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Intelligent Learning Tools and Senior High School Students' Classroom Participation, Learning Experience, and Psychological Stress: A Mixed-Methods Study Based on a Sample of Intelligent Learning Tool Users

Zifu Wang[1,a,#], Ziqi Wang[1,b,#], Tongxi Wang[1,c,#], Xingye Gu[1,d,#], Yukun Wang[1,e,#]

[1]Beijing 21st Century School, Beijing, China
[a]wangzifu1107@163.com, [b]13716961775@163.com, [c]A13001159568@163.com,
[d]guxingye70@gmail.com, [e]wyk201008102025@163.com
[#]Co-first author

Abstract: *Senior high school students in this study used intelligent learning tools; we surveyed them online and interviewed students and teachers in parallel, giving both data types equal weight. Frequency and duration of tool use correlated with none of the three outcomes we tracked — participation facilitation, classroom silence, and tool-related pressure. The six participation items split into two factors, facilitation and silence, and this two-factor structure fit far better than a single factor; validity was acceptable, and the two factors barely correlated. Facilitation was predicted by self-efficacy in autonomous learning and by self-regulated tool use. Silence was predicted mainly by tool-related pressure. Grade differences appeared in pressure and silence only, both peaking in the second year. Gender differences did not reach significance. The exploratory mediation test of pressure was under-powered and returned no supported path. What distinguishes classroom participation is not how much students use these tools but how they use them, and the pressure that use generates. Schools would do better to regulate how tools are used than to debate whether to permit them. All conclusions apply to tool users only.*

Keywords: *intelligent learning tools; classroom participation; classroom silence; self-regulated tool use; self-efficacy in autonomous learning; tool-related pressure; mixed-methods research*

1. Introduction

Generative artificial intelligence, intelligent question answering platforms and adaptive learning systems have currently been integrated into the learning scenarios of secondary school students. Meta-analytical studies have confirmed that educational technology can bring moderate improvements to learning outcomes[1-6]., but its large-scale popularization has also posed new challenges to the evaluation and implementation work of educational institutions[7]. At this stage, the core research question is no longer whether intelligent learning tools should be applied in school education, but what behaviors students actually exhibit when using these tools, and what effects these behaviors produce.

Those effects are inconsistent. Digital distraction can pull grades down [8,9], and a simple for-or-against verdict explains nothing. Self-regulation, psychological experience, and classroom behaviour—both speaking up and staying silent—need to be examined together.

Existing research leaves three gaps. Most studies design and evaluate technological systems; those on secondary students mostly tie screen exposure to performance or to a generic engagement, and rarely bring self-regulated tool use, self-efficacy for autonomous learning, and tool-related pressure into one model. Classroom participation is then treated as one construct equivalent to engagement, even though work on silence shows it takes heterogeneous forms—cognitive hesitation, deliberate reflection, interpersonal pressure—not just lost interest. And because samples are usually confined to one school and one method, findings from other settings do not transfer directly to Chinese senior high classrooms.

This study, therefore, used a convergent parallel mixed-methods design. An online questionnaire, drawn mainly from Beijing senior high students, carried the factor, correlation, regression, and group-

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difference analyses; interviews with nine students and five teachers interpreted and checked those results.

The research questions are:

(1) What are the patterns of intelligent learning tool use in terms of frequency, duration, and learning tasks? Are these patterns related to different aspects of classroom participation and tool-related pressure?

(2) How do self-regulated tool use, self-efficacy in autonomous learning, and tool-related pressure predict participation facilitation and classroom silence?

(3) Are there significant differences among students of different grades and genders?

(4) How do students and teachers understand the influence of intelligent learning tools on deep learning, peer comparison anxiety, and possible cognitive dependence?

2. Literature Review

2.1. Intelligent Learning Tool Use and Classroom Participation: From "Screen Time" to "Self-Regulated Tool Use"

Early studies focused on "digital distraction" in classrooms: non-academic browsing or social communication during class is negatively associated with academic performance [8], and divided attention from digital devices reduces test performance [9], though the negative effects vary across situations. In China, the use quality of intelligent learning platforms is positively related to secondary school students' autonomous learning engagement [10].

However, many of these studies equate "screen time" with technology effects, use broad outcomes such as "learning engagement," and overlook two mechanisms: active discussion and silent reliance on tools. Since classroom participation includes behavioral, emotional, and cognitive dimensions [11], the key difference may lie not in how long students use intelligent tools but in how they use them.

Self-regulated tool use captures whether students treat tools as thinking support or replacement—either "thinking independently first and verifying with tools later" or "searching for answers directly." Using it as a predictor may explain both the negative effects of distraction and the positive effects of support.

2.2. Classroom Silence: Previous Research and the Perspective of This Study

Silence has a long research record. Jaworski and Sachdev (1998) found teachers and students reading the same silence differently—as non-cooperation, but also as respect, reflection, or careful thought[12]. Cheng (2000) tied Asian students' silence to cultural expectations and to the interaction patterns of the classroom[13].

In China, Lei et al. (2017) sorted difficulties in speaking into unwillingness, fear, and inability [14]. L ü (2018, 2020) argued that hesitant speakers may develop an altruistic silence, and that controlled expression can sometimes deepen learning [15,16]. Shao and Zhang (2025) read silence as a survival strategy of the digital era [17].

All of this work explains silence through teacher questioning, classroom culture, and social concern. What gets less attention is how students use intelligent learning tools, and what that use does to them psychologically.

2.3. Autonomous Learning Confidence and Tool-Related Pressure in Intelligent Learning Environments

Whether these tools raise or lower academic anxiety is unsettled.

One line of argument stresses technological empowerment and stress relief: used appropriately, the tools offer support and personalised help, easing helplessness and burnout [3,5,6].

The other stresses dependence and psychological burden. Under intense academic competition, an efficient tool can become a source of pressure rather than relief.

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This study takes the second line and calls it tool-related pressure: worry about dependence, about cognitive decline, about peer comparison, and about parental restriction. When a tool hands over a solution immediately, students may feel they never really mastered the material; measuring their own pace against the tool's efficiency adds to that unease.

Earlier work has dwelt on negative outcomes and neglected positive psychological resources. Self-efficacy in autonomous learning is introduced here as one such resource—an internal motive that helps students face peer comparison and admit gaps in their understanding.

2.4. Grade and Gender Differences

Digital tools and the psychological responses they trigger may differ by gender and by grade [18].

The three years of senior high bring different levels of pressure and different learning demands, so students' strategies for using intelligent tools probably shift as they move through school.

First-year students are usually still exploring and adjusting. They accept the tools readily, but their self-regulation is not yet developed.

Third-year students tend to be more goal-directed and more rational in strategy: work through a problem independently first, then use a tool to check and correct.

Second-year students sit in the middle of a difficult transition, with rising academic difficulty and competitive pressure. Grade differences, if they exist, should therefore be most visible in the second year—though this is an exploratory expectation, not a firm prediction.

2.5. Research Evaluation and Theoretical Framework

The framework here steps past "screen time" to three predictors: self-regulated tool use, self-efficacy in autonomous learning, and tool-related pressure (Figure 1).

The first two represent internal control and positive resources, and should encourage classroom expression. Tool-related pressure represents the psychological cost of technology in a competitive setting, and may push toward silence.

Two hypotheses follow:

H1: Participation facilitation and classroom silence represent two relatively independent dimensions of classroom participation.

H2: Participation facilitation is mainly predicted by self-regulated tool use and self-efficacy in autonomous learning, while classroom silence is mainly predicted by tool-related pressure.

Both rest on earlier work on classroom silence [13-15] and are tested below through factor analysis and regression.

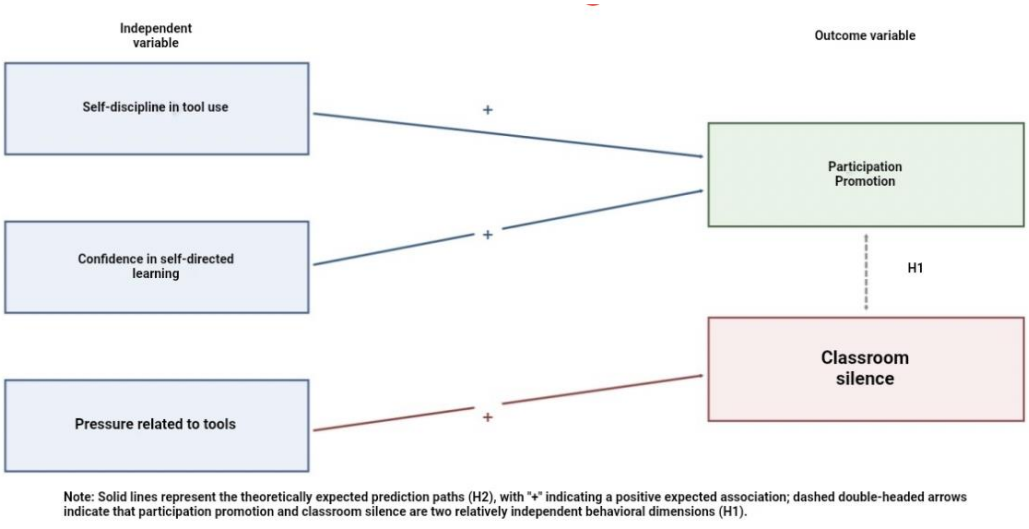


Figure 1. Theoretical Framework

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3. Research Design

3.1. Research Design and Participants

The design was convergent parallel [19]: quantitative and qualitative data came from the same semester, carried equal weight, were analysed separately, and were merged only at the interpretation stage.

An explanatory sequential design did not fit, since the interview guide was fixed in advance and the two phases had no sequential relation. Integration followed the joint display approach of Fetters et al. (2013), setting both evidence types side by side for each research question.

Participants were senior high school students. An anonymous online link reached them through several channels, using convenience and snowball sampling.

The target was 200–250 valid responses across Grades 10–12. Skip logic routed non-users past the main measurement items, so every quantitative comparison below covers tool users only.

3.2. Research Instruments and Interviews

The questionnaire had six parts—basic information, tool use, characteristics of use, caregiver experiences, tool-related learning experiences, and classroom participation—plus open-ended items.

Every scale item used a 5-point Likert format, answered with the previous semester in mind.

Tool use was captured by whether students used such tools at all, weekly days of use, daily duration, tool types, and the learning tasks they served.

Self-regulated tool use combined three behavioural items—thinking independently before turning to a tool, verifying answers afterward, and reorganising knowledge once finished—with higher scores meaning stronger self-regulation.

Classroom participation used six items across two dimensions, participation facilitation and classroom silence, three items each. Silence kept its original scoring direction, so higher scores meant a stronger pull toward silence. The two dimensions were scored separately because they capture different things.

Tool-related pressure had three sources: parental restriction and pressure (four items adapted from the Middle School Students' Learning Stress Questionnaire [20]); tool dependence and autonomy concerns (five items on worry about dependence and shrinking independent thinking); and peer comparison (two items on anxiety from comparing with classmates).

Self-efficacy in autonomous learning used two items, and parental support three. Background variables were grade, gender, learning location, and within-class academic performance.

Semi-structured interviews used an eight-question student guide (use habits, participation, pressure) and a six-question teacher guide (observed tool use, effects on participation, teaching applications, answer-seeking, school policy).

Student interviewees spanned all three grades with attention to gender balance; three to five teachers were planned. Most came from schools tied to the research team, so the interview data carry a single-school perspective, used mainly to support and interpret the quantitative results.

3.3. Data Collection, Analysis, and Ethics

The questionnaire was run on Wenjuanxing with skip logic: those who did not consent or were not senior high school students exited, while non-users entered a separate branch. Informed consent came first.

Descriptive statistics reported the distribution of scale scores, usage rates, and usage duration. Reliability was assessed with Cronbach's alpha.

For classroom participation, principal component and principal-axis exploratory factor analyses came first, then a confirmatory factor analysis (maximum likelihood) comparing one- and two-factor models. Fit used χ^2/df, CFI, TLI, RMSEA, and SRMR [21]; CR and AVE were reported, and discriminant validity followed Fornell and Larcker (1981).

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Correlation and multiple regression then examined the relationships among variables, with supplementary regressions on the separate pressure dimensions and a high/low self-regulation group comparison.

Grade and gender differences were analyzed using analysis of variance and t-tests, with effect sizes reported. Common method bias was checked with Harman's single-factor test [22].

Mediation was exploratory only, because statistical power was limited; it used the bootstrap method [23].

Participation was anonymous and voluntary, with the right to withdraw. No names, student numbers, phone numbers, exact school names, or tool account information were collected. Data were stored securely, and recordings were deleted after transcription.

4. Data Analysis

4.1. Data Cleaning and Sample Profile

Wenjuanxing logged 187 submissions and 166 complete exports; the 21-case gap came mainly from duplicates and incomplete responses. Skip logic terminated two cases and one did not consent, leaving N = 163 valid responses (153 users, 93.9%; Table 1). All analyses below use the 153 users. By IP location, 84.7% came from Beijing, and first-year students were over-represented among users—both worth remembering when reading the grade differences.

Table 1. Sample Composition Overview

Characteristic	Full sample (N = 163)	Users (n = 153)	Non-users (n = 10)
Grade 10	82 (50.3%)	77 (50.3%)	5
Grade 11	39 (23.9%)	37 (24.2%)	2
Grade 12	42 (25.8%)	39 (25.5%)	3
Male	66 (40.5%)	57 (37.3%)	9
Female	90 (55.2%)	90 (58.8%)	0
Other / not willing to answer	7 (4.3%)	6 (3.9%)	1
Beijing (by IP origin)	138 (84.7%)	128 (83.7%)	10

4.2. Tool Use and Scale Reliability

Of 163 respondents, 153 (93.9%) had used smart learning tools the previous semester. The ten non-users, who could give multiple reasons, cited "no immediate need" (4) and "being accustomed to thinking independently" (2). Most used the tools 4–5 days per week (38.6%), then 2–3 days (25.5%) and daily (22.9%); daily duration was most often 31–60 minutes (42.5%), then 15–30 minutes (34.6%). Generative AI Q&A/chat ranked first by tool type (80.4%), followed by translation pens/dictionaries (56.9%) and question banks/photo-solving (46.4%). The two most common tasks were understanding unknown problems (87.6%) and checking homework answers (57.5%).

The composite self-discipline mean was M = 3.87 (SD = 0.72), an overall “think first, then verify” tendency, though some open-ended responses still reported “going straight to answers without realizing it.” Means for weekly days and daily duration are based on interval midpoints.

Harman's single-factor test [22] on all 25 items put the first unrotated factor at 27.8% of variance, under the 40% threshold. Reliability and descriptives appear in Table 2.

Table 2. Reliability and Descriptive Statistics by Dimension (n = 153)

Dimension	Items	M	SD	Reliability
Parental restriction and pressure	4	2.55	1.06	α = .907
Parental support	3	3.35	1.06	α = .801
Tool dependence and autonomy concerns	5	3.18	0.85	α = .865
Peer comparison	2	2.66	1.17	r = .847 (SB = .917)
Autonomous learning confidence	2	3.69	0.83	r = .646 (SB = .785)
Tool-use self-discipline	3	3.87	0.72	α = .719
Participation facilitation	3	3.70	0.79	α = .811

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Classroom silence	3	2.77	0.93	α = .849
Tool-related pressure (composite)	11	2.86	0.83	α = .910

Note: Peer comparison and autonomous learning confidence are two-item dimensions, so inter-item r and Spearman-Brown (SB) coefficients are reported instead of α. The "Tool-related pressure (composite)" sums the three subscales and is listed separately. Classroom silence keeps its original scoring: higher scores indicate a stronger tendency toward silence.

4.3. The Structure of Classroom Participation

The six participation items, reverse-scored and combined, held together poorly (α = .646; .686 in the original direction), which points to the structure of the items rather than to reverse wording. Principal component analysis produced the first two eigenvalues of 2.355 and 2.166 (39.2% and 36.1% of variance), the third falling to 0.536 (cumulative 63.7%); the first component set facilitation against silence, with negative loadings on one side and positive on the other. Principal-axis factoring with varimax rotation confirmed the split (Table 3).

Table 3. Factor Structure, Reliability, and Validity of the Six Classroom Participation Items (n = 153)

Item	Factor 1: Facilitation	Factor 2: Silence	CR	AVE
15.1 With tool support, I am more willing to answer questions after class.	.816	.067	.814	.595
15.2 With tool support, pre-class preview and review help me follow the lecture better.	.798	-.088		
15.3 After resolving initial questions, I am more willing to ask further questions.	.701	.060		
15.4 With tools available, I ask fewer questions in class.	.041	.695	.853	.660
15.5 After using a tool, I tend to wait for the answer rather than join the discussion.	-.079	.891		
15.6 My willingness to join open discussions has decreased.	.094	.847		

Note: Loadings are from principal-axis exploratory factor analysis with varimax rotation. CR and AVE were computed from standardized loadings in a two-factor confirmatory factor analysis.

In confirmatory factor analysis, the two-factor model reached $\chi^2/df = 3.43$, CFI = .948, TLI = .902, SRMR = .069, and RMSEA = .126. The first three met Hu and Bentler's (1999) criteria; the high RMSEA was expected, given five-point ordinal data, the inflated covariance-based χ^2 [24], and only 8 degrees of freedom. The one-factor model fit far worse, $\chi^2(9) = 181.19$, CFI = .539, TLI = .231, RMSEA = .355, SRMR = .271, $\Delta\chi^2(1) = 153.75$ ($p < .001$). CR was .814 and .853, AVE .595 and .660, and the factor correlation .024 — far below the √AVE values (.771, .813), which indicates good convergent and discriminant validity [25]. H1 held: the dimensions were close to independent, and nothing in the psychometrics justified summing them.

4.4. Correlation and Regression Analysis

Table 4. Correlation Matrix of Key Variables (n = 153)

Variable	1	2	3	4	5	6	Facilitation	Silence
1. Weekly days of use	—							
2. Daily duration	.380***	—						
3. Tool-use self-discipline	.052	-.032	—					
4. Autonomous learning confidence	.055	-.054	.330***	—				
5. Tool-related pressure	.030	.047	-.091	-.006	—			
6. Participation facilitation	.076	.147	.393***	.425***	.166*	—		
7. Classroom	.080	-.026	-.153	-.185*	.519***	.038	—	

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silence								
Tool-related pressure: parental restriction & pressure							.114	.401***
Tool-related pressure: dependence concerns							.196*	.452***
Tool-related pressure: peer comparison							.083	.472***

Note: *p < .05, ***p < .001 (two-tailed). Weekly days and daily duration were scored 1–5; classroom silence keeps original scoring, so a positive correlation with pressure means students under greater pressure tend to be more silent.

Frequency and duration correlated with none of the three outcomes (Table 4). Participation facilitation moved with confidence (r = .425) and self-discipline (r = .393). Classroom silence moved with pressure (r = .519) and ran slightly against confidence (r = -.185) and self-discipline (r = -.153). Because the pressure composite bundles three sources, the subscales were examined separately: all three correlated with classroom silence (r = .401–.472), while the link to participation facilitation was weaker, and only dependence concerns reached significance (r = .196). No single source drove the pressure–silence association.

Separate regressions (Table 5) entered self-discipline, confidence, and pressure to predict the two outcomes. Participation facilitation was predicted mainly by confidence (β = .326) and self-discipline (β = .303), with a smaller positive contribution from pressure (β = .196). Classroom silence was predicted mainly by pressure (β = .514); self-discipline was non-significant (β = -.052) and confidence only weakly negative (β = -.165, p = .024). H2 held. In the facilitation model, the positive pressure coefficient matched its zero-order correlation (r = .166)—the ordinary multicollinearity pattern, not suppression.

Table 5. Multiple Regression Predicting Participation Facilitation and Classroom Silence (n = 153)

Dependent variable	Predictor	Model	β	t	p
Participation facilitation	Tool-use self-discipline	M1	.303	4.13	<.001
Participation facilitation	Autonomous learning confidence	M1	.326	4.45	<.001
Participation facilitation	Tool-related pressure	M1	.196	2.82	.005
Classroom silence	Tool-use self-discipline	M1	-.052	-0.72	.476
Classroom silence	Autonomous learning confidence	M1	-.165	-2.28	.024
Classroom silence	Tool-related pressure	M1	.514	7.49	<.001
Participation facilitation	Tool-use self-discipline	M2	.309	4.19	<.001
Participation facilitation	Autonomous learning confidence	M2	.314	4.26	<.001
Participation facilitation	Parental restriction and pressure	M2	.065	0.77	.441
Participation facilitation	Tool dependence and autonomy concerns	M2	.213	2.25	.026
Participation facilitation	Peer comparison	M2	-.055	-0.59	.556
Classroom silence	Tool-use self-discipline	M2	-.046	-0.63	.527
Classroom silence	Autonomous learning confidence	M2	-.169	-2.32	.022
Classroom silence	Parental restriction and pressure	M2	.151	1.82	.071
Classroom silence	Tool dependence and autonomy concerns	M2	.219	2.33	.021
Classroom silence	Peer comparison	M2	.248	2.68	.008

Both M1 models were significant: facilitation $F(3, 149) = 20.29$, $p < .001$, $R^2 = .290$; silence $F(3, 149) = 21.82$, $p < .001$, $R^2 = .305$. Substituting the subscales (M2) lifted R^2 to .300 and .315 (both $p < .001$); the subscales were strongly intercorrelated, so this is a source-decomposition reference only. With n = 153 and three predictors, power for a medium effect ($f^2 = .15$) was about .99.

To separate the sources that the composite had hidden, the models were refitted with the three subscales replacing composite pressure (M2 in Table 5).

All three subscales were positively associated with classroom silence. Peer comparison (β = .248)

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and dependence concerns (β = .219) were strongest; parental pressure was marginal (β = .151, p = .071).

4.5. Group Differences and Exploratory Mediation Analysis

For a supplementary comparison, respondents were split at the self-discipline mean of 4.0 (high n = 84, low n = 69). The high group scored higher on participation facilitation (3.90 vs. 3.45, t = 3.67, p < .001, d = 0.60) and on confidence (t = 2.97, p = .004, d = 0.48); silence and pressure showed no group difference (|d| ≤ 0.21). Because 27.5% (42) scored exactly 4.0, the cutoff is unstable, and the analysis remains supplementary.

Grade and gender difference tests follow.

Table 6. Grade Differences in Key Variables (n = 153)

Variable	Grade 10 M	Grade 11 M	Grade 12 M	F(2, 150)	p	η^2
Participation facilitation	3.66	3.81	3.67	0.51	.604	.007
Classroom silence	2.62	3.14	2.70	4.20	.017	.053
Tool-related pressure	2.83	3.13	2.65	3.45	.034	.044
Autonomous learning confidence	3.78	3.50	3.71	1.42	.244	.019
Tool-use self-discipline	3.94	3.77	3.82	0.83	.438	.011

Note: n = 153 (77 first-year, 37 second-year, 39 third-year). Weekly days and daily duration were scored 1–5. Brown–Forsythe tests supported variance homogeneity (p = .076–.846), so ordinary F tests were used.

Only classroom silence and tool-related pressure differed by grade (Table 6). Full post hoc comparisons (LSD) appear in Table 7.

Table 7. Full Post Hoc Comparisons of Grade Differences (LSD method, n = 153)

Variable	Comparison	Mean difference	p	p (Bonferroni)	95% CI
Classroom silence	Grade 11 vs. Grade 10	0.52	.005	.015	[0.16, 0.88]
Classroom silence	Grade 11 vs. Grade 12	0.44	.036	.109	[0.03, 0.85]
Classroom silence	Grade 10 vs. Grade 12	-0.08	.667	1.000	[-0.43, 0.27]
Tool-related pressure	Grade 11 vs. Grade 12	0.48	.010	.031	[0.12, 0.85]
Tool-related pressure	Grade 11 vs. Grade 10	0.30	.068	.204	[-0.02, 0.62]
Tool-related pressure	Grade 10 vs. Grade 12	0.19	.248	.743	[-0.13, 0.50]

Note: Mean differences are computed as the former group minus the latter; silence keeps its original scoring, so a positive difference indicates more silence in the former group. LSD is the primary criterion, with Bonferroni-corrected p-values for reference; only two pairs remained significant ("silence: second- vs. first-year"; "pressure: second- vs. third-year"). Effect sizes: silence d = 0.57 (second vs. first) and 0.50 (second vs. third); pressure d = 0.61 (second vs. third). At d = 0.5, power was approximately .70 and .58, so non-significant results should not be read as no difference.

After Bonferroni correction, Grade 11 students reported more pressure than Grade 12 students (p = .031) and more silence than Grade 10 students (p = .015); no other comparison survived. Grade 11 thus carried the highest pressure and silence (Figure 2).

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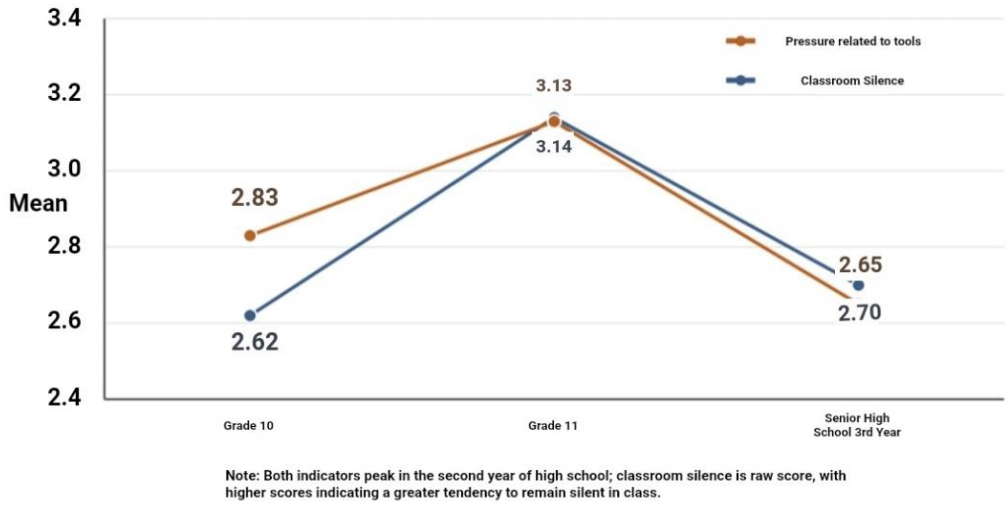


Figure 2. Mean Scores for Tool-Related Pressure and Classroom Silence by Grade Level

For gender, six respondents choosing "other/preferred not to answer" were excluded, leaving 147 (57 male, 90 female). No difference reached significance ($|d| \leq 0.22$). Only participation facilitation showed unequal variances (Brown–Forsythe $F = 4.57$, $p = .034$) and was tested with Welch's t ($df = 92.2$); Student's t ($df = 145$) was applied elsewhere.

The literature review sets self-discipline and pressure side by side as predictors, so the planned mediation path had no firm theoretical footing. With $n = 153$, the analysis remained exploratory and underpowered [23].

With tool-use self-discipline as the independent variable, pressure as mediator, and classroom silence as outcome, the a-path was non-significant ($B = -0.105$, $p = .261$) and the indirect effect was -0.060, bootstrap 95% CI [-0.185, 0.060], which includes zero. For participation facilitation, the indirect effect was -0.021, 95% CI [-0.080, 0.021], also including zero. Power was limited, so these results do not show that self-discipline leaves pressure untouched.

Weekly days of use was also a single ordinal item, so "frequency × grade/gender" moderation was not formally tested.

4.6. Qualitative Results and Integration

Nine students (2 first-year, 4 second-year, 3 third-year) and five teachers (Chinese, politics, chemistry, and others) were interviewed. Verbatim transcripts and open-ended responses were coded into four themes (S1–S9 students, T1–T5 teachers).

4.6.1. Tool Substitution for Thinking

One risk came up repeatedly: seeing the answer before working through the process. S1 (first-year) put it plainly: "Looking directly at the answer skips your own thinking process... During an exam, when the tool is not available, you may not be able to solve the problem because you never really understood it." S2 (third-year) admitted that when using AI directly, "most of the time I probably just copy the answer." Teachers drew the same line. T1 reported that "many first-year students prefer to search for answers directly when solving problems, while most third-year students first work independently and then use tools to identify and fill gaps." T2 described first-year students who "can easily search for ready-made answers to character analysis beforehand, and then in class they are unwilling to work through the textual details themselves." "Not truly understanding" and "worrying about losing independent thinking" recurred across the open-ended responses.

4.6.2. Two-Way Changes in Classroom Participation

Some students described the opposite of silence. S3 (second-year) previewed with tools before class: "I understand the material better, so I am more willing to raise my hand and share my views in class." S4 (second-year) said, "After the tool helps me clarify the knowledge points, I feel more confident answering questions in class." S5 (third-year), having looked up materials in advance, "was more

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willing to answer questions voluntarily and join class discussions." Others moved the other way. S6 (second-year) felt tools "might make me more silent," and would hold back what he did not understand until "after I get home, when I use my phone or computer to help myself figure them out." Everything turns on whether the tool is used with understanding.

4.6.3. Pressure and Dependence

Pressure had three sources. Dependence and skill decline was the first: S3 (second-year), with a major exam coming, "worried that I had not fully mastered these knowledge points"; S4 (second-year) "occasionally worries about becoming overly dependent on tools and always wants to look for hints when solving problems"; S2 (third-year) went further, feeling "a sense of helplessness that my brain is deteriorating." The second was efficiency comparison, against the tool and against peers: S5 (third-year) found the tool's process "very polished and concise," and after comparing, "might feel that I think more slowly." Parental restriction and expectation was the third. T1 observed that "first-year students' pressure comes more from peer comparison, while third-year students mainly bear the pressure of college entrance examination admission." T3 saw no obvious pressure from tools but thought they might "reduce students' motivation to think independently."

4.6.4. Grade Differences and Guidance

Teachers' observations of grade differences varied, but on the whole they placed the differences in the purpose of use and the degree of dependence rather than in the amount of use. T1 observed that frequency of use increased with grade, while dependence decreased. T2 believed that "the higher the grade, the more focused tool use is on learning goals." T3 cautioned that one should "look at when students first began using smart tools." Student suggestions centered on guidance and rules: S7 (second-year) hoped teachers would "guide us to use them reasonably and appropriately, clarify the scenarios for use, and explicitly prohibit copying answers directly"; S1 (first-year) hoped for classroom features that could "automatically summarize the core content of the teacher's lecture and generate concise notes"; S4 (second-year) hoped to use tools to "look up supplementary materials and open up lines of thinking, rather than directly searching for answers."

4.6.5. Integrated Matrix

Following Fetters et al. (2013), the quantitative results, qualitative evidence, and integrated conclusions for the four research questions sit side by side in Table 8.

Table 8. Integrated Matrix of Quantitative Results and Qualitative Evidence

Research question	Quantitative results	Qualitative evidence	Integrated conclusion	Consistency
RQ1: Distribution of use and its correlation with classroom behavior	93.9% were users; neither frequency nor duration of use correlated significantly with participation facilitation, classroom silence, or tool-related pressure.	Students and teachers both described the tools as part of everyday learning; "using the tools to solve problems when encountering difficulties" was a common case.	Use is widespread, but the amount of exposure alone does not distinguish classroom behavior.	Confirmed
RQ2: The predictive effects of self-discipline, confidence, and pressure	Participation facilitation ← self-discipline (β = .30), confidence (β = .33); classroom silence ← pressure (β = .51)	Those who think before they speak are more likely to speak up; those who are concerned about dependence and who are more prone to comparing themselves with others tend to be quieter in class.	The claim that "two engines (self-discipline, confidence) drive active expression, and pressure is associated with silence" is supported by both strands of evidence.	Consistent
RQ3: Grade and Gender Differences	Both pressure and silence peaked in Grade 11 (p = .034 / .017); no gender difference reached	Teachers observed that Grade 11 students differentiated sharply and clustered with their peers, though	Grade differences appear mainly in psychological experience rather than in amount of	Partially consistent

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	significance, and effect sizes were very small.	they were wary of dividing students by grade.	use; gender differences are negligible.	
RQ4: In-depth Investigation, Competitive Anxiety, and Guidance	Four of the ten inactive users were willing to receive guidance on use.	Students want clear rules on when tools may be used, with direct copying banned; teachers suggest varying these by subject and grade.	Guidance should address how and when tools are used, rather than simply "prohibiting" or "allowing" them.	Consistent

Tools were embedded in academic tasks, yet frequency and duration predicted nothing. What separated the outcomes was mode of use and psychological experience. The interview data agreed: students who used tools to preview and review spoke more, while those who took answers directly and carried comparison and dependence worries drifted toward silence.

5. Conclusion and Discussion

5.1. Research Conclusions

This study used a parallel mixed-methods design to trace how intelligent learning tool use relates to the two dimensions of classroom participation, to tool-related pressure, and to learning experience. Four conclusions stand out.

(1) Tool use is now near-universal among senior high school students.

Of 163 valid participants, 153 (93.9%) had used intelligent learning tools, most often 4–5 days per week (38.6%) and 31–60 minutes a day (42.5%). Generative AI Q&A tools (80.4%), translation tools (56.9%), and question-search platforms (46.4%) led the field, and the tasks were dominated by understanding difficult questions (87.6%) and checking homework (57.5%)—an unmistakable answer-seeking orientation.

(2) Neither frequency nor duration of use tracked any of the three core variables.

What students did in class followed from how they used the tools and what they felt, not from how much they used them. Facilitation moved with self-efficacy ($r = .425$) and self-regulated tool use ($r = .393$); silence moved with pressure ($r = .519$). The two dimensions were almost unrelated ($r = .038$), and the two-factor model fit significantly better ($\Delta\chi^2(1) = 153.75$, $p < .001$). Facilitation was predicted by self-regulated tool use ($\beta = .303$) and self-efficacy ($\beta = .326$); silence by pressure ($\beta = .514$).

(3) Grade differences showed up only in tool-related pressure and classroom silence, both highest in Grade 11.

Grade 11 students reported significantly more tool-related pressure than Grade 12 students (Bonferroni $p = .031$) and significantly more classroom silence than Grade 10 students (Bonferroni $p = .015$). Power was limited, so a non-significant comparison is not proof that no difference exists. Gender differences were non-significant throughout ($|d| \leq 0.22$).

(4) The exploratory analysis did not support a mediating role for pressure.

The bootstrap 95% CI for the indirect effect included zero, and with limited power, the result is suggestive at best. Four qualitative themes—tools replacing thinking, two-way shifts in participation, pressure and dependence, and grade differences with guidance—lined up with the quantitative findings, above all the point that how students use tools matters more than how much. All conclusions hold for tool users only.

5.2. Discussion

5.2.1. The Popularity of Intelligent Learning Tools and the "Answer-Seeking Orientation"

Among valid participants, 93.9% had used intelligent learning tools, mostly to understand difficult questions and check homework. That sits some distance from the learner-centred paradigm proposed for AI in education [7].

The focus should shift from whether students use tools to how they use them. Work on distraction

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and divided attention [8,9] already points the same way: what matters is whether students think independently before reaching for a tool, or simply extract the answer.

5.2.2. Two Dimensions of Classroom Participation: Confidence and Self-Regulation Promote Speaking, While Pressure Is Related to Silence

The internal structure of classroom participation turned out to be the central finding. The six items combined poorly ($\alpha = .646$)—not because of reverse wording, but because the two dimensions were each stable and nearly unrelated ($r = .038$).

Silence, then, is not merely the absence of participation. It has its own types and its own causes [12,13,15].

Facilitation was predicted mainly by self-efficacy and self-regulated tool use; silence was associated mainly with tool-related pressure. Reverse-scoring and summing the two dimensions into one total would flatten exactly these separate effects.

Earlier accounts explained silence through teacher questioning, classroom culture, and face concerns [16,14,17]. This study adds a form of silence tied to tool-related pressure.

5.2.3. The Positive Relationship Between Tool-Related Pressure and Classroom Silence

Pressure and silence moved together ($r = .519$). That points to silence as a response to what students feel, not to how much they use intelligent tools. Three readings fit the data. Pressure may drain cognitive and emotional resources, leaving little willingness to ask questions or expose gaps in understanding. Students who doubt they can finish work without a tool may settle into avoidance. And the anxiety of peer comparison can eat into the motivation to take part at all.

Both pressure and silence came from self-report, though. Common method bias stayed within an acceptable range (Harman's single-factor test = 27.8%), yet it may still have inflated the correlation. The cross-sectional design also rules out causal claims.

5.2.4. Grade Differences Mainly Appeared in Psychological Experiences and Classroom Silence

Pressure and silence were the only variables that differed by grade, both highest in Grade 11. Teachers read the same pattern: Grade 11 is a transitional year, with academic competition tightening and the spread among students widening.

They also warned against reading too much into grades alone. The Grade 11 sample held only 37 students against Grade 10's 50.3% share, so part of the gap may come from how the convenience sample fell.

Regular and international high schools were pooled, and school type was never entered as a variable. Differences along that line remain for future work.

5.2.5. Gender Differences Were Negligible

Gender differences did not reach significance on any variable ($|d| \leq 0.22$), which runs against Wu and Cheng's (2019) result for digital distraction.

The sample tilted heavily toward Beijing and online. Students there may share similar learning environments and tool habits, so broad indicators of this kind could have hidden gender differences in specific behaviours.

5.2.6. Methodological Implications of the Exploratory Mediation Analysis

In the exploratory mediation analysis, self-regulated tool use did not significantly predict tool-related pressure ($B = -0.105$, $p = .261$), and the indirect effect's confidence interval included zero.

Two methodological points follow.

The framework treated self-regulated tool use and tool-related pressure as parallel predictors, so the mediation pathway never had enough theoretical support to begin with.

And at $n = 153$, the study may simply have lacked power. A non-significant result here is not evidence that the mechanism is absent.

5.3. Educational Implications

For schools and teachers, the lever is not prohibition but regulation—clear boundaries and defined

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situations where tool use is appropriate.

Some students had already worked out their own tactics: “covering the answer and solving the problem again by themselves” and "deliberately controlling themselves instead of directly copying answers" (S3, S4). These are ready to be turned into classroom guidelines.

The Ministry of Education's Basic Education Teaching Steering Committee (2025a, 2025b) has issued guidance on generative AI use and on AI literacy for primary and secondary students; schools can build school-based usage lists from it.

Grade 11 students carry the highest pressure and silence, so they may warrant closer attention. Schools should still resist applying one identical rule across the board.

For parents, rules worked out together beat prohibition or monitoring. Parental restriction and pressure averaged 2.55 with a wide individual spread (α = .907)—room enough to discuss usage situations and goals, and turn worry into shared management.

The working rule for students is “think first, ask for help second, verify afterwards.” Teachers suggested varying it by grade and subject, and trialing it on a small scale before writing formal school guidelines.

Students who have not taken up such tools should not be pushed. Adoption should follow need and willingness.

5.4. Research Limitations and Future Directions

Several limitations qualify these results.

- The valid sample (N = 163, 153 of them users) fell short of the target. Grade 10 made up 50.3%, and convenience and snowball sampling concentrated participants in Beijing (84.7%), which limits representativeness.
- Skip logic left non-users' core variables missing, so no user–non-user contrast was possible; every quantitative conclusion applies to tool users only.
- The two-factor structure held, but RMSEA exceeded .08. With five-point ordinal data inflating χ^2-based indicators [24], validation on a larger sample is needed.
- Frequency and duration rested on single items, and the adapted and self-developed items still need external criterion validity and test–retest reliability.
- The cross-sectional self-report design precludes causal claims. Self-regulated tool use also overlaps conceptually with facilitation (item correlations .218–.395), so its predictive effect may not be fully independent.
- The interviews offered a single-school perspective only, and school type never entered the analysis.

Four directions suggest themselves:

- Stratified samples should reach more regions and school types, include non-users, and set up comparable outcome measures.
- Longitudinal or classroom-observation designs could track usage patterns—thinking first, then using tools against directly obtaining answers—and their links to classroom expression and performance.
- Future work should separate tool types, usage situations, and school policy, trace where grade differences in psychological experience come from, and test school type as a moderator.
- And intervention studies aimed at non-users could assess whether voluntary guidance programmes for tool use actually help.

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