



EARTHQUAKE LITERACY AND AWARENESS AMONG LOWER-SECONDARY SCHOOL STUDENTS

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Abstract

Earthquake preparedness education is critical in earthquake-prone regions, yet understanding students' literacy and awareness levels remains essential for effective disaster risk reduction. This study aimed to determine lower-secondary school students' earthquake literacy and earthquake awareness levels, examine differences by gender and grade level, and analyse the relationship between these constructs. A convergent parallel mixed-methods design was employed, integrating a quantitative descriptive-correlational survey with qualitative semi-structured interviews. The sample included 523 students in Grades 5–8 from a public lower-secondary school in Çanakkale, Türkiye (2025–2026 academic year). Quantitative data were collected using the Earthquake Literacy Scale and the Earthquake Awareness Scale, and qualitative data were collected through interviews with 12 students. Findings indicated moderate to high levels of earthquake literacy, with the highest scores in the cognitive and behavioural dimensions and the lowest in the affective dimension. Significant gender differences were observed, favouring female students in behavioural, affective, and total literacy scores, whereas no difference was found in the cognitive dimension. Grade-level comparisons revealed that younger students (5th–6th grades) scored significantly higher than older students (7th–8th grades). Students demonstrated high earthquake awareness but only moderate preparedness, indicating a clear awareness–preparedness gap. A moderate positive correlation was found between earthquake literacy and awareness. These findings highlight the importance of strengthening affective and behavioural components ensuring continuity in school-based disaster education programmes.

Keywords: earthquake literacy, earthquake awareness, disaster education, school disaster preparedness, disaster risk reduction

Introduction

Disaster education has become a central component of global disaster risk reduction strategies, equipping individuals with the knowledge, attitudes, and behavioural competencies needed to prepare for and respond effectively to natural hazards. In recent decades, increasing global vulnerability to natural hazards has intensified the need for proactive disaster risk reduction and education strategies. Natural disasters pose significant threats to human life, infrastructure, and socioeconomic stability worldwide (Sutrisno et al., 2025). Among these hazards, earthquakes are particularly devastating due to their sudden onset, unpredictable nature, and potential for widespread destruction. Earthquake disasters can cause severe human, economic, and infrastructural losses, particularly in seismically active regions. Consequently, strengthening disaster preparedness through education has become a central component of disaster risk reduction efforts across many countries (Becker et al., 2013; Izadkhah & Gibbs, 2015). Recent research also highlights that integrating natural hazard topics into science education can strengthen students' risk perception and promote more informed responses to disaster situations (Dewi et al., 2025).

Earthquakes are among the most destructive natural hazards worldwide, including in Türkiye. The catastrophic consequences of recent seismic events, particularly the 2023 Kahramanmaraş earthquakes that caused widespread loss of life and displacement, have

highlighted the urgent need to enhance public preparedness and disaster awareness (Kuloğlu et al., 2024). Türkiye is considered highly vulnerable to earthquakes, with approximately 92% of its land area and 95% of its population located in seismically active zones (AFAD, 2023). In such contexts, disaster education plays a critical role in fostering disaster-ready communities, especially among younger populations who represent both present and future members of society (Ronan & Johnston, 2005; Tuswadi & Hayashi, 2014). Lower-secondary school students constitute a particularly important group, as cognitive, affective, and behavioural competencies related to disaster preparedness can be effectively developed during this developmental period (Codreanu et al., 2014; Ronan & Johnston, 2005).

Within the framework of disaster education, earthquake literacy has emerged as an important concept describing individuals' knowledge, attitudes, and preparedness behaviours related to earthquakes (Rahim & Wu, 2015). Earthquake literacy reflects individuals' ability to understand earthquake risks, develop appropriate attitudes toward preparedness, and apply protective behaviours during emergency situations. Closely related to this concept, earthquake awareness refers to individuals' recognition of earthquake risks and their readiness to engage in preparedness actions (Mahanoğlu & Balcı, 2025; Setyaningrum et al., 2025). Previous research suggests that higher levels of awareness are generally associated with increased preparedness behaviours, although the relationship between awareness and action may vary across contexts and psychological factors (Yildiz et al., 2020; Kuloğlu et al., 2024).

Literature Review

Earthquake Literacy

Earthquake literacy has emerged as an important construct in disaster risk reduction, referring to individuals' knowledge, attitudes, and behavioural competencies related to understanding earthquake hazards and responding appropriately during seismic events (Rahim & Wu, 2015; Arslan et al., 2023). In disaster education research, earthquake literacy is typically conceptualised as a multidimensional framework integrating cognitive, affective, and behavioural components of preparedness (Becker et al., 2013; Wei et al., 2020).

The cognitive dimension involves individuals' understanding of earthquake-related concepts, including seismic processes, hazard characteristics, and risk mitigation strategies (Toprak-Dereli & Savasci-Acikalin, 2018; Henson et al., 2020). Research indicates that students frequently hold incomplete or inaccurate conceptions about earthquakes, particularly regarding earthquake predictability and the relationship between magnitude and damage (Toprak-Dereli & Savasci-Acikalin, 2018; Wei et al., 2020). Studies conducted in earthquake-prone regions have shown that although students may demonstrate general awareness of earthquake risks, their conceptual understanding of seismic phenomena often remains limited (Santos-Reyes et al., 2017; Henson et al., 2020).

The affective dimension encompasses emotional responses to earthquake risk, including fear, perceived vulnerability, and attitudes toward preparedness (Karancı et al., 2005; Tuswadi & Hayashi, 2014; Yeon et al., 2020). These emotional responses play a significant role in shaping individuals' risk perception and motivation to engage in preparedness behaviours. However, research also suggests that excessive fear may reduce individuals' sense of control and discourage preparedness actions (Karancı et al., 2005).

The behavioural dimension reflects the practical application of earthquake knowledge and attitudes through preparedness behaviours such as participating in drills, preparing emergency kits, and applying protective actions during earthquakes (Becker et al., 2013; Widdyusuf et al., 2022). Despite increased awareness of recommended safety behaviours, several studies have reported a gap between earthquake knowledge and actual preparedness practices (Yildiz et al., 2020; Kuloğlu et al., 2024).

School-based disaster education has been widely recognised as an effective approach to improving students' earthquake literacy and preparedness (Ronan & Johnston, 2005; Tuswadi & Hayashi, 2014; Izadkhah & Gibbs, 2015). Educational interventions incorporating experiential learning, preparedness drills, and participatory activities have been shown to improve students' knowledge of earthquakes and their preparedness behaviours (Shaw et al., 2004). Nevertheless, ensuring that increased knowledge translates into sustained preparedness behaviours remains a continuing challenge in disaster education research (Yilmaz & Yildirim, 2023).

Previous studies have also explored demographic variations in earthquake literacy. Some studies indicate that females tend to report higher levels of risk perception, concern, and emotional responses toward disaster risks, although findings regarding preparedness behaviours remain mixed across studies (Karancı et al., 2005; Setyaningrum et al., 2025), whereas other studies report no significant gender differences in disaster preparedness (Kuloğlu et al., 2024). In addition, developmental factors may influence earthquake literacy, as cognitive and emotional capacities evolve throughout childhood and adolescence (Ronan & Johnston, 2005; Mutch, 2014).

In the Turkish context, existing research on earthquake literacy has largely focused on adults, university students, or pre-service teachers, with relatively limited attention given to middle school populations. Although some studies have examined Turkish children's perceptions of earthquake risk and preparedness (e.g., Yildiz et al., 2020), comprehensive research on earthquake literacy and awareness among lower-secondary school students remains limited. This highlights the need for further research examining earthquake literacy among younger students in Türkiye.

Earthquake preparedness education is not only a national priority for Türkiye but also holds significant international value. As a country situated in one of the world's most seismically active regions, Türkiye's experiences and research findings can inform global disaster education policy and practice. International studies conducted in earthquake-prone countries such as Japan (Katada & Kanai, 2016), Indonesia (Tuswadi & Hayashi, 2014), Mexico (Santos-Reyes et al., 2017), and the USA (Henson et al., 2020) have similarly emphasised the critical role of school-based disaster education in building resilient communities. By examining earthquake literacy and awareness among lower-secondary school students in Türkiye, this study contributes to the global body of knowledge on school-based disaster education, not only by confirming previously reported patterns (e.g., gender differences and awareness-preparedness gaps), but also by providing context-specific evidence from a high-risk seismic region, thereby enhancing the cross-cultural comparability and external validity of disaster education research. Furthermore, understanding how students in different cultural and educational contexts develop disaster-related competencies can support the development of more effective, culturally responsive disaster education frameworks at the international level.

Earthquake Awareness

Earthquake awareness refers to individuals' recognition of earthquake risks and their understanding of the need for preparedness actions (Paton & Johnston, 2001; Yildiz et al., 2020; Mahanoğlu & Balcı, 2025; Sutrisno et al., 2025). Although closely related to earthquake literacy, awareness is typically conceptualised as a broader construct encompassing both knowledge of earthquake hazards and perceived readiness to respond to disasters (Kuloğlu et al., 2024; Setyaningrum et al., 2025). Studies examining science education and natural hazards have shown that students' understanding of the nature of science and technology (NOS/NOT) may influence their willingness to engage in protective and preventive actions in disaster contexts (Cerulli & Holbrook, 2019).

Research conducted in earthquake-prone regions has generally reported moderate to high levels of earthquake awareness among school-aged children (Yildiz et al., 2020; Maulana et al., 2023). However, studies frequently highlight a discrepancy between individuals' awareness of earthquake risks and their actual preparedness behaviours, commonly described as the awareness-preparedness gap (Kuloğlu et al., 2024; Sutrisno et al., 2025).

Several explanations have been proposed for this gap, including optimistic bias, perceived lack of efficacy, resource constraints, and social norms that discourage preparedness behaviours (Karancı et al., 2005; Becker et al., 2013). In addition, research with children in Türkiye suggests that earthquake education and family-based information sharing may play an important role in shaping how awareness translates into preparedness (Yildiz et al., 2020). These findings suggest that increasing awareness alone may not be sufficient to promote effective preparedness behaviours without addressing motivational and behavioural factors.

Gender differences in earthquake awareness have also been observed in previous studies, with female students often reporting higher levels of risk awareness than male students or expressing greater concern about potential disaster impacts (Karancı et al., 2005; Setyaningrum et al., 2025). However, findings regarding gender differences in preparedness behaviours have been inconsistent across studies (Santos-Reyes et al., 2017; Kuloğlu et al., 2024). Developmental factors may also influence awareness levels, as students' engagement with disaster education and risk perception may change across grade levels (Mutch, 2014).

Earthquake literacy and earthquake awareness are closely related constructs within the broader framework of disaster education. Conceptually, earthquake literacy encompasses the knowledge, attitudes, and behavioural competencies that contribute to individuals' awareness of seismic risks and preparedness actions (Rahim & Wu, 2015). Accordingly, higher levels of earthquake literacy are generally expected to promote greater awareness and preparedness.

Empirical studies have supported the existence of a positive relationship between earthquake literacy and earthquake awareness. Individuals with greater knowledge of earthquake hazards and preparedness strategies tend to report higher levels of risk awareness and preparedness intentions (Wei et al., 2020; Arslan et al., 2023; Mahanoğlu & Balcı, 2025). However, research also indicates that increased awareness does not always translate into actual preparedness behaviours, suggesting that additional psychological and contextual factors may influence this relationship (Kuloğlu et al., 2024).

Despite the growing importance of disaster education, empirical research examining earthquake literacy and earthquake awareness among lower-secondary school students remains limited. Most previous studies have focused on adults, university students, or pre-service teachers, while comparatively fewer studies have examined disaster-related competencies among younger school populations. Moreover, existing research often examines earthquake knowledge, awareness, and preparedness separately rather than exploring their interrelationships within a unified framework. In the Turkish context, studies addressing gender and grade-level differences in earthquake literacy and awareness are also scarce.

Therefore, the present study examined lower-secondary school students' earthquake literacy and earthquake awareness and explored the relationship between these constructs using a mixed-methods approach. Specifically, the study aimed to: (1) determine students' earthquake literacy levels across cognitive, affective, and behavioural dimensions; (2) examine whether earthquake literacy and awareness differ by gender and grade level; and (3) analyse the relationship between earthquake literacy and earthquake awareness.

In line with these aims, the following research questions guided the study:

RQ1. What are lower-secondary school students' earthquake literacy levels across cognitive, affective, and behavioural dimensions, and what is their overall earthquake awareness level?

RQ2. Do lower-secondary school students' earthquake literacy and earthquake awareness differ significantly by gender and grade level?

RQ3. What is the relationship between lower-secondary school students' earthquake literacy and earthquake awareness?

Research Methodology

Design

This study employed a convergent parallel mixed-methods design, integrating quantitative and qualitative approaches to provide a comprehensive understanding of lower-secondary school students' earthquake literacy and awareness (Creswell & Clark, 2017). The quantitative component utilised a relational survey model to assess literacy and awareness levels, examine demographic differences, and explore correlational relationships (Fraenkel et al., 2012). Concurrently, the qualitative component employed semi-structured interviews to explore students' perceptions, experiences, and reasoning in greater depth (Kvale & Brinkmann, 2015). This mixed-methods approach was selected to capitalise on the complementary strengths of both paradigms, enabling triangulation of findings and enhanced validity (Johnson & Onwuegbuzie, 2004).

Participants

This study was conducted during the 2025–2026 academic year at a public lower-secondary school in Çanakkale, Türkiye, a region characterized by significant seismic activity. The quantitative sample consisted of 523 students enrolled in Grades 5 through 8, a purposive convenience sampling strategy was employed. Participants were recruited from a single public lower-secondary school in Çanakkale, Türkiye, which was selected based on accessibility and institutional approval. The selection of this school was also supported by the relevance of the regional context to the research topic, as earthquake risk, preparedness, and awareness are particularly important issues in Çanakkale due to its seismic characteristics. Including students from four consecutive grade levels (Grades 5–8) provided the opportunity to examine developmental differences across age groups and contributed to a broader understanding of students' earthquake literacy and awareness levels within the lower-secondary school context.

The adequacy of the sample size was evaluated in relation to both the measurement instruments and the planned statistical analyses. In the present study, data were collected using the 26-item Earthquake Literacy Scale and the 20-item Earthquake Awareness Scale, yielding a total of 46 observed variables. Methodological guidelines for scale-based research recommend a minimum item-to-sample ratio of 1:5 to 1:10, with larger samples yielding more stable parameter estimates and greater statistical power (Hair et al., 2010; Tabachnick & Fidell, 2013). With data obtained from 523 students across four grade levels, the present study exceeds an approximate 1:11 ratio, which is above the commonly recommended threshold. In addition, the relatively large sample size supports more reliable comparisons across grade level and gender groups and strengthens the robustness of correlational analyses examining the relationship between earthquake literacy and earthquake awareness. Therefore, the sample size was considered statistically sufficient to produce reliable and valid findings for the purposes of the study.

Demographic characteristics of the participants by gender and grade level are presented in Table 1.

Table 1
Demographic Characteristics of the Sample by Grade Level and Gender

Grade level	Female <i>n</i>	Female %	Male <i>n</i>	Male %	Total <i>n</i>	Total %
5th grade	56	42.4	76	57.6	132	25.2
6th grade	65	52.0	60	48.0	125	23.9
7th grade	61	47.7	67	52.3	128	24.5
8th grade	75	54.3	63	45.7	138	26.4
Total	257	100.0	266	100.0	523	100.0

Note. *n* = number of students.

The study sample comprised 523 lower-secondary school students, distributed relatively evenly across grade levels. The largest proportion of participants was in the 8th grade (26.4%), followed by the 5th (25.2%), 7th (24.5%), and 6th (23.9%) grades. Overall, the gender distribution was balanced, with 257 females (49.1%) and 266 males (50.9%) in the sample. While minor variations in gender composition were observed across grade levels, female and male students were represented at comparable rates in each grade, indicating that the sample was well balanced by grade and gender.

For the qualitative component, purposive sampling was employed to select 12 students who had experienced an earthquake and were the most willing to participate in the interviews. The participants represented different grade levels, with three students from each grade (5th, 6th, 7th, and 8th). The gender distribution was as follows: in 5th grade, 2 boys and 1 girl; in 6th grade, 1 boy and 2 girls; in 7th grade, 1 boy and 2 girls; and in 8th grade, 2 boys and 1 girl. The primary selection criterion was students' life experience of an earthquake and their voluntary participation in the interview process.

Instruments

Data were collected using the "Earthquake Literacy Scale," the "Earthquake Awareness Scale," and a semi-structured interview form.

Earthquake Literacy Scale (ELS)

Earthquake literacy was measured using the Earthquake Literacy Scale developed and validated by Arslan et al. (2023). The scale comprises 26 items organised under three subdimensions: cognitive (6 items), behavioural (11 items), and affective (9 items).

The cognitive subdimension assesses students' conceptual knowledge and understanding of earthquakes, including awareness of earthquake-related concepts, knowledge of safe behaviours and emergency procedures, understanding of societal impacts, and recognition of disaster-conscious planning in reducing loss of life and property.

The behavioural subdimension evaluates students' self-reported preparedness behaviours and practical competencies, such as identifying safe positions during an earthquake, applying the drop-cover-hold on technique, preparing emergency kits, developing family communication plans, and avoiding hazardous structures after an earthquake.

The affective subdimension measures students' emotional responses to earthquake risk, including fear, anxiety, perceived impact on daily life, and emotional reactions to earthquake-related information.

The instrument uses a five-point Likert-type response format (1 = Strongly Disagree to 5 = Strongly Agree), with higher scores indicating greater earthquake literacy. In the original validation study, Cronbach's alpha coefficients were reported as .731 (cognitive), .865 (behavioural), .950 (affective), and .896 (overall), indicating acceptable to high internal consistency (Arslan et al., 2023).

In the present study, Cronbach's alpha coefficients were .597 for the cognitive subdimension, .795 for the behavioural subdimension, .884 for the affective subdimension, and .837 for the overall scale. Overall reliability coefficients met acceptable thresholds, indicating satisfactory internal consistency (Tabachnick & Fidell, 2013; Pallant, 2020). It should be noted that the Cronbach's alpha coefficient of .597 for the cognitive subdimension falls below the conventionally accepted threshold of .70 (Pallant, 2020). This lower reliability coefficient may reflect the limited number of items in the cognitive subscale (six items) and suggests that cognitive dimension findings should be interpreted with caution. Nonetheless, values approaching .60 have been considered acceptable in exploratory research contexts (Hair et al., 2010).

Earthquake Awareness Scale (EAS)

Earthquake awareness was assessed using the Earthquake Awareness Scale for Secondary School Students, developed and validated by Mahanoğlu and Balcı (2025). The scale consists of 20 items organised under two subdimensions: earthquake awareness (14 items) and preparedness (6 items).

The earthquake awareness subdimension evaluates students' knowledge and awareness of fundamental earthquake-related concepts and safety principles. Items assess awareness of protective measures (e.g., securing furniture), appropriate behaviours during and after earthquakes, the importance and contents of emergency kits, safety precautions (e.g., avoiding damaged buildings and shutting off utilities), and evacuation routes and school assembly areas. This subdimension primarily reflects cognitive awareness of earthquake risks and recommended safety procedures.

The preparedness subdimension measures students' perceived readiness at individual, school, peer, community, and national levels. Items assess personal preparedness, perceptions of classmates' and school readiness, awareness of local assembly areas, and perceptions of city- and country-level disaster preparedness. This subdimension reflects perceived individual and collective preparedness related to earthquake risk.

The instrument uses a three-point Likert-type response format (1 = No, 2 = Partially, 3 = Yes), with higher scores indicating greater earthquake awareness and preparedness. Considering that the Earthquake Awareness Scale ranges from 1 to 3 and has a theoretical midpoint of 2.00, mean scores above 2.00 indicate above-moderate levels of earthquake awareness and preparedness. In the original validation study, Cronbach's alpha coefficients were reported as .923 for the earthquake awareness subdimension, .708 for the preparedness subdimension, and .847 for the overall scale, indicating satisfactory to high internal consistency (Mahanoğlu & Balcı, 2025).

In the present study, Cronbach's alpha coefficients were .831 for the earthquake awareness subdimension, .725 for the preparedness subdimension, and .826 for the overall scale. Reliability analyses confirmed that the scale demonstrated acceptable internal consistency (Bachman, 2004; Pallant, 2020).

Semi-Structured Interview Questions

Qualitative data were collected through semi-structured interviews designed to explore students' earthquake-related knowledge, experiences, preparedness behaviours, emotional responses, and evaluations of school-based disaster education. The interview protocol consisted of 15 main questions organised under seven thematic dimensions to ensure conceptual coherence and comprehensive coverage of earthquake literacy, with each question supported by probing prompts designed to elicit elaboration and clarification. The structure of the protocol reflected the multidimensional framework of earthquake literacy, encompassing cognitive, behavioural, and affective components.

The first dimension included introductory and warm-up questions aimed at eliciting students' spontaneous associations with earthquakes and, where applicable, their personal earthquake experiences (Q1–Q2). These questions were supported by probing prompts to deepen descriptions of recalled images, emotions, and perceived changes following earthquake experiences. The overall thematic organisation of the interview protocol is presented in Table 2.

Table 2
Thematic Framework of Semi-Structured Interview Questions

Dimension	Question Numbers	Content Focus
1. Introduction and Warm-up	Q1–Q2	Students' initial associations with earthquakes; personal earthquake experiences; recalled images, emotions, and perceived changes following earthquake events
2. Earthquake Knowledge and Disaster Literacy (Cognitive Dimension)	Q3–Q5	Meaning of being knowledgeable about earthquakes; essential earthquake-related knowledge; sources of information (school, family, media); perceived adequacy of knowledge
3. Earthquake Preparedness and Awareness (Behavioural Dimension)	Q6–Q8	Individual and family preparedness actions; emergency kits; family communication plans; school-based preparedness practices (e.g., drills); procedural knowledge of appropriate actions during and after earthquakes
4. Emotional Responses and Coping (Affective Dimension)	Q9–Q10	Emotional reactions to earthquake risk (fear, anxiety, calmness); impact on daily life; coping strategies; social support mechanisms
5. Evaluation of School-Based Earthquake Education	Q11–Q12	Perceived adequacy and effectiveness of school activities; beneficial and ineffective practices; suggestions for improvement (e.g., simulations, drama, interactive activities)
6. Reflective Questions on Quantitative Scales	Q13–Q14	Students' reflections after completing earthquake literacy scales; realizations during response process; perceived changes in awareness or preparedness intentions
7. Closing Question	Q15	Additional comments, experiences, or perspectives not previously addressed

The second dimension focused on earthquake knowledge and disaster literacy (Q3–Q5). Students were asked to reflect on what it means to be knowledgeable about earthquakes, essential information individuals should possess, primary sources of earthquake-related information (e.g., school, family, media), and the adequacy of their knowledge in fostering a sense of safety.

The third dimension addressed earthquake preparedness and awareness (behavioural dimension) (Q6–Q8). Questions explored pre-earthquake preparedness measures at the

individual and family levels, the presence of emergency kits, family communication plans, school-based preparedness practices (e.g., drills), and students' procedural knowledge of appropriate actions during and after an earthquake across contexts (home, school, outdoors).

The fourth dimension examined emotional responses, anxiety, and coping strategies (affective dimension) (Q9–Q10). Students were invited to describe their emotional reactions to earthquake risk, the situational triggers of these emotions, their impact on daily life, and personal or social coping mechanisms.

The fifth dimension focused on students' evaluations of school-based earthquake education (Q11–Q12). Participants assessed the adequacy of instructional activities, identified beneficial or ineffective practices, and proposed suggestions for improving earthquake education (e.g., simulations, drama, interactive activities).

The sixth dimension included reflective questions related to the quantitative scales administered in the study (Q13–Q14). After completing the earthquake literacy scales, students were asked to reflect on their thought processes while responding, any realizations that emerged, and whether completing the scales influenced their perceptions of personal, familial, or school-based preparedness.

Finally, the seventh dimension consisted of a closing question (Q15), providing students with the opportunity to share additional thoughts or experiences not previously addressed.

All main questions were supported by follow-up probes to encourage elaboration and clarification when needed. This structured yet flexible design ensured alignment with the multidimensional framework of earthquake literacy, cognitive, behavioural, and affective, while allowing participants to articulate their perspectives in depth.

Data Collection

Data were collected in classroom settings by the researcher during regular school hours. Prior to administration, students were informed about the study's purpose, voluntary participation, and confidentiality procedures.

Quantitative data were obtained using the 26-item Earthquake Literacy Scale and the 20-item Earthquake Awareness Scale (46 observed variables in total). Responses from 11 students who left more than half of the items unanswered were excluded. The final sample consisted of 523 students enrolled in Grades 5–8.

For the qualitative component, criterion-based purposive sampling was used to select 12 students who had directly experienced an earthquake and volunteered to participate. Three students were selected from each grade level (Grades 5–8). Individual semi-structured interviews were conducted in a classroom setting outside regular lesson hours, lasting approximately 20 minutes. Interviews were audio-recorded with consent, transcribed verbatim, and anonymised through coding procedures.

Data Analysis

Preliminary analyses were conducted to examine statistical assumptions. Univariate normality was assessed using skewness and kurtosis coefficients; values within ± 2 were considered acceptable (George & Mallery, 2003). Skewness and kurtosis values for total Earthquake Literacy and Earthquake Awareness scores fell within recommended limits, indicating approximate normal distribution. Although some subgroup kurtosis values exceeded the recommended threshold, such deviations are common in large samples and do not necessarily invalidate parametric analyses. In large samples, distributional indices and formal normality tests may become overly sensitive and detect trivial deviations from normality (Tabachnick & Fidell, 2013; Field, 2018). Given the relatively large sample size of the present study ($N = 523$),

parametric tests such as *t*-tests and ANOVA are considered robust to moderate violations of normality (Bachman, 2004; Stevens, 2012).

Homogeneity of variances was evaluated using Levene's test. While variance homogeneity was satisfied for most dimensions, a few subscales yielded significant results. Given balanced group sizes and the robustness of independent-samples *t*-tests and ANOVA to moderate violations of homogeneity, analyses proceeded with cautious interpretation.

Descriptive statistics (minimum, maximum, mean, and standard deviation) were calculated to summarise students' earthquake literacy and awareness levels. Independent-samples *t*-tests were conducted to examine gender differences, and a one-way ANOVA was used to test grade-level differences. When the assumption of homogeneity of variances was violated (Levene's test $p < .05$), Welch's *t*-test and Welch's ANOVA were employed as robust alternatives, as recommended in methodological literature (Field, 2018; Pituch & Stevens, 2016). Tukey HSD post hoc tests were performed following significant omnibus results, while Games–Howell post hoc tests were used in cases where variance homogeneity was not met (Field, 2018). Pearson product–moment correlation analysis was conducted to examine the relationship between total earthquake literacy and total earthquake awareness scores. Statistical significance was set at $p < .05$.

Research Results

Students' Earthquake Literacy Levels

Descriptive results of students' earthquake literacy scale are shown in Table 3.

Table 3
Descriptive Results of Students' Earthquake Literacy Levels

Dependent variable	<i>N</i>	Minimum	Maximum	<i>M</i>	<i>SD</i>
Cognitive	523	1.00	5.00	4.11	0.621
Behavioural	523	1.45	5.00	4.07	0.643
Affective	523	1.00	5.00	3.07	1.04
Total scale	523	1.50	4.88	3.61	0.538

Note. *M* = mean; *SD* = standard deviation.

Descriptive analysis indicated that students exhibited moderate to high levels of earthquake literacy. Considering that the Earthquake Literacy Scale is a five-point Likert-type instrument ranging from 1 to 5, with a theoretical midpoint of 3.00, mean scores above 3.00 indicated above-moderate levels, and scores above 4.00 corresponded to high levels. The overall mean score on the Earthquake Literacy Scale was 3.61 ($SD = 0.53$), indicating an above-moderate level of earthquake literacy. Among the subdimensions, the highest mean was observed in the cognitive dimension ($M = 4.11$, $SD = 0.62$), followed by the behavioural dimension ($M = 4.07$, $SD = 0.64$), both corresponding to high levels.

Students demonstrated strong cognitive understanding of earthquake safety measures, as evidenced by their knowledge of protective actions. For instance, one student articulated: “*When an earthquake occurs, the first thing that comes to my mind is that we should go to whatever is the strongest item in our house and grab it. Then, we should check that the earthquake is over and go down immediately. We should have a phone with us during this process... We should go to the meeting places and wait there*” (S11, 6th grade, Female). Another student similarly

explained: “*Get under the table and hold me, I’ll do it when the earthquake subsides, I’ll go out*” (S12, 6th grade, Male). These quotes illustrated students’ cognitive awareness of the “drop, cover, and hold on” protocol and evacuation procedures.

In contrast, the affective dimension showed a comparatively lower mean score ($M = 3.07$, $SD = 1.04$), indicating a moderate level (Table 3). This finding was reflected in students’ emotional responses during interviews. One student expressed: “*When I think about the earthquake, I see myself as a scared and anxious person because it is not clear what will happen at any moment, including whether I will survive or not, sometimes it affects me when I stay alone at night. I get really scared when I think about it*” (S1, 7th grade, Female). Another student described their emotional state as: “*I felt so helpless... I can’t feel comfortable anymore when I’m left alone at home because my parents are working, fear and anxiety are building up inside me*” (S11, 6th grade, Female). These statements revealed the moderate affective engagement characterized by fear and anxiety rather than confident preparedness.

Earthquake Literacy by Gender

An independent-samples *t*-test was used to examine gender differences in earthquake literacy. Normality and homogeneity assumptions were met (Pituch & Stevens, 2016). Descriptive results are presented in Table 4.

Table 4
Descriptive Results by Gender

Dependent variable	Gender	N	M	SD	Skewness	Kurtosis
Cognitive	Female	257	4.16	0.603	-1.47	3.51
	Male	266	4.07	0.636	-1.35	3.62
Behavioural	Female	257	4.12	0.624	-1.41	2.66
	Male	266	4.01	0.657	-1.08	1.57
Affective	Female	257	3.34	1.01	-0.268	-0.736
	Male	266	2.80	1.00	0.122	-0.686
Total scale	Female	257	3.73	0.529	-0.683	0.844
	Male	266	3.49	0.521	-0.232	0.074
	Total	523	3.61	0.538	-0.413	0.204

Note. *M* = mean; *SD* = standard deviation.

Female students obtained higher mean scores than male students across all dimensions of earthquake literacy. The largest mean difference was observed on the affective dimension, with female students reporting substantially higher scores ($M = 3.34$, $SD = 1.01$) than male students ($M = 2.80$, $SD = 1.00$).

This gender difference in affective engagement was evident in the qualitative data. Female students expressed more detailed emotional responses and concern for family members. One female student stated: “*When I feel anything, I consult my family about this issue and talk to them because I trust them very much, and when I talk to them about this issue, I feel relieved, and they give me confidence*” (S1, 7th grade, Female), demonstrating emotional awareness and help-seeking behaviour. Another student described: “*There was an earthquake at school, I was afraid something would happen to my family, something would happen to my brother*” (S12, 6th grade, Male), though this quote from a male student also showed concern, the female students’ interviews generally contained more elaborate emotional expressions and coping strategies.

Female students also demonstrated slightly higher mean scores in the cognitive dimension ($M = 4.16$, $SD = 0.60$) than male students ($M = 4.07$, $SD = 0.64$), as well as in the behavioural dimension ($M = 4.12$, $SD = 0.62$ for females; $M = 4.01$, $SD = 0.66$ for males). Similarly, the total earthquake literacy score was higher among female students ($M = 3.73$, $SD = 0.53$) than male students ($M = 3.49$, $SD = 0.52$), while the overall sample mean was 3.61 ($SD = 0.53$).

Skewness and kurtosis values for most variables fell within acceptable ranges (± 2), as suggested by George and Mallery (2003), although some deviations were observed, particularly in the cognitive dimension. However, given the large sample size, these deviations were not considered severe enough to violate the assumptions of parametric testing, as parametric tests are generally robust to moderate violations of normality in large samples (Byrne, 2010; Hair et al., 2010).

The results of the independent-samples *t*-test examining whether earthquake literacy scores differ by gender are presented in Table 5.

Table 5
Independent-Samples t-Test Results by Gender

Dependent variable	Gender	N	M	SD	df	t	p
Cognitive	Female	257	4.16	0.603	521	1.66	.097
	Male	266	4.07	0.636			
Behavioural	Female	257	4.12	0.624	521	2.03	.043*
	Male	266	4.01	0.657			
Affective	Female	257	3.34	1.01	521	6.12	< .001*
	Male	266	2.80	1.00			
Total scale	Female	257	3.73	0.529	521	5.27	< .001*
	Male	266	3.49	0.521			

Note. M = mean; SD = standard deviation; * $p < .05$.

While no significant difference was found between female and male students in the cognitive dimension ($t(521) = 1.66$, $p = .097$), significant differences emerged in the behavioural dimension ($t(521) = 2.03$, $p = .043$), the affective dimension ($t(521) = 6.12$, $p < .001$), and the total earthquake literacy score ($t(521) = 5.27$, $p < .001$), all favouring female students. The most pronounced difference was observed in the affective dimension, reflecting markedly higher emotional engagement and sensitivity toward earthquake-related issues among female students. Overall, these findings indicated that gender-related differences in earthquake literacy were more evident in affective and behavioural components than in cognitive knowledge.

Earthquake Literacy by Grade Level

A one-way ANOVA tested differences in earthquake literacy across grade levels. Assumptions of independence and normality were met. The homogeneity of variances assumption was satisfied for the cognitive, affective, and total scale dimensions; however, a violation was observed for the behavioural dimension (Levene's $p < .05$), for which Welch's ANOVA was employed as a robust alternative (Field, 2018). Descriptive results are shown in Table 6.

Table 6
Descriptive Results of Earthquake Literacy Scores by Grade Level

Dependent variable	Grade level	<i>N</i>	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
Cognitive	5th grade	132	4.21	0.687	-2.09	5.37
	6th grade	125	4.16	0.512	-0.594	0.563
	7th grade	128	4.07	0.535	-0.932	1.43
	8th grade	138	4.02	0.711	-1.26	3.03
Behavioural	5th grade	132	4.23	0.699	-1.87	4.15
	6th grade	125	4.19	0.451	-0.574	0.063
	7th grade	128	4.01	0.582	-0.885	0.791
	8th grade	138	3.84	0.717	-0.919	0.764
Affective	5th grade	132	3.28	1.05	-0.336	-0.647
	6th grade	125	3.15	1.05	-0.148	-0.805
	7th grade	128	2.79	0.978	0.121	-0.706
	8th grade	138	3.04	1.03	0.052	-0.774
Total scale	5th grade	132	3.77	0.550	-0.854	1.20
	6th grade	125	3.70	0.474	-0.180	-0.886
	7th grade	128	3.49	0.505	-0.209	0.033
	8th grade	138	3.48	0.558	-0.364	0.460
	Total	523	3.61	0.538	-0.413	0.204

Note. *M* = mean; *SD* = standard deviation.

Earthquake literacy scores varied across grade levels. On the cognitive dimension, mean scores showed a gradual decline from 5th grade ($M = 4.21$, $SD = 0.69$) to 8th grade ($M = 4.02$, $SD = 0.71$), with intermediate values observed in 6th ($M = 4.16$, $SD = 0.51$) and 7th grades ($M = 4.07$, $SD = 0.54$). A similar decreasing trend was evident in the behavioural dimension, where 5th-grade students obtained the highest mean score ($M = 4.23$, $SD = 0.70$), followed by 6th ($M = 4.19$, $SD = 0.45$), 7th ($M = 4.01$, $SD = 0.58$), and 8th grades ($M = 3.84$, $SD = 0.72$).

The qualitative data revealed that younger students demonstrated more comprehensive knowledge and preparedness behaviours. A 6th-grade female student explained: “*When an earthquake occurs, the first thing that comes to my mind is that we should go to whatever is the strongest item in our house and grab it. Then, we should check that the earthquake is over and go down immediately. We should have a phone with us during this process... We should go to the meeting places and wait there*” (S11, 6th grade, Female). In contrast, a 7th-grade student expressed more uncertainty: “*I think what I know about the earthquake is enough to make me feel safe, but I would like to know more. There is one thing I feel is missing: I didn’t prepare a bag because I didn’t know when it would happen. I’m scared about it*” (S1, 7th grade, Female).

In the affective dimension, 5th-grade students reported the highest mean score ($M = 3.28$, $SD = 1.05$), while 7th-grade students demonstrated the lowest ($M = 2.79$, $SD = 0.98$). Notably, affective scores slightly increased again in 8th grade ($M = 3.04$, $SD = 1.03$). Regarding the total scale, mean scores declined from 5th grade ($M = 3.77$, $SD = 0.55$) to 7th grade ($M = 3.49$, $SD = 0.51$) and remained relatively stable in 8th grade ($M = 3.48$, $SD = 0.56$). The overall sample mean was 3.61 ($SD = 0.53$).

Levene’s test supported equal variances across grade levels for most dimensions (Table 7); however, the behavioural dimension showed a significant violation ($p < .05$), for which Welch’s ANOVA was conducted.

Table 7
Levene’s Test of Homogeneity of Variances

Dependent variable	df1	df2	p
Cognitive	3	519	.055
Behavioural	3	519	.001
Affective	3	519	.811
Total scale	3	519	.712

Note. * $p < .05$, indicating violation of the homogeneity of variances assumption. Games-Howell post hoc test was applied for dimensions where this assumption was violated.

Table 7 indicated that the assumption of homogeneity of variances was met for most dimensions of earthquake literacy. Levene’s test results were non-significant for the cognitive ($p = .055$), affective ($p = .811$), and total scale ($p = .712$), supporting the use of parametric tests with equal variances assumed. Although Levene’s test was significant for the behavioural dimension ($p < .05$), indicating a violation of the homogeneity of variances assumption, ANOVA is generally robust to moderate violations when group sizes are relatively balanced. However, to ensure more reliable and robust results under variance heterogeneity, Welch’s ANOVA was also conducted, as recommended by Field (2018) and Pituch and Stevens (2016). Table 8 presents ANOVA results by grade level.

Table 8*One-Way ANOVA Results of Students' Earthquake Literacy by Grade Level*

Dependent variable	Source	SS	df	MS	F	p
Cognitive	Between groups	3.11	3	1.04	2.70	.045*
	Within groups	198.84	519	.383		
	Total	201.95	522			
Behavioural	Between groups	13.20	3	4.40	11.24	< .001*
	Within groups	203.20	519	.392		
	Total	216.40	522			
Affective	Between groups	17.27	3	5.76	5.42	.001*
	Within groups	551.61	519	1.06		
	Total	568.88	522			
Total scale	Between groups	8.66	3	2.89	10.49	< .001*
	Within groups	142.82	519	.275		
	Total	151.48	522			

Note. SS = sum of squares; MS = mean square; * $p < .05$.

As presented in Table 8, one-way ANOVA results revealed statistically significant differences across grade levels in all subdimensions of earthquake literacy and in the total scale. Specifically, significant grade-level differences were found in the cognitive dimension ($F(3, 519) = 2.70, p = .045$), behavioural dimension (Welch's $F(3, 285.74) = 10.31, p < .001$), affective dimension ($F(3, 519) = 5.42, p < .001$), and the total earthquake literacy score ($F(3, 519) = 10.49, p < .001$). These findings indicated that students' earthquake literacy levels differed significantly across grade levels, with lower grade levels generally demonstrating higher scores. The results of Welch's ANOVA confirmed a statistically significant difference across grade levels in the behavioural dimension (Welch $F(3, 285.735) = 10.31, p < .001$).

Post hoc results are shown in Table 9.

Table 9*Post Hoc Comparisons of Earthquake Literacy by Grade Level*

Dependent variable	Grade level (I)	Grade level (J)	MD (I-J)	SE	p	Significant Difference
Cognitive	5th	8th	0.195	.075	.048	5th>8th
Behavioural	5th	7th	0.223	.078	.022	5th>7th
		8th	0.396	.076	< .001	5th>8th
	6th	7th	0.180	.070	.033	6th>7th
		8th	0.352	.077	< .001	6th>8th
Affective	5th	7th	0.498	.128	.001	5th>7th
	6th	7th	0.363	.130	.027	6th>7th
Total scale	5th	7th	0.279	.065	< .001	5th>7th
		8th	0.294	.064	< .001	5th>8th
	6th	7th	0.209	.066	.009	6th>7th
		8th	0.224	.065	.003	6th>8th

Note. MD = mean difference; SE = standard error; * $p < .05$. Tukey HSD post hoc test was applied for cognitive and affective dimensions (equal variances assumed); Games-Howell post hoc test was applied for the behavioural dimension (unequal variances). Only statistically significant comparisons are reported.

Table 9 presented the results of the post-hoc analyses. Since the assumption of homogeneity of variances was met for the cognitive and affective dimensions, Tukey's HSD post hoc test was applied for these dimensions. In contrast, as Levene's test indicated a violation of the homogeneity assumption for the behavioural dimension ($p < .05$), the Games-Howell post hoc test was applied for this dimension and for the total scale.

In the cognitive dimension, 5th-grade students scored significantly higher than 8th-grade students ($p < .05$). For the behavioural dimension, 5th-grade students outperformed both 7th- and 8th-grade students, and 6th-grade students also scored significantly higher than 8th-grade students. In the affective dimension, both 5th- and 6th-grade students demonstrated significantly higher scores than 7th-grade students. Regarding the total earthquake literacy score, 5th- and 6th-grade students scored significantly higher than 7th- and 8th-grade students. Overall, post hoc results consistently indicate that lower grade levels, particularly 5th and 6th grade, exhibited higher earthquake literacy than upper grade levels.

Students' Earthquake Awareness Levels

Descriptive results of students' earthquake awareness levels are shown in Table 10.

Table 10

Descriptive Results of Students' Earthquake Awareness Levels

Dependent variable	N	Minimum	Maximum	M	SD
Earthquake Awareness	523	1.07	3.00	2.75	0.364
Earthquake Preparedness	523	1.00	3.00	2.21	0.461
Total scale	523	1.15	3.00	2.59	0.323

Note. M = mean; SD = standard deviation.

Based on equal interval classification (1.00–1.66 = low; 1.67–2.33 = moderate; 2.34–3.00 = high), the total mean score ($M = 2.59$, $SD = 0.32$) corresponds to a high level of earthquake awareness. The Earthquake Awareness subdimension ($M = 2.75$, $SD = 0.36$) also falls within the high range, whereas the Earthquake Preparedness subdimension ($M = 2.21$, $SD = 0.46$) corresponds to a moderate level.

The gap between awareness and preparedness was evident in student interviews. While students demonstrated knowledge about earthquakes, their actual preparedness behaviours lagged behind. One student acknowledged: "I think being knowledgeable about earthquakes is actually like protecting yourself. If we know what to do in the event of an earthquake and establish a life triangle, we will protect ourselves" (S1, 7th grade, Female), yet the same student admitted: "We never made an earthquake bag, we only did it once after the February 6 earthquake, and then this pattern did not continue" (S1, 7th grade, Female). Similarly, another student stated: "I'm not making any preparations for an earthquake" (S12, 6th grade, Male), despite being aware of earthquake risks. Overall, these findings indicated that students demonstrated relatively high levels of awareness, with preparedness remaining moderate.

Earthquake Awareness by Gender

An independent-samples *t*-test examined gender differences. Descriptive results are in Table 11.

Table 11
Descriptive Results of Earthquake Awareness Scores by Gender

Dependent variable	Gender	<i>N</i>	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
Earthquake Awareness	Female	257	2.79	0.347	-1.24	12.7
	Male	266	2.69	0.373	-1.64	2.66
Earthquake Preparedness	Female	257	2.17	0.457	-0.11	-0.532
	Male	266	2.24	0.462	-0.24	-0.559
Total scale	Female	257	2.61	0.309	-1.24	4.36
	Male	266	2.56	0.333	-1.16	1.49
	Total	523	2.58	0.320	-1.20	2.68

Note. *M* = mean; *SD* = standard deviation.

As shown in Table 11, descriptive statistics for earthquake awareness scores by gender are presented. Female students obtained higher mean scores than male students on the Earthquake Awareness subscale (Female: $M = 2.80$, $SD = 0.35$; Male: $M = 2.70$, $SD = 0.37$). For Earthquake Preparedness, male students reported slightly higher mean scores ($M = 2.25$, $SD = 0.46$) than female students ($M = 2.18$, $SD = 0.46$). Mean total scale scores were also slightly higher for female students ($M = 2.61$, $SD = 0.31$) compared to male students ($M = 2.56$, $SD = 0.33$). Prior to inferential analysis, the assumptions of normality and homogeneity of variances were evaluated. Levene's test indicated unequal variances for the Earthquake Awareness subscale and the Total Scale; accordingly, Welch's *t*-test was applied for these variables. The results of the *t*-test are presented in Table 12.

Table 12
Independent-Samples *t*-Test Results by Gender

Dependent variable	Gender	<i>N</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Earthquake Awareness	Female	257	2.80	0.348	520.28	3.15	.002*
	Male	266	2.70	0.374			
Earthquake Preparedness	Female	257	2.18	0.458	521	-1.70	.089
	Male	266	2.25	0.463			
Total scale	Female	257	2.61	0.310	520.24	1.74	.082
	Male	266	2.56	0.333			

Note. *M* = mean; *SD* = standard deviation; * $p < .05$. Welch's *t*-test was applied for Earthquake Awareness and Total Scale due to unequal variances.

As shown in Table 12, a statistically significant gender difference was found only in the Earthquake Awareness subdimension. Since the homogeneity of variances assumption was not met for this variable, Welch's *t*-test was applied, revealing that female students ($M = 2.80$, $SD = 0.35$) scored significantly higher than male students ($M = 2.70$, $SD = 0.37$), $t(520.28) = 3.15$, $p = .002$. In contrast, no statistically significant gender differences were observed for Earthquake Preparedness, $t(521) = -1.70$, $p = .089$, or for the Total Scale, $t(520.24) = 1.74$, $p = .082$. These findings suggested that while female students demonstrate slightly higher earthquake awareness, gender did not significantly differentiate preparedness behaviour or overall earthquake awareness scores.

Earthquake Awareness by Grade Level

A one-way ANOVA tested grade-level differences. Descriptive results for earthquake awareness, preparedness, and total scores by grade level are presented in Table 13.

Table 13
Descriptive Results of Earthquake Awareness Scores by Grade Level

Dependent variable	Grade level	N	M	SD	Skewness	Kurtosis
Earthquake Awareness	5th grade	132	2.79	0.343	-2.73	8.04
	6th grade	125	2.79	0.280	-1.81	2.98
	7th grade	128	2.71	0.329	-1.51	3.01
	8th grade	138	2.67	0.459	-0.566	6.64
Earthquake Preparedness	5th grade	132	2.45	0.385	-0.183	-0.770
	6th grade	125	2.31	0.394	-0.429	-0.034
	7th grade	128	2.12	0.456	0.183	-0.415
	8th grade	138	1.97	0.457	0.107	-0.685
Total scale	5th grade	132	2.69	0.297	-1.98	4.71
	6th grade	125	2.65	0.251	-0.983	0.476
	7th grade	128	2.54	0.305	-1.02	2.21
	8th grade	138	2.46	0.371	-0.810	2.67
	Total	523	2.58	0.320	-1.20	2.68

Note. M = mean; SD = standard deviation.

As shown in Table 13, mean scores for earthquake awareness were highest among 5th- and 6th-grade students ($M = 2.79$, $SD = 0.34$ and $SD = 0.28$, respectively) and lowest among 8th-grade students ($M = 2.67$, $SD = 0.46$). For earthquake preparedness, mean scores showed a consistent and progressive decline across grade levels, from 5th grade ($M = 2.45$, $SD = 0.39$) to 8th grade ($M = 1.97$, $SD = 0.46$), suggesting that preparedness levels decrease substantially as students advance through lower-secondary school. A similar descending pattern was observed for the total scale, with 5th-grade students obtaining the highest mean score ($M = 2.69$, $SD = 0.30$) and 8th-grade students the lowest ($M = 2.46$, $SD = 0.37$). Skewness and kurtosis values were generally within acceptable limits, supporting approximate normality for most variables.

The declining trend in preparedness across grade levels was reflected in students' descriptions of their earthquake readiness. A 6th-grade student demonstrated relatively comprehensive preparedness awareness: "*Earthquake bag to pre-arrange emergency meeting places... flashlight whistle water blanket emergency aid bag*" (S11, 6th grade, Female), listing specific items needed for earthquake preparedness. However, the same student admitted: "*Not at the moment... we didn't*" (S11, 6th grade, Female), indicating a gap between knowledge and action. Another 6th-grade student similarly acknowledged: "*I'm not making any preparations for an earthquake*" (S12, 6th grade, Male), despite being able to articulate what should be done during an earthquake.

To further examine statistical assumptions, Levene's test was conducted to assess variance homogeneity across grade levels. The results are presented in Table 14.

Table 14*Results of Levene's Test for Homogeneity of Variances*

Dependent variable	df1	df2	p
Earthquake Awareness	3	519	.011
Earthquake Preparedness	3	519	.087
Total scale	3	519	.023

Note. * $p < .05$.

As shown in Table 14, the assumption of homogeneity of variances was violated for Earthquake Awareness ($p = .011$) and for the Total Scale ($p = .023$), as the significance values fell below the .05 threshold. In contrast, the assumption was met for Earthquake Preparedness ($p = .087$). Given these violations, Welch's ANOVA was applied for Earthquake Awareness and the Total Scale as a robust alternative to standard one-way ANOVA, while the standard one-way ANOVA was retained for Earthquake Preparedness.

The results of the one-way ANOVA (standard and Welch, where appropriate) examining differences in earthquake awareness, preparedness, and total scale scores by grade level are presented in Table 15.

Table 15*One-Way ANOVA and Welch's ANOVA Results of Earthquake Awareness by Grade Level*

Dependent variable	Source	Sum of squares	df	Mean square	F	p
Earthquake Awareness	Between groups	1.34	3	0.446	3.41	.017*
	Within groups	67.87	519	0.131		
	Total	69.21	522			
Earthquake Preparedness	Between groups	17.18	3	5.73	31.67	< .001
	Within groups	93.83	519	0.181		
	Total	111.00	522			
Total scale	Between groups	4.14	3	1.38	14.29	< .001
	Within groups	50.17	519	0.097		
	Total	54.31	522			

Note. * $p < .05$. For Earthquake Awareness and Total Scale, Welch's ANOVA results are reported due to unequal variances.

As shown in Table 15, the one-way ANOVA and Welch's ANOVA indicated that grade level had a statistically significant effect on earthquake awareness, preparedness, and total scale scores. For Earthquake Awareness, where Welch's ANOVA was applied due to unequal variances, a significant difference was found among grade levels, $F(3, 287.23) = 3.21$, $p = .023$. For Earthquake Preparedness, the standard one-way ANOVA revealed a highly significant difference, $F(3, 519) = 31.67$, $p < .001$. For the Total Scale, Welch's ANOVA also indicated a statistically significant difference among grade levels, $F(3, 284.54) = 14.29$, $p < .001$. These results indicate that grade level is a significant factor influencing students' earthquake awareness, preparedness, and overall earthquake awareness scores.

Table 16 presents the results of the post hoc comparisons conducted to determine which grade levels differed significantly.

Table 16

Post Hoc Comparisons of Earthquake Awareness by Grade Level (Tukey HSD and Games-Howell)

Dependent variable	Grade level (I)	Grade level (J)	MD (I-J)	SE	p	Significant Difference
Earthquake Preparedness	5th	6th	0.139	.053	.045	5th>6th
		7th	0.324	.053	< .001	5th>7th
		8th	0.471	.052	< .001	5th>8th
	6th	7th	0.186	.052	.003	6th>7th
		8th	0.333	.052	< .001	6th>8th
	7th	8th	0.147	.052	.026	7th>8th
Total scale	5th	7th	0.151	.039	.001	5th>7th
		8th	0.223	.038	< .001	5th>8th
	6th	7th	0.109	.039	.011	6th>7th
		8th	0.181	.038	< .001	6th>8th

Note. MD = Mean difference; SE = standard error; * $p < .05$. Games-Howell post hoc test was performed for Awareness and Total Scale; Tukey HSD was performed for Preparedness. Only statistically significant comparisons are reported.

As shown in Table 16, post hoc comparisons were conducted to identify specific grade-level differences. Games-Howell test was applied for Earthquake Awareness and the Total Scale (due to unequal variances), while Tukey's HSD test was used for Earthquake Preparedness.

For Earthquake Awareness, although Welch's ANOVA indicated a statistically significant overall effect, $F(3, 287.23) = 3.21$, $p = .023$, no individual pairwise comparisons reached statistical significance following the Games-Howell correction. This pattern, in which the omnibus test is significant but pairwise comparisons are not likely, reflects the relatively small effect size and the conservative nature of the post hoc correction applied to account for multiple comparisons.

In contrast, for Earthquake Preparedness, Tukey's HSD test revealed that 5th-grade students scored significantly higher than all other grade levels (5th > 6th, $p = .045$; 5th > 7th, $p < .001$; 5th > 8th, $p < .001$). Additionally, 6th-grade students scored significantly higher than 7th-grade ($p = .003$) and 8th-grade students ($p < .001$), and 7th-grade students scored significantly higher than 8th-grade students ($p = .026$). These findings indicate a clear and consistent decline in earthquake preparedness as grade level increases.

For the Total Scale, Games-Howell post hoc comparisons indicated that 5th- and 6th-grade students had significantly higher overall scores compared to 7th- and 8th-grade students (5th > 7th, $p = .001$; 5th > 8th, $p < .001$; 6th > 7th, $p = .011$; 6th > 8th, $p < .001$), further confirming that lower grade levels demonstrate higher overall earthquake awareness.

Correlation Between Students' Earthquake Literacy and Earthquake Awareness

Prior to the analysis, the assumptions of independence and normality were assessed. Although some variables exhibited elevated kurtosis values, the large sample size ($N > 520$) was considered sufficient to ensure the robustness of Pearson correlation analysis in accordance with the central limit theorem (Tabachnick & Fidell, 2013). As shown in Table 17, a positive and statistically significant correlation was found between earthquake literacy and earthquake

awareness ($r(521) = .42, p < .01$), which, according to Cohen's (1988) classification criteria, represents a medium effect size, indicating a statistically significant relationship between earthquake literacy and awareness.

Table 17*Correlation Between Earthquake Literacy and Earthquake Awareness*

Variable	1	2
1. Earthquake literacy (total)	—	.42**
2. Earthquake awareness (total)	.42**	—

Note. $N = 521$. ** $p < .01$ (two-tailed).

The qualitative data illustrated how knowledge and awareness interacted in students' earthquake-related thinking. Students who demonstrated higher literacy often expressed more nuanced awareness of both risks and protective measures. One student reflected: "*I think being knowledgeable about earthquakes is actually like protecting yourself. If we know what to do in the event of an earthquake and establish a life triangle, we will protect ourselves*" (S1, 7th grade, Female), directly linking knowledge to self-protection. Another student's comprehensive response demonstrated the integration of cognitive knowledge with awareness: "*First of all, I know that I need a bag with me during an earthquake, and I know where I should go in case of an earthquake in my room or in any environment. I should not go near the windows*" (S1, 7th grade, Female). These statements illustrated how earthquake literacy contributed to heightened awareness of both immediate protective actions and broader preparedness needs.

Discussion

This study examined lower-secondary school students' earthquake literacy and earthquake awareness, explored gender and grade-level differences, and analysed the relationship between these constructs through a convergent parallel mixed-methods design. Overall, the findings indicated moderate to high levels of earthquake literacy and generally positive earthquake awareness, while also revealing important differences across gender and grade levels. A moderate positive relationship between earthquake literacy and awareness was identified. Together, these findings suggest that although students possess substantial knowledge of earthquake risks and protective actions, important gaps remain in emotional readiness and sustained preparedness behaviours. While these findings largely replicate patterns reported in prior research, the present study contributes by integrating literacy and awareness constructs and by providing mixed-methods evidence that clarifies how cognitive, affective, and behavioural dimensions interact in adolescent disaster preparedness. This study further contributes to disaster education literature by integrating earthquake literacy and earthquake awareness within a unified multidimensional framework and by providing evidence from a high-risk seismic context.

Students demonstrated moderate to high levels of earthquake literacy, with the highest scores in the cognitive and behavioural dimensions and the lowest scores in the affective dimension. This pattern suggests that students generally know what earthquakes are and what to do during an emergency, but their emotional preparedness is less developed. This pattern aligns with prior research demonstrating that school-based disaster programmes tend to yield stronger gains in declarative and procedural knowledge than in emotional readiness or adaptive coping capacity (Henson et al., 2020; Wei et al., 2020).

This is supported by the qualitative findings that students were generally able to describe appropriate protective actions, evacuation behaviours, and emergency procedures, indicating

that school-based disaster education and recent earthquake experiences have contributed to their cognitive and procedural knowledge. However, interview data also showed that this knowledge does not always translate into actual preparedness practices. Some students reported knowing that emergency kits should be prepared or that safety plans were necessary, yet these actions had not been sustained in daily life. This finding reflects the well-documented gap between disaster knowledge and preparedness behaviour (Yildiz et al., 2020; Kuloğlu et al., 2024), particularly in studies showing that children may be aware of earthquake risks but still report low levels of actual preparedness.

The affective dimension yielded the lowest scores, suggesting that students' emotional responses to earthquakes are characterized by fear, anxiety, and uncertainty rather than adaptive coping. Interview responses revealed that some students experienced considerable distress when thinking about earthquakes, particularly when alone or when imagining potential harm to family members. These findings are consistent with previous research, which emphasises that disaster-related emotions may either motivate preparedness or, when unmanaged, contribute to helplessness and avoidance (Karancı et al., 2005; Yeon et al., 2020). Together, these results indicate that earthquake education should not be limited to knowledge transmission and procedural drills but should also include emotional coping, risk communication, and self-efficacy building.

The findings showed significant gender differences in earthquake literacy: female students scored higher than males on the affective and behavioural dimensions and in total literacy, whereas no significant gender difference was found in the cognitive dimension. This pattern suggested that male and female students possess similar levels of earthquake-related knowledge, but female students are more emotionally engaged with earthquake risks and report stronger preparedness-related behaviours. This result is consistent with studies indicating that females tend to report higher risk perception, greater emotional sensitivity, and a greater preparedness orientation in disaster contexts (Karancı et al., 2005; Setyaningrum et al., 2025).

This is supported by the qualitative findings that female students generally provided more detailed accounts of their fears, concerns, and coping efforts compared with the comparatively brief and more fact-oriented responses of male students. This difference may reflect both variation in emotional experience and differences in emotional expression. From an educational perspective, these findings suggest that disaster education should be sensitive to gendered patterns of emotional engagement; while female students may benefit from support in managing fear and anxiety constructively, male students may benefit from interventions that strengthen emotional awareness, perceived vulnerability, and help-seeking tendencies.

Gender differences were also found in earthquake awareness, but only for the awareness subdimension, not for preparedness or total awareness. This suggested that female students may be more aware of earthquake risks, but heightened awareness does not necessarily translate into stronger perceptions of preparedness. Thus, awareness alone may be insufficient unless supported by opportunities for action at the family, school, and community levels.

One of the most striking findings of the study was that 5th- and 6th-grade students scored higher than 7th- and 8th-grade students across most literacy and preparedness dimensions, as well as in overall earthquake awareness scores. This pattern is particularly noteworthy because it does not align with the expectation that knowledge and preparedness should increase with age and schooling. Instead, the findings suggest a decline in earthquake-related literacy and awareness across grade levels.

Several explanations may account for this result. First, disaster education may be more visible or actively emphasised in lower grades, whereas upper grades may prioritise examination-oriented academic content. Second, developmental changes during early adolescence may reduce students' emotional engagement and receptivity to preparedness messages. As students grow older, perceptions of invulnerability, competing academic priorities, and reduced

dependence on adults may weaken the salience of disaster preparedness (Ronan & Johnston, 2005; Mutch, 2014). Third, earthquake-related knowledge may decline over time if it is not continuously reinforced through repeated practice and instruction. It is equally important to acknowledge that, given the cross-sectional design of this study, cohort effects cannot be ruled out as an alternative explanation for the observed grade-level differences. Students at different grade levels may have been exposed to varying curricula, distinct earthquake experiences (particularly given the 2023 Kahramanmaraş earthquakes), and differing levels of family-based disaster communication. Consequently, the apparent decline in literacy and awareness across grades may not solely reflect a loss of previously acquired knowledge, but may instead reflect systematic differences in the educational experiences and contextual exposures of successive student cohorts. Therefore, this pattern should not be interpreted solely as a developmental decline, but also as a potential cohort effect shaped by differences in curriculum exposure and lived earthquake experiences.

This is supported by the qualitative findings that younger students often gave more concrete and confident descriptions of preparedness actions, whereas some older students expressed uncertainty or acknowledged incomplete preparation. These results suggest that earthquake education should be organised as a spiral and developmentally progressive curriculum rather than as a one-time or lower-grade-focused intervention. Sustained reinforcement across grade levels appears essential for maintaining both knowledge and motivation to be prepared.

Students reported generally high earthquake awareness but only moderate levels of preparedness. This pattern clearly reflects the awareness-preparedness gap identified in disaster research (Yildiz et al., 2020; Kuloğlu et al., 2024; Sutrisno et al., 2025). In other words, students know that earthquakes are serious risks and recognise the importance of protective measures, yet they do not always perceive themselves, their families, or their environments as adequately prepared. The interview data provided concrete examples of this discrepancy. Students were often able to explain what should be done during or after an earthquake, but many also reported that emergency kits had not been prepared, plans were incomplete, or preparedness actions had not been maintained. This gap may be shaped by several interrelated factors, including optimistic bias, limited self-efficacy, family-level inaction, and the practical difficulty of sustaining preparedness behaviours in everyday life. Previous research has similarly indicated that although students may demonstrate awareness of natural hazards, translating this awareness into concrete behavioural actions often requires deeper engagement with scientific understanding and decision-making processes (Cerulli & Holbrook, 2019). These findings reinforce the argument that disaster education should move beyond awareness-raising and focus more directly on behaviour change, routine practice, and family participation.

A moderate positive correlation was found between earthquake literacy and earthquake awareness, indicating that students with higher literacy also tend to demonstrate greater awareness. This finding supports the theoretical view that knowledge, attitudes, and preparedness competencies form an important basis for disaster awareness (Becker et al., 2013; Rahim & Wu, 2015). At the same time, the relationship was moderate rather than strong, suggesting that awareness is not shaped solely by literacy.

This is supported by the qualitative findings that students with stronger knowledge often expressed clearer awareness of protective actions and the importance of preparedness; however, they still did not always report sustained preparedness practices. This indicated that literacy can support awareness, but additional factors such as family support, emotional regulation, prior experience, and perceived control are also critical. Accordingly, strengthening earthquake preparedness requires attention not only to what students know, but also to the conditions that enable them to act on that knowledge.

The qualitative findings deepened the interpretation of the quantitative results in several ways. First, they showed that students' knowledge was largely procedural and focused on

immediate response behaviours rather than deeper conceptual understanding. Second, they revealed uncertainty and lack of confidence beneath relatively high survey scores, suggesting that students may know the correct responses without fully feeling prepared. Third, they highlighted the central role of families in shaping preparedness behaviours, indicating that students' readiness is strongly influenced by household practices rather than individual knowledge alone. Finally, they demonstrated that emotional responses to earthquakes vary considerably and that social support, especially from family members, is important in coping with fear and anxiety.

Taken together, the findings highlight the multidimensional nature of adolescents' disaster preparedness. While students generally demonstrate strong cognitive knowledge of protective actions, translating this knowledge into sustained preparedness behaviours remains a persistent challenge. These results reinforce previous research indicating that disaster education programmes must move beyond awareness-raising and emphasise experiential learning, repeated practice, and family engagement in order to foster long-term preparedness behaviours.

Conclusion and Implications

First, regarding the assessment of students' earthquake literacy and awareness levels, the findings indicated that students demonstrated moderate to high levels of earthquake literacy and generally positive earthquake awareness. This study provides important evidence that while students demonstrated strong cognitive knowledge and familiarity with protective behaviours, their affective engagement with earthquake risks remained comparatively moderate and the lowest among the three dimensions. This finding suggests a potential imbalance in disaster education, where emotional preparedness may receive comparatively less emphasis than cognitive and behavioural components.

Second, regarding demographic differences in earthquake literacy and awareness, significant gender differences were observed, with female students reporting higher levels of affective and behavioural literacy as well as higher earthquake awareness. In addition, younger students (5th–6th grades) demonstrated higher literacy and awareness scores than older students (7th–8th grades), suggesting that earthquake-related knowledge and awareness may decline if not reinforced over time. These findings indicate that both gender and grade level are associated with variations in earthquake literacy and awareness, with the observed age-related pattern pointing to the need for sustained reinforcement across grade levels.

Third, with respect to the relationship between earthquake literacy and awareness, a moderate positive relationship between earthquake literacy and earthquake awareness was identified, indicating that higher levels of knowledge and perceived competencies are associated with greater awareness of earthquake risks. This finding is consistent with theoretical perspectives suggesting that literacy and awareness are closely related constructs, thereby highlighting the importance of comprehensive literacy development in disaster education.

These findings highlight the importance of strengthening school-based disaster education programmes. Based on the identified affective literacy gap, earthquake education should be implemented as a continuous and developmentally appropriate process across grade levels and should address cognitive, affective, and behavioural dimensions simultaneously. In particular, educational programmes should place greater emphasis on emotional coping, self-efficacy, and the translation of knowledge into sustained preparedness behaviours. To address the observed age-related decline in literacy and awareness, educational interventions must incorporate systematic reinforcement strategies and grade-appropriate curricula that maintain engagement throughout students' academic progression. The results also underscore the role of families in shaping students' preparedness practices, suggesting that school-based disaster education should involve parents and communities more actively. Given the documented gender differences,

educators should consider differentiated instructional approaches that enhance affective and behavioural engagement among male students while maintaining the strengths observed in female students.

Future research should examine earthquake literacy and preparedness across diverse regional contexts and evaluate the effectiveness of school-based disaster education interventions designed to strengthen students' long-term preparedness behaviours and resilience. Additionally, longitudinal studies are needed to track the persistence of earthquake literacy over time and to identify the specific mechanisms underlying the observed decline in older students. Intervention studies should also investigate the optimal balance between cognitive, affective, and behavioural components in disaster education curricula, with particular attention to strategies that enhance emotional preparedness and sustained behavioural change.

Study Limitations

Several limitations of this study should be acknowledged. First, the study was conducted in a single lower-secondary school in Çanakkale, Türkiye, which may limit the generalizability of the findings to other regions or educational contexts. Second, the quantitative data were based on self-reported measures, which may be influenced by social desirability or students' subjective perceptions of their knowledge and preparedness. Third, the cross-sectional design of the study precludes causal inference about the relationship between earthquake literacy and earthquake awareness. Future research should employ longitudinal or intervention-based designs to examine how disaster education programmes influence literacy and preparedness over time.

Declaration of Interest

The authors declare no competing interests.

Statement on the Use of Generative AI

During the preparation of this manuscript, ChatGPT (OpenAI, GPT-5.3) and Grammarly were used solely for language editing and proofreading. All AI-assisted outputs were reviewed and approved by the authors, who take full responsibility for the final manuscript.

References

- AFAD. (2023). *Türkiye deprem tehlike haritası* [Turkey earthquake hazard map]. Afet ve Acil Durum Yönetimi Başkanlığı. <https://www.afad.gov.tr>
- Arslan, K., Görgülü Arı, A., & Hayır Kanat, M. (2023). Ortaokul öğrencilerine yönelik deprem okuryazarlığı ölçeği geliştirme çalışması [Earthquake literacy scale development study for secondary school students]. *Türk Coğrafya Dergisi*, 83, 163–178. <https://doi.org/10.17211/tcd.1274001>
- Bachman, L. F. (2004). *Statistical analyses for language assessment*. Cambridge University Press.
- Becker, J. S., Paton, D., Johnston, D. M., Ronan, K. R., & McClure, J. (2013). The role of prior experience in informing and motivating earthquake preparedness. *International Journal of Disaster Risk Reduction*, 22, 179–193. <https://doi.org/10.1016/j.ijdr.2017.03.006>
- Byrne, B. M. (2010). *Structural Equation Modeling with AMOS: Basic concepts, applications, and programming*. Taylor and Francis Group Publication.
- Cerulli, D. A., & Holbrook, J. B. (2019). Exploring the effect of NOS/NOT learning and dispositions on undertaking behavioural actions in the case of natural hazards. *Journal of Baltic Science Education*, 18(4), 519–536. <https://doi.org/10.33225/jbse/19.18.519>

- Codreanu, T. A., Celenza, A., & Jacobs, I. (2014). Does disaster education of teenagers translate into better survival knowledge, knowledge of skills, and adaptive behavioral change? A systematic literature review. *Prehospital and Disaster Medicine*, 29(6), 629–642. <https://doi.org/10.1017/S1049023X14001083>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage Publications.
- Dewi, N. W. R. U., Jan, W., & Kim, M. (2025). Risk perception and response to natural hazards within science curriculum. *Journal of Baltic Science Education*, 24(2), 239–254. <https://doi.org/10.33225/jbse/25.24.239>
- Ersoy, Ş., & Koçak, A. (2016). Disasters and earthquake preparedness of children and schools in Istanbul, Turkey. *Geomatics, Natural Hazards and Risk*, 7(4), 1307–1336. <https://doi.org/10.1080/19475705.2015.1060637>
- Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE Publications.
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education*. McGraw-Hill Education.
- George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference* (4th ed.). Allyn & Bacon.
- Glass, G. V., Peckham, P. D., & Sanders, J. R. (1972). Consequences of failure to meet assumptions underlying the fixed effects analyses of variance and covariance. *Review of Educational Research*, 42(3), 237–288. <https://doi.org/10.3102/00346543042003237>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective* (7th ed.). Prentice Hall.
- Henson, H., McDaniel, J., Subramanian, R., & Edwards, T. (2020). Intervention and assessment of earthquake knowledge at rural schools near the New Madrid seismic zone, USA. *Natural Hazards*, 104(2), 1315–1329. <https://doi.org/10.1007/s11069-020-04215-1>
- Izadkhah, Y. O., & Gibbs, L. (2015). A study of preschoolers' perceptions of earthquakes through drawing. *International Journal of Disaster Risk Reduction*, 14, 132–139. <https://doi.org/10.1016/j.ijdr.2015.06.002>
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14–26. <https://doi.org/10.3102/0013189X033007014>
- Katada, T., & Kanai, M. (2016). The school education to improve the disaster response capacity: A case of “Kamaishi Miracle.” *Journal of Disaster Research*, 11(5), 845–856. <https://doi.org/10.20965/jdr.2016.p0845>
- Karancı, A. N., Aksit, B., & Dirik, G. (2005). Impact of a community disaster awareness training program in Turkey: Does it influence hazard-related cognitions and preparedness behaviors. *Social Behavior and Personality*, 33(3), 243–258. <https://doi.org/10.2224/sbp.2005.33.3.243>
- Kuloğlu, A., Tutuş, F., & Özer, M. (2024). Secondary school students' disaster preparedness perception: A mixed method approach. *Sakarya University Journal of Education*, 14(3), 563–580. <https://doi.org/10.19126/suje.1382630>
- Kvale, S., & Brinkmann, S. (2015). *Interviews: Learning the craft of qualitative research interviewing*. Sage.
- Mahanoğlu, S., & Balcı, S. (2025). Ortaokul öğrencileri için deprem farkındalığı ölçeği: Geçerlik ve güvenirlik çalışması [Earthquake awareness scale for secondary school students: Validity and reliability study]. *Mevzu: Sosyal Bilimler Dergisi*, 13, 991–1015. <https://doi.org/10.56720/mevzu.1610681>
- Maulana, T. I., Rahmawati, A., Syamsi, M. I., Setyawan, E. A., Fauzi, M. A. A., & Djola, B. M. (2023). Improving the awareness of earthquake natural disasters preparedness of SMP Muhammadiyah Sewon students. *Proceeding International Conference of Community Service*, 1(2), 856–862..
- Mutch, C. (2014). The role of schools in disaster preparedness, response and recovery: What can we learn from the literature? *Pastoral Care in Education*, 32(1), 5–22. <https://doi.org/10.1080/02643944.2014.880123>
- Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS* (7th ed.). Routledge.

- Paton, D., & Johnston, D. (2001). Disasters and communities: vulnerability, resilience and preparedness. *Disaster Prevention and Management: An International Journal*, 10(4), 270–277. <https://doi.org/10.1108/EUM0000000005930>
- Pituch, K. A., & Stevens, J. P. (2016). *Applied multivariate statistics for the social sciences* (6th ed.). Routledge.
- Rahim, N. B. A., & Wu, B. S. (2015). Disaster prevention literacies: Assessing the knowledge, skills and attitude of Taiwanese students for an earthquake disaster. *HSSE Online*, 4(1), 30–40.
- Ronan, K. R., & Johnston, D. M. (2005). *Promoting community resilience in disasters: The role for schools, youth, and families*. Springer.
- Santos-Reyes, J., Santos-Reyes, G., Gouzeva, T., & Velazquez-Martinez, D. (2017). Schoolchildren's earthquake knowledge, preparedness, and risk perception of a seismic-prone region of Mexico. *Human and Ecological Risk Assessment: An International Journal*, 23(3), 494–507. <https://doi.org/10.1080/10807039.2016.1188368>
- Setyaningrum, N., Nobel Bistara, D., Setyorini, A., Nur Adkhana Sari, D., Yulia Purwitaningtyas, R., & Samaran, E. (2025). Determinants of earthquake preparedness among junior high school students in Bantul Regency, Yogyakarta: An analysis of demographic and socioeconomic factors. *Journal of Human Behavior in the Social Environment*, 1–16. <https://doi.org/10.1080/10911359.2025.2481974>
- Shaw, R., Shiwaku, K., Kobayashi, H., & Kobayashi, M. (2004). Linking experience, education, perception, and earthquake preparedness. *Disaster Prevention and Management*, 13(1), 39–49. <https://doi.org/10.1108/09653560410521689>
- Solikhah, M., & Purwito, D. (2024). Community preparedness for earthquake natural disasters on empirical study. *Proceedings Series on Health & Medical Sciences*, 5, 151–155. <https://doi.org/10.30595/pshms.v5i.978>
- Stevens, J. P. (2012). *Applied multivariate statistics for the social sciences* (5th ed.). Routledge.
- Sutrisno, D., Suwarno, Y., Rahadiati, A., Habibie, M. I., Putra, P. K., Prayogi, H., ... & Kosasih, A. (2025). Community preparedness for earthquake disasters: A preliminary assessment of awareness and disaster infrastructure response in Cianjur, West Java-Indonesia. *F1000Research*, 13, Article 256. <https://doi.org/10.12688/f1000research.143577.3>
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Pearson.
- Toprak-Dereli, D., & Savasci-Acikalın, F. (2018). Middle school students' conceptual understanding of earthquakes. *SHS Web of Conferences*, 48, Article 01024. <https://doi.org/10.1051/shsconf/20184801024>
- Tuswadi, T., & Hayashi, T. (2014). Disaster prevention education in Merapi volcano area primary schools: Focusing on students' perception and teachers' performance. *Procedia Environmental Sciences*, 20, 668–677. <https://doi.org/10.1016/j.proenv.2014.03.080>
- Wei, B., Su, G., & Li, Y. (2020). Evaluating the cognition and response of middle/high school students to earthquake—A case study from the 2013 Mw6.6 Lushan earthquake-hit area, China. *International Journal of Disaster Risk Reduction*, 51, Article 101825. <https://doi.org/10.1016/j.ijdrr.2020.101825>
- Widyusuf, L., Muktiarni, M., & Mupita, J. (2022). Earthquake disaster preparedness for students of junior high school. *ASEAN Journal of Science and Engineering Education*, 2(2), 129–136. <https://doi.org/10.17509/ajsee.v2i2.38679>
- Wikan, P. A., Kinanthi, R., & Khoir, A. Z. (2022). Understanding the roles of experience, self-efficacy, and attitude in SIBAT community for earthquake disaster preparedness. *Social, Humanities, and Educational Studies (SHES): Conference Series*, 5(4), 206–211.
- Yeon, D. H., Chung, J. B., & Im, D. H. (2020). The effects of earthquake experience on disaster education for children and teens. *International Journal of Environmental Research and Public Health*, 17(15), Article 5347. <https://doi.org/10.3390/ijerph17155347>
- Yildiz, A., Teeuw, R., Dickinson, J., & Roberts, N. (2020). Children's earthquake preparedness and risk perception: A comparative study of two cities in Turkey, using a modified PRISM approach. *International Journal of Disaster Risk Reduction*, 49, Article 101666. <https://doi.org/10.1016/j.ijdrr.2020.101666>
- Yilmaz, E., & Yildirim, A. (2023). Too little, too late: Addressing the roles of a school safety programme in earthquake preparedness of elementary students in Turkey. *Asia Pacific Journal of Education*, 43(4), 1049–1070. <https://doi.org/10.1080/02188791.2021.1965956>

Received: *March 27, 2026*

Revised: *April 18, 2026*

Accepted: *May 25, 2026*

Cite as: Yalçinkaya-Önder, E., & Tatli, S. (2026). Earthquake literacy and awareness among lower-secondary school students. *Problems of Education in the 21st Century*, 84(3), 417–444. <https://doi.org/10.33225/pec/26.84.417>

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