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# Academic Change, Online Learning Experiences and COVID-19-Related Emotional Responses among Chinese Primary School Children: A Cross-Sectional Study

Gang Liu[1*], Samsiah binti Mohd Jais[2], Jingyi Zhou[3]
[1]*PhD Candidate, Faculty of Human Development, Universiti Pendidikan Sultan Idris, Malaysia*
[2]*Associate Professor, Department of Psychology, Faculty of Human Development, Universiti Pendidikan Sultan Idris, Malaysia*
[3]*The High School Affiliated to Xi'an Jiaotong University*
**Corresponding Author*

**Abstract:** This study described COVID-19-related experiences and emotional responses among Chinese primary school children and examined whether academic change and online learning experiences were associated with emotional responses after accounting for selected family and demographic characteristics. A cross-sectional study included 212 children aged 10–12 years in Grades 5 and 6 in China. Data were collected using a researcher-developed 15-item COVID-19 Experience Checklist (CEC). Eight items assessed pandemic-related experiences and contextual characteristics, while seven assessed emotional responses using a three-point Likert-type format and were summed into a composite score. Descriptive analyses, group comparisons and a multivariable general linear model were conducted using IBM SPSS Statistics version 20. Most children (73.1%) reported at least one period of online learning, and 22.2% perceived worsened academic performance. The mean emotional-response score was 4.69 (SD = 3.04). The multivariable model was significant, $F(13, 198) = 2.46$, $p = .004$, explaining 13.9% of the variance. Academic performance change, technological difficulties and online learning frequency showed significant overall associations with emotional responses, whereas only-child status, living arrangement, gender and grade did not. Children reporting worsened academic performance had significantly higher adjusted scores than those reporting improvement. These findings highlight academic deterioration and disrupted learning experiences as relevant considerations for school and public mental health support.

**Keywords:** Academic performance; Primary school children; COVID-19; Emotional responses; Online learning; Public mental health

## 1. Introduction

The COVID-19 pandemic substantially disrupted children's everyday lives, particularly their schooling, peer contact, family routines and access to normal social activities. Previous studies have reported increased emotional difficulties among children and adolescents during the pandemic, including symptoms of anxiety, depression and loneliness (Loades et al., 2020; Racine et al., 2021). Evidence from China similarly indicated mental health difficulties among school-aged children during the pandemic, alongside substantial changes in educational delivery (Ma et al., 2021).Children approaching early adolescence may be especially sensitive to such disruption because academic competence, peer relationships and increasing independence become more important during this developmental period (Eccles, 1999). However, children's experiences during the pandemic were not uniform, and the emotional consequences of disruption may have depended on the specific circumstances they encountered.

Educational disruption was one of the most prominent features of the pandemic. School closures resulted in a rapid shift toward online and remote learning, including widespread implementation of online education in China (Cui et al., 2021; Zhu et al., 2022). Although this approach provided continuity of education, children and families encountered challenges related to learning effectiveness, interaction, adaptation and access to appropriate learning conditions. Systematic reviews have also documented learning losses and reduced academic performance during pandemic-related school closures and remote learning, although effects varied across settings and student groups (Hammerstein et al., 2021; Cortés-Albornoz et al., 2023). These findings suggest that participation in online learning alone may not carry the same emotional meaning as difficulties encountered during learning or a perceived deterioration in academic performance.

Research conducted among Chinese primary and secondary school students further suggests that specific characteristics of online education may be relevant to children's mental health. Zhou et al. (2022), for example, found that difficulties understanding online course content and longer exposure to online courses were associated with poorer mental health outcomes, whereas device or internet connection problems were not

independently associated with mental health in their sample. Other Chinese studies have similarly shown that children's and parents' experiences of online learning were heterogeneous rather than uniformly positive or negative (Cui et al., 2021; Zhu et al., 2022). This evidence supports examining specific educational experiences separately rather than treating online education or pandemic exposure as a single experience.

The present study examined COVID-19-related experiences and emotional responses among Chinese primary school children aged 10–12 years. Information was collected using the researcher-developed 15-item COVID-19 Experience Checklist (CEC), comprising eight items on pandemic-related experiences and contextual characteristics, including quarantine and infection, living arrangements, only-child status, online learning, technological difficulties and perceived academic change, and seven items on emotional responses, including school-related worry, perceived parental stress, family tension, sadness, irritability, anxiety and difficulty expressing emotions. The study specifically examined whether academic change and online learning experiences were associated with children's COVID-19-related emotional responses after accounting for selected family and demographic characteristics.

## 2. Methods

### 2.1 Participants and Procedure

The present study used data from the cross-sectional phase of a larger school-based research project conducted among primary school children in Xi'an, China. The analytic sample consisted of 212 students aged 10–12 years from Grades 5 and 6. Of the participants, 102 (48.1%) were boys and 110 (51.9%) were girls. Thirty-five children (16.5%) were aged 10 years, 98 (46.2%) were aged 11 years and 79 (37.3%) were aged 12 years. Grade 5 students accounted for 135 participants (63.7%), while 77 (36.3%) were in Grade 6.

Data were collected in the school setting using paper-based questionnaires. Participation was voluntary and took place with school administrative permission, parental consent and child assent. Students were informed that their responses would be treated confidentially and used for research purposes. For the present article, only the cross-sectional data concerning COVID-19-related experiences, emotional responses and selected demographic characteristics were analysed.

### 2.2 COVID-19 Experience Checklist (CEC)

COVID-19-related experiences were assessed using the researcher-developed 15-item COVID-19 Experience Checklist (CEC). The CEC was designed as a survey tool to document children's pandemic-related experiences and emotional responses rather than as a standardized psychological scale. The first eight items assessed contextual experiences and background characteristics, including home quarantine, personal and family COVID-19 infection, living arrangements, only-child status, participation in online learning, technological difficulties during online classes and perceived changes in academic performance. These items were analysed individually and were not combined into an overall score.

The remaining seven items assessed COVID-19-related emotional responses, including worry or stress about schoolwork, perceived increases in parental stress, family conflict or tension, sadness, irritability, anxiety or worry, and difficulty expressing emotions. Each item used a three-point Likert-type response format ranging from 0 to 2. The seven item scores were summed to produce a composite emotional-response score (CEC_ER), with higher scores indicating stronger reported emotional responses. The possible score range was 0–14; observed scores in the present sample ranged from 0 to 12.

### 2.3 Statistical Analysis

Analyses were conducted using IBM SPSS Statistics version 20. Frequencies and percentages were calculated for demographic characteristics and COVID-19-related contextual experiences, while means and standard deviations were used to describe the emotional-response items and the composite CEC_ER score.

Initial group comparisons examined whether CEC_ER scores differed according to selected contextual experiences. Independent-samples t-tests were used for two-category variables where appropriate, and one-way analyses of variance (ANOVA) were used for variables with three or more categories. Where the homogeneity-of-variance assumption was violated, Welch's robust test was used. Post-hoc comparisons were conducted using Tukey HSD when homogeneity of variance was supported and Games–Howell when it was not.

A multivariable general linear model was subsequently used to examine the independent associations between contextual characteristics and the composite CEC_ER score. Perceived academic performance change, technological difficulties during online learning, frequency of participation in online classes, only-child status, living arrangement, gender and grade were entered simultaneously as fixed factors. Only main effects were specified, using Type III sums of squares. COVID-19 infection variables were retained for descriptive reporting but were excluded from the multivariable model because of highly imbalanced category sizes.

For factors showing statistically significant overall effects in the multivariable model, estimated marginal

means were compared using Bonferroni-adjusted pairwise comparisons. Effect sizes were reported using partial eta squared ($\eta p^2$), and statistical significance was set at $p < .05$.

## 3. Results

### 3.1 Participant Characteristics and COVID-19-Related Experiences

The final sample comprised 212 primary school children aged 10–12 years. Of these, 102 (48.1%) were boys and 110 (51.9%) were girls. Thirty-five participants (16.5%) were aged 10 years, 98 (46.2%) were aged 11 years and 79 (37.3%) were aged 12 years. Grade 5 students accounted for 135 participants (63.7%), while 77 (36.3%) were in Grade 6.

Participants reported a range of COVID-19-related experiences. Most children had experienced home quarantine at least once. Self-reported COVID-19 infection was reported by 206 participants (97.2%), while 204 (96.2%) reported infection among family members. Most participants lived with both parents (81.1%), and 24.1% were only children. Experiences of online learning varied: 26.9% reported no participation, 33.5% reported one period of online learning, 11.8% reported two periods and 27.8% reported three or more periods. Technological difficulties were also common, with 43.9% reporting such problems sometimes and 42.9% often. Regarding academic performance, 30.7% perceived improvement, 47.2% reported no change and 22.2% reported deterioration.

### 3.2 Emotional Responses

The seven COVID-19-related emotional-response items covered school-related worry, perceived parental stress, family conflict, sadness, irritability, anxiety and difficulty expressing emotions. The seven items showed satisfactory internal consistency in the present sample (Cronbach's $\alpha = .812$). School-related worry had the highest item mean ($M = 0.92$, $SD = 0.59$), whereas family conflict or tension had the lowest ($M = 0.47$, $SD = 0.56$). The composite CEC_ER score ranged from 0 to 12, with a mean of 4.69 ($SD = 3.04$).

### 3.3 Unadjusted Group Comparisons

Perceived academic performance change was significantly associated with the composite CEC_ER score, $F(2, 209) = 4.29$, $p = .015$, $\eta^2 = .039$. Children reporting worsened academic performance had the highest mean emotional-response score ($M = 5.79$, $SD = 3.26$), compared with those reporting no change ($M = 4.50$, $SD = 2.97$) or improvement ($M = 4.18$, $SD = 2.82$). Tukey comparisons showed that the worsening group scored significantly higher than both the improvement group ($p = .015$) and the no-change group ($p = .042$).

Participation frequency in online learning was not significantly related to CEC_ER scores in the unadjusted analysis, $F(3, 208) = 1.99$, $p = .116$. For technological difficulties, the conventional ANOVA was significant, $F(3, 208) = 2.75$, $p = .044$; however, the homogeneity-of-variance assumption was violated, and the Welch test was not significant, $F(3, 31.00) = 2.29$, $p = .098$. Thus, this unadjusted association was interpreted cautiously.

### 3.4 Multivariable Analysis

The multivariable general linear model was statistically significant, $F(13, 198) = 2.46$, $p = .004$, explaining 13.9% of the variance in CEC_ER scores (adjusted $R^2 = .083$). After simultaneous adjustment, academic performance change, technological difficulties and frequency of participation in online classes each showed significant overall associations with CEC_ER scores. In contrast, only-child status, living arrangement, gender and grade were not significantly associated with emotional-response scores.

Bonferroni-adjusted comparisons showed that children reporting worsened academic performance had significantly higher adjusted CEC_ER scores than those reporting improvement ($p = .021$), while the difference between worsened performance and no change narrowly missed statistical significance ($p = .056$). Although technological difficulties showed a significant overall effect, no individual pairwise comparison remained significant after Bonferroni adjustment. For online learning participation, children reporting one period of online learning had significantly higher adjusted CEC_ER scores than those reporting no online learning ($p = .014$); all other pairwise comparisons were non-significant.

Table 1: Participant Characteristics and Selected COVID-19-Related Experiences

| Variable | Category | n | % |
|---|---|---|---|
| Gender | Male | 102 | 48.1 |
| | Female | 110 | 51.9 |
| Age | 10 years | 35 | 16.5 |
| | 11 years | 98 | 46.2 |
| | 12 years | 79 | 37.3 |

| | | | |
|---|---|---|---|
| Grade | Grade 5 | 135 | 63.7 |
| | Grade 6 | 77 | 36.3 |
| Online learning | Never | 57 | 26.9 |
| | Once | 71 | 33.5 |
| | Twice | 25 | 11.8 |
| | Three or more times | 59 | 27.8 |
| Technological difficulties | Never | 18 | 8.5 |
| | Sometimes | 93 | 43.9 |
| | Often | 91 | 42.9 |
| | Almost every day | 10 | 4.7 |
| Academic performance change | Improved | 65 | 30.7 |
| | No change | 100 | 47.2 |
| | Worse | 47 | 22.2 |

Table 2: Multivariable Associations with CEC_ER Composite Scores

| Factor | F | p | Partial $\eta^2$ |
|---|---|---|---|
| Academic performance change | 4.058 | .019 | .039 |
| Technological difficulties | 4.001 | .009 | .057 |
| Attend online classes | 3.423 | .018 | .049 |
| Only-child status | 0.254 | .615 | .001 |
| Living arrangement | 0.903 | .407 | .009 |
| Gender | 0.514 | .474 | .003 |
| Grade | 0.117 | .733 | .001 |

## 4. Discussion

This study examined associations between academic change, online learning experiences and COVID-19-related emotional responses among Chinese primary school children aged 10–12 years. Educational experiences showed stronger associations with emotional responses than the family-structure and demographic characteristics examined. Perceived academic change was the clearest and most consistent factor. Children reporting worsened academic performance had higher emotional-response scores in the unadjusted analysis, and this association remained significant after adjustment. This finding is consistent with evidence that COVID-19-related school closures and remote learning were often accompanied by learning losses and poorer academic performance (Hammerstein et al., 2021; Cortés-Albornoz et al., 2023). For children approaching early adolescence, academic competence contributes increasingly to self-evaluation and achievement (Eccles, 1999). Perceived academic deterioration may therefore reflect not only educational disruption but also challenges to competence and stability. However, the cross-sectional design does not establish directionality: emotional difficulties may have contributed to perceived academic decline, academic difficulties may have intensified emotional responses, or both may have occurred.

The findings for online learning were more complex. Participation frequency was not significantly associated with CEC_ER scores in the unadjusted analysis but showed a significant overall association after adjustment. Technological difficulties also showed a significant overall effect in the multivariable model, although no pairwise comparison remained significant after Bonferroni correction. Previous Chinese studies likewise suggest that online learning is not a uniform experience. Cui et al. (2021) described changes in student engagement and parental concerns, Zhu et al. (2022) identified implementation and effectiveness challenges, and Zhou et al. (2022) found that difficulty understanding online content and longer course exposure were associated with poorer mental health, whereas device or internet problems were not significant after adjustment. These findings support examining different dimensions of online learning separately rather than treating participation as inherently harmful or beneficial.

The finding that children reporting one period of online learning had higher adjusted emotional-response scores than those reporting no online learning should be interpreted cautiously. No consistent increase in scores was observed across increasing levels of participation, providing no evidence of a simple dose-response relationship. This pattern may reflect differences in the circumstances of online learning rather than participation frequency itself. Previous Chinese research has similarly shown substantial variation in children's adaptation to online learning and parents' perceptions of its effectiveness (Ma et al., 2021; Cui et al., 2021).

Only-child status, living arrangement, gender and grade were not significantly associated with the composite emotional-response score. This should not be interpreted as evidence that family and demographic factors are unimportant. The structural characteristics examined here may not capture more proximal influences

such as parental support, communication, conflict, parental stress or socioeconomic pressure. Future studies should examine these family processes alongside educational experiences.

Several limitations should be noted. The cross-sectional design precludes causal inference. The CEC was developed as a checklist of pandemic-related experiences rather than as a standardized psychological scale, so the findings should be interpreted as associations involving reported experiences and a composite emotional-response score rather than as assessment of a diagnostic construct. Personal and family infection histories were highly imbalanced, limiting inferential comparisons. In addition, participants were drawn from one local school context in China, which may limit generalizability. Future research should use longitudinal designs, broader samples and more detailed measures of family functioning, school support and socioeconomic circumstances.

From a school and public mental health perspective, the findings highlight the importance of considering how children experienced educational disruption, rather than simply whether they participated in online learning. Perceived academic deterioration may help identify children who need additional emotional or academic support. During future large-scale disruptions, integrating academic monitoring with school-based mental health support may facilitate earlier and more targeted intervention.

## 5. Conclusion

This study found that children's COVID-19-related emotional responses were more closely associated with selected educational experiences than with the family-structure and demographic characteristics examined. Perceived academic deterioration showed the clearest and most consistent relationship with higher emotional-response scores, while online learning participation and technological difficulties also demonstrated significant overall associations in the multivariable model. In contrast, only-child status, living arrangement, gender and grade were not significantly associated with emotional responses after adjustment. These findings suggest that school and public mental health responses to future large-scale disruptions should pay particular attention to children who experience academic decline or difficulties adapting to disrupted learning environments.

**Ethics statement**

Permission to conduct the study was obtained from the participating school administration. Participation was voluntary. Written informed consent was obtained from the children's parents or legal guardians, and assent was obtained from the participating children before data collection. Participants were informed that their responses would be treated confidentially and used only for research purposes. Data were anonymised for analysis and reporting.

**Informed consent statement**

Written informed consent was obtained from the parents or legal guardians of all participating children. Assent was obtained from the children before participation. Information about the purpose of the study, voluntary participation, confidentiality and the use of responses for research purposes was provided on the first page of the questionnaire before completion. Participants were informed that they could decline to participate without penalty.

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**Conflict of interest statement**

The authors declare that there are no conflicts of interest related to this research.

**Data availability statement**

The data underlying this study are not publicly available because they contain information collected from minor participants and are subject to ethical and confidentiality restrictions. De-identified data may be made available from the corresponding author upon reasonable request, subject to applicable ethical requirements and permissions.

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