 1.934$, $p = 0.05$, 90% CI [0.004, 0.139]). The following simple slope analysis (Figure 4) showed that classroom environment positively predicted academic self-concept for the higher achieving students ($\beta = 0.252$, $t = 1.916$, $p = 0.061$, 90% CI [0.141, 0.692]). However, the effect of classroom environment on academic self-concept was not significant for the lower achieving students ($\beta = 0.091$, $t = 0.930$, $p > 0.05$). In addition, from the data in Figure 3 suggest that classroom environment, academic achievement, interaction effect between classroom environment and academic achievement, and control variables (including gender and grade) combined to explain 33.4% variance on academic self-concept. The 33.4% variance on academic self-concept was not only explained by classroom environment and control variables but also by the incremental variance added by the achievement-related measures. Furthermore, the total variance of enjoyment accounted for by the moderated mediation model was 65.2%. The proportion of variance explained of enjoyment

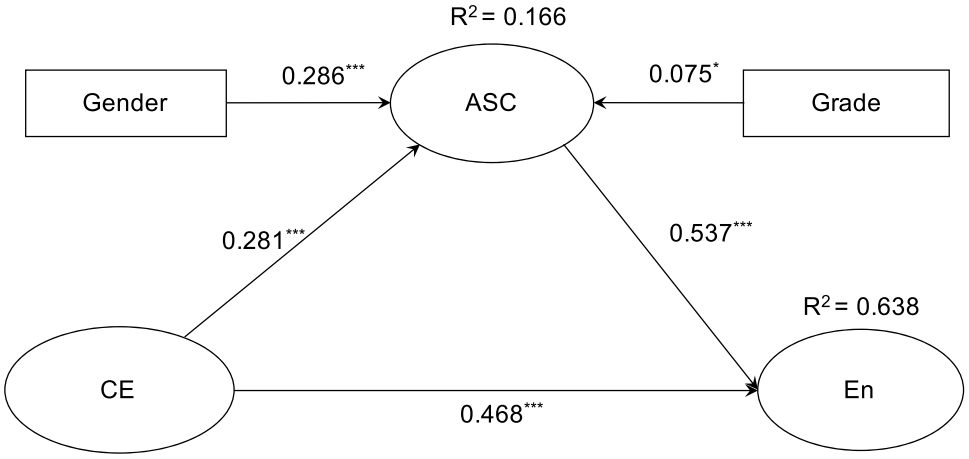

Figure 2 The results of the mediation model. * $p < 0.05$, *** $p < 0.001$.
Abbreviations: CE, classroom environment; ASC, academic self-concept; En, enjoyment.

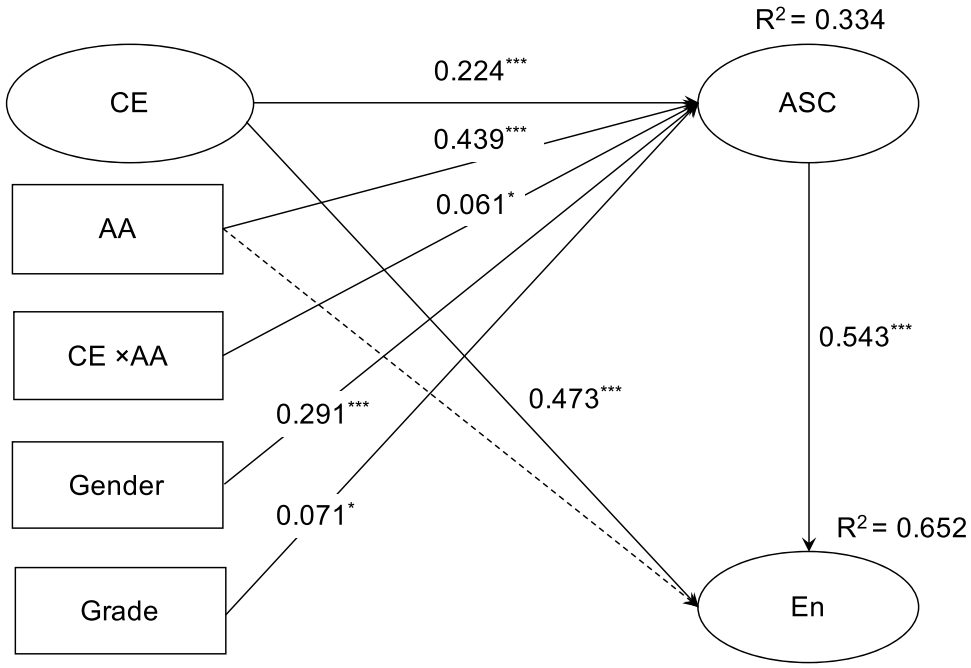

Figure 3 The results of the moderated mediation model. * $p < 0.05$, *** $p < 0.001$. The dashed line indicates that the coefficient is not significant.
Abbreviations: CE, classroom environment; AA, academic achievement; ASC, academic self-concept; En, enjoyment.

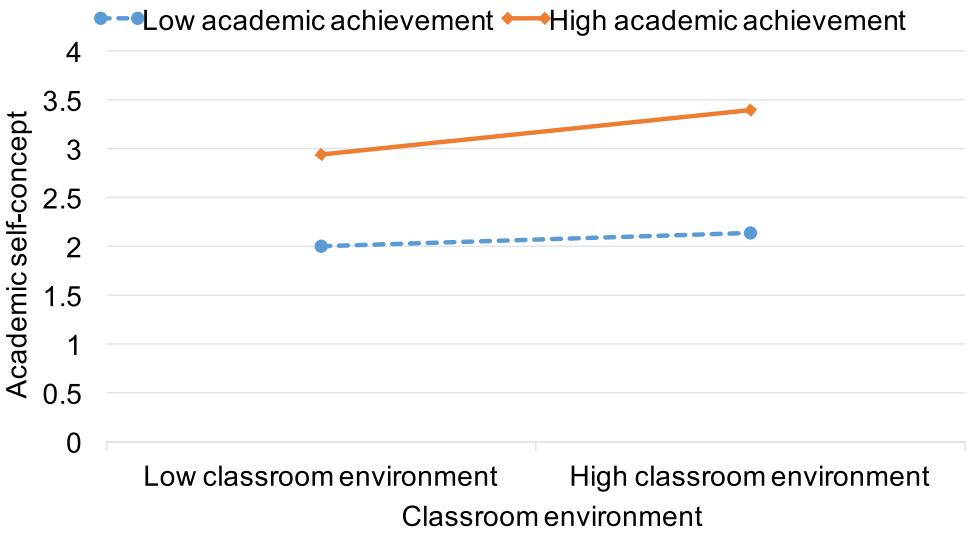

Figure 4 The interactive effect of classroom environment and academic achievement on academic self-concept.

increased by 1.4% (R^2 increased from 0.638 to 0.652) after adding the moderating variable to the first half path of the mediation effect.

Discussion

Based on the control-value theory and individual-context interaction model, the current study constructed a moderated mediation model to examine the mediation effect of academic self-concept in the relationship between classroom environment and enjoyment, and the moderating role of academic achievement in the association between classroom environment and academic self-concept. In line with our hypothesis, academic self-concept was proved to partially mediate the association between classroom environment and enjoyment. It is consistent with the expectation based on the

control-value theory.[1,76] Thus, H1 was supported. Moreover, academic achievement moderated the mediation path from classroom environment to academic self-concept. Specifically, contrary to our assumptions, classroom environment positively predicted academic self-concept for the higher achieving students. However, the effect of classroom environment on academic self-concept was not significant for the lower achieving students. Thus, H2 was partially supported.

As expected, after controlling for gender and grade differences in academic self-concept, girls reported levels of enjoyment in mathematics similar to their male counterparts. As such, the findings suggest that gender and grade differences in enjoyment found in existing studies are possibly due to differences in perceived competence.[77] Meanwhile, by controlling for relevant background variables that were related to the key study variables, we made sure that associations in the model were not due to the confounding effects of third variables, such as gender and grade.

The Mediating Effect of Academic Self-Concept

In line with assumptions derived from Pekrun's control-value theory and social cognitive theory,[2,18] our findings showed that classroom environment positively predicted academic self-concept in math class among Chinese middle school students. Then, academic self-concept positively predicted enjoyment. The mediation model accounted for 63.8% of the enjoyment variance explained. The results indicated that students who perceive their classroom environment as a place that supports their learning may have a greater sense of control of their learning and perceive more learning-related enjoyment.

In addition, our results showed that classroom environment positively and directly predicted enjoyment in math class. All of the studies explained the relationship between classroom environment and enjoyment through the mediation effects of appraisals of control or value.[17,27] This implies that classroom environmental perceptions do not trigger enjoyment directly but have to be cognitively value-appraised or control-appraised to trigger a sense of enjoyment. Notably, the control-value theory further states that the relationship between learning environment and academic emotions is not always mediated by conscious appraisals.[18] Conversely, it emphasizes that recurring cognitive appraisals induce academic emotions automatically.[1] In comparison to Western countries' class settings and composition, the class section composition is constant across subjects and ages in China. Specifically, the class setting and composition in China is fixed based upon initial registration or distribution and remains unchanged for several years (ie, the same group of peers moves together from Grades 7 to 9 in middle school). All students learn with the same classmates and teachers and interact with each other for a long time. The fixed class composition provides a particularly stable psychological and social environment in the middle school classroom. In a fixed class setting, recurring experienced routinized classroom atmosphere perceptions produce routinized cognitive appraisals, which induce academic emotions automatically and directly. Moreover, the habitualized unconscious cognition appraisals might not need to be present and measured, but may have produced these emotions in the first place when the process of habitualization started.

The Moderation Effect of Academic Achievement

Findings of the present study showed that academic achievement moderated the mediation path from classroom environment to academic self-concept. Specifically, contrary to our assumptions, classroom environment positively predicted academic self-concept for the higher achieving students in mathematics. However, the effect of classroom environment on academic self-concept was not significant for the lower achieving students.

Although the finding has not been documented in other studies, it is not incomprehensible. Specifically, higher achieving students might have experienced more stress than lower achieving students because of the added pressure of high expectations from teachers and parents to succeed academically.[78] An overemphasis on academic achievement has made it challenging for higher achieving students to cope with their successes and failures, especially in the context of academic settings with frequent examinations such as in China. After experiencing failure in an academic area, high-achieving students may be more likely than low-achieving students to question their academic competency. Consequently, higher achieving students may have to depend more on continuous encouragement and positive evaluations from teachers to maintain their inherent self-worth than their lower achieving counterparts. However, the lack of significant association between teacher–student relationships and lower achieving students' academic self-concept may reflect the differential needs of lower achieving students. Lower achieving students cannot change their academic status

by relying only on positive external evaluation due to cumulative failing performance. They may need extra academic guidance and help from teachers in order to promote their academic self-concept. Furthermore, self-concept is defined as a multidimensional construct. Generally, lower achieving students may have more opportunities to exhibit their nonacademic abilities in the process of social interactions with classmates.[79] Involvement in close and supportive relationships with peers may be strongly linked with self-perceptions of social competencies for lower achieving students.[80] For these students, future study could further verify the mediating role of social self-concept between classroom environment and enjoyment. Additionally, the motivations of lower achieving students in cooperative classrooms could be reduced by the free-rider effect,[81] which means that lower achieving learners tend to receive help passively whereas highly able learners tend to do most of the work. This gives higher achieving students more opportunities to exhibit their academic ability. Such an effect could support the stronger relationship between cooperative goal structure and higher achieving students' academic self-concept.

The moderated mediation model accounted for 65.2% of the enjoyment variance explained. Notably, the added moderating variable (academic achievement) in the mediation model explained 1.4% of the variance, but this number does not mean that the moderating effect was meaningless. In fact, it is indisputable that the overall, observed moderating effects usually are smaller than what is conventionally defined as a small effect.[82] Smaller effect size may therefore be of theoretical importance if it supports the theoretical views being tested. Moreover, the interaction effect between classroom environment variables and academic achievement on academic self-concept has been reported in other studies. For example, recent research found that the protective effect of social relationship in class is more salient in high-achieving students' self-concept, in comparison to low-achieving individuals.[83] In the future, more empirical studies might be needed to further investigate more diversified classroom environment variables to verify the generalizability and stability of the results.

In addition, our study results showed that academic achievement and related experiences of success and failure might be a major source of students' academic self-concept and enjoyment development. Presumably, in environments involving frequent assessments such as Chinese classroom settings, students' academic performance is likely of primary importance for the arousal of academic self-concept, which then further affects academic emotions. It is coherent with what is assumed by the control-value theory, which assigns higher relevance to individual antecedents than to environmental antecedents.[1,76]

Implications for Practice

The present study extends our understanding by providing a comprehensive picture of the mediation path between classroom environment and enjoyment through academic self-concept for higher and lower achieving students. First, teachers often underestimate their influence on students' emotional experiences. In contrast, our findings provide empirical support for informing the impact of significant others (including teachers and classmates) not only on higher achieving students' knowledge acquisition but also on their emotional experiences. Second, while a supportive, positive classroom environment can promote the academic self-concept of higher achievers, it may have little effect on lower achievers. Future studies need to explore factors affecting the academic self-concept of lower achievers that are conducive to promoting their positive academic emotions. Third, the results showed that academic achievement is a salient factor influencing academic self-concept and enjoyment. Educators need to consider changing assessment systems from a singular-assessment approach to a multi-assessment approach.

Limitations and Future Directions

There are several limitations that need to be addressed and directions for future research that need to be pointed out. First, we considered academic enjoyment as the main positive academic emotion in the school context. Future study may shed more light on the contribution of other positive academic emotions, such as pride. Second, we did not collect data on the sense of value. We measured only academic self-concept as a control-related cognition antecedent of enjoyment. Most students believe that mathematics is of high value, especially in China.[84] But the difference of sense of control varies from person to person, so our research focused on the mediating role of the sense of control. A more complete investigation that includes not only control-related cognition but also value-related cognition will allow a more

comprehensive understanding of these antecedents. Third, we considered sample sizes for our mediation and moderation models followed some popular rules-of-thumb, such as 5 or 10 observations per estimated parameter.[85] However, such rules are problematic because they are not model-specific and may lead to underestimation of sample size. In fact, a sample size was required for the complexity models condition with the small indirect effect size.[86] The actual sample sizes used in the current study may be insufficient to estimate our complexity models of interest, which might result in unstable estimation of the model parameters. Future study could use data simulation techniques (ie, Monte Carlo method) to evaluate sample size requirements for commonly applied SEMs. Besides, the sample size of the present study did not allow the cluster structure of the data to be taken into account (students were grouped in their classrooms). Thus, we could not implement an optimal test of data that comprised a multilevel structure by applying hierarchical linear modeling methodology. Additionally, the sample was drawn from a heterogeneous fixed class setting in grade 7 and 8 students in China, so the findings cannot be generalized to classes with distinctly different composition, such as tracking class. As such, it would be necessary to replicate this study in different types of classes, preferably over a wider age range. Finally, academic achievement, academic self-concept, and enjoyment have been found to be reciprocal and mutually reinforcing from a developmental perspective.[11,87,88] Furthermore, a recent study supported the potential reciprocal relationship between classroom environment and academic self-concept.[88] In addition to the known influence of classroom environment on academic self-concept, their research further demonstrated the predictive effect of academic self-concept on perceived classroom environment. Students who evaluate themselves as having a higher academic ability are more likely to report perceived positive in-class and out-of-class learning experiences and thus engage more in learning. However, our study only explored the relationship among classroom environment, academic achievement, academic self-concept, and enjoyment from the traditional unidirectional perspectives. We suggest that future research could explore their causal orderings and mechanism by a longitudinal design.

Conclusion

Based on the control-value theory and the individual-context interaction model, this research explained the impacting mechanism of classroom environment on middle school students' enjoyment in math class. The results underpin a more salient impact of classroom environment on enjoyment via academic self-concept for higher achieving students. However, the above mediational path was not significant for the lower achieving students. As such, the initial findings of this study highlight that the differentiated instruction and intervention support in classroom is necessary for fostering all students' positive achievement-related emotion. It is particularly suggested that educators should consider not only impact of supportive classroom environment on academic self-concept and emotions for higher achieving students, but also the extra demands of the classroom environment for lower achieving students.

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Ying Liu and Yu Wang contributed equally to this manuscript and share the first authorship.

Compliance with Ethical Standards

This study closely followed all ethical standards established by Institutional Review Board at the authors' universities and the participating schools.

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Disclosure

The authors declare no conflicts of interest in this work.

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