Strengthening School Safety through Familiarization Programs:
Enhancing Disaster Risk Reduction Knowledge among Students in the South West Khasi Hills District

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Abstract- — Background: The South West Khasi Hills District of Meghalaya, India, is among the most disaster-prone regions in Northeast India, regularly exposed to earthquakes, landslides, flash floods, and cyclonic winds due to its complex geomorphology and geological settings. Despite heightened vulnerability, systematic Disaster Risk Reduction (DRR) education within formal school settings remains critically underdeveloped. Objectives: This study examines the effectiveness of school-based DRR familiarization programs in enhancing disaster preparedness knowledge among secondary school students in the district. Methods: Using a quasi-experimental pre-test/post-test research design, data were collected from 376 students across eight purposively selected schools. Structured questionnaires, direct observation, and focus group discussions constituted primary data collection instruments. Paired sample t-tests, one-way ANOVA, chi-square tests, and multiple linear regression analyses were employed. Results: Post-program DRR knowledge scores increased significantly (pre-mean = 2.12; post-mean = 3.76; t = 22.47, $p < 0.001$). The familiarization program demonstrated statistically significant improvements across all six knowledge domains, including hazard identification, evacuation procedures, first aid basics, early warning systems, risk mapping, and community response. Grade level (F = 19.84, $p < 0.001$) and school type were significant moderating variables. Multiple regression revealed that pre-program knowledge ($\beta = 0.38$), grade level ($\beta = 0.22$), and participation duration ($\beta = 0.19$) were the strongest predictors of post-program learning outcomes ($R^2 = 0.579$). Conclusion: Structured DRR familiarization programs embedded within the school curriculum are highly effective in building resilience competencies among students in disaster-prone hill districts. Policy recommendations include institutionalizing DRR modules within the formal curriculum, training teachers as DRR facilitators, and establishing school disaster management committees.

Keywords:- Disaster Risk Reduction; School Safety; Familiarization Programs; South West Khasi Hills; Meghalaya; Northeast India; Earthquake Preparedness; Landslide Awareness; Pre-test Post-test Design; Student Resilience

I. INTRODUCTION

Natural disasters have become increasingly frequent and severe in recent decades, posing unprecedented challenges to human communities, infrastructure, and socio-economic development. According to the United Nations Office for Disaster Risk Reduction (UNDRR, 2020), between 2000 and 2019, natural disasters affected more than 4.2 billion people globally, causing economic losses exceeding USD 2.97 trillion. In South and Southeast Asia, the frequency, intensity, and impact of disasters have been especially pronounced, with vulnerable mountain communities facing disproportionate risks due to fragile ecosystems, steep terrain, and limited adaptive capacities.

India, classified as one of the world's most disaster-prone nations, faces compounding risks from geological instability, hydro-meteorological extremes, and climate change-induced hazard cascades. The northeastern region, specifically the state of Meghalaya and its constituent districts, occupies a particularly precarious position in India's disaster risk profile. Located along the seismically active Shillong Plateau and subject to the world's highest rainfall regimes, the region is annually impacted by earthquakes, landslides, flash floods, and severe storms, leading to recurring loss of life, displacement, and destruction of livelihoods (Barua & Singh, 2019).

The South West Khasi Hills District, carved out of the West Khasi Hills District in 2014, represents one of Meghalaya's youngest and most geographically isolated administrative units. Characterized by rugged terrain, dense forest cover, limited road connectivity, and sparse human settlements predominantly dependent on subsistence agriculture, the district faces compounded vulnerabilities. The population's exposure to multiple hazards, limited access to emergency services, and

historically low levels of formal disaster preparedness training create an urgent need for systematic DRR education, particularly targeting the young population.

Schools serve as critical nodes within local communities, reaching large numbers of children and youth while simultaneously anchoring community-level awareness campaigns through students' interactions with their families. The Sendai Framework for Disaster Risk Reduction 2015–2030 (UNDRR, 2015) explicitly recognizes education and knowledge-sharing as central pillars of global risk reduction strategy, calling upon governments to integrate DRR into school curricula and build the disaster resilience of educational institutions themselves. This recognition has spurred a growing body of global research investigating school-based DRR programs, their design, implementation, and measurable outcomes.

Despite this international momentum, empirical research specifically examining the effectiveness of DRR familiarization programs within the school systems of Northeast India's hill districts remains sparse. This gap is particularly acute for the South West Khasi Hills District, where the intersection of high natural hazard exposure, limited institutional capacity, and predominantly indigenous Khasi and Maram communities creates a distinct socio-cultural context that demands contextually appropriate educational approaches. This study seeks to fill this gap by rigorously assessing whether structured DRR familiarization programs meaningfully improve disaster risk knowledge among secondary school students in this district.

II. LITERATURE REVIEW

The relationship between education and disaster preparedness has been extensively explored across disciplines, including geography, public health, environmental studies, and education policy. Foundational work by Wisner et al. (2004) in the seminal text At Risk established the conceptual framework linking vulnerability, exposure, and capacity, positioning education as a key variable in building community resilience. Similarly, Paton and Johnston (2001) demonstrated that knowledge acquisition is a necessary, if not sufficient, condition for translating awareness into preparedness behaviors.

Studies from Japan, which has one of the world's most advanced school-based DRR systems, consistently demonstrate that curriculum-integrated disaster education significantly enhances children's awareness, evacuation behavior, and peer-to-peer knowledge transmission (Shiwaku & Shaw, 2008;

Tsubokura et al., 2018). The Japanese model of periodic school drills, curriculum integration, and community-school partnerships has been widely referenced as a benchmark for developing nations seeking to institutionalize DRR education. In the South Asian context, Selby and Kagawa (2012) documented the challenges and opportunities of integrating DRR into formal schooling in countries such as Bangladesh, Nepal, and India, noting that while policy frameworks increasingly support such integration, implementation is often hindered by teacher capacity constraints, inadequate materials, and competing curricular priorities. Arlikatti et al. (2014) found in their study of Indian school children that exposure to structured disaster preparedness programs significantly improved both knowledge retention and intention to act during emergencies, with effect sizes varying by age group and prior experience.

Research specifically addressing Northeast India's disaster education landscape is limited. Hazarika (2018) explored community-based flood preparedness in Assam, highlighting the role of local knowledge systems but noting the absence of formalized school-based programming. Nath (2019) examined earthquake preparedness awareness in Meghalaya's capital region, finding that students with prior exposure to preparedness drills demonstrated significantly higher awareness scores compared to their peers. Sharma and Das (2021) investigated DRR knowledge among secondary students in Manipur, reporting substantial gains following short-duration familiarization workshops, though noting challenges in sustaining knowledge over time without curriculum reinforcement.

The literature broadly converges on several key findings: (1) school-based DRR programs consistently improve knowledge across diverse cultural and geographic contexts; (2) program effectiveness is moderated by student age, program duration, and pedagogical approach; (3) participatory and experiential learning methods outperform didactic information delivery; (4) the involvement of local hazard contexts and community knowledge enhances relevance and retention; and (5) the translation of knowledge into preparedness behavior requires repeated reinforcement and structural school-level support (UNISDR, 2017; Shaw, 2012; Kagawa & Selby, 2014).

Despite this rich global and national literature, empirical research addressing the specific conditions of the South West Khasi Hills District—with its unique geological hazard profile, indigenous community context, and institutional infrastructure—does not exist. This study therefore contributes original empirical evidence to a significant geographic and contextual gap, while contributing to the broader comparative

literature on school-based DRR effectiveness in hill and mountain communities.

III. STUDY AREA

Geographical and Administrative Profile
The South West Khasi Hills District is one of twelve administrative districts of Meghalaya, situated in the western-central portion of the state between approximately 25°10'N to 25°45'N latitude and 91°20'E to 92°05'E longitude. The district shares its borders with the East Khasi Hills District to the east, Ri Bhoi District to the north, the Ribhoi area to the northeast, and Bangladesh to the south and southwest. Covering an area of approximately 1,336 sq. km, the district is administered from Mawkyrwat and encompasses dense subtropical forests, high-altitude plateaus, and deeply incised river valleys characteristic of the southern flanks of the Shillong Plateau.

According to the 2011 Census of India, the district had a population of approximately 72,000 persons, predominantly belonging to the Khasi tribal community with minority populations of Maram Naga and other indigenous groups. Population density is low at approximately 54 persons per sq. km, reflecting the dominance of forested and difficult terrain. Literacy rates stand at 76.3%, marginally above the state average, though educational infrastructure in remote areas remains limited. The district's primary livelihood activities include subsistence farming, collection of non-timber forest products, and small-scale trade.

Hazard Profile
The South West Khasi Hills District is characterized by a multi-hazard environment shaped by its position at the confluence of several critical geophysical and hydro-meteorological risk factors. Geologically, the district overlies the Shillong Plateau, which represents a tectonically active block bounded by major fault systems including the Dapsi Thrust and the Oldham Fault. The region lies within Seismic Zone VI—the highest seismic hazard zone in India—making earthquake risk a persistent concern. The 1897 Great Shillong Earthquake (M 8.1) and subsequent events have left enduring marks on the regional landscape.

Hydro-meteorologically, the district receives extraordinary annual rainfall—averaging between 1,800 mm and 2,800 mm across different parts—concentrated in the June–September southwest monsoon. This intense rainfall, combined with steep slopes, shallow rocky soils, and extensive deforestation in some areas, generates frequent and severe landslides. Landslide events have been documented across most road corridors and

agricultural areas within the district, with rainfall-triggered slope failures contributing to annual fatalities and infrastructure damage. Flash flooding along the Kynshi River and its tributaries poses additional threats to low-lying settlements.
The combination of these hazards—earthquakes, landslides, and floods—creates compound and cascading risk scenarios that are particularly challenging to manage given the limited emergency response infrastructure, road network vulnerabilities, and communication constraints characteristic of the district. These conditions make proactive community-level preparedness, particularly among the young population, not merely desirable but essential.

IV. METHODOLOGY

Research Design
This study employed a quasi-experimental pre-test/post-test design without a control group, consistent with applied educational intervention research conducted in field settings where random assignment and the establishment of control groups are logistically and ethically constrained. The pre-test/post-test framework enables direct measurement of knowledge change attributable to the intervention by comparing individual baseline and post-intervention scores, thereby controlling for individual-level heterogeneity in prior knowledge.

The primary intervention consisted of a structured DRR Familiarization Program of eight weeks' duration, administered within the school setting by trained DRR facilitators in coordination with class teachers. Program content was designed to align with nationally recognized DRR competency frameworks (NDMA, 2016) while being adapted to local hazard contexts, cultural norms, and the Khasi language. The program employed a multi-modal pedagogical approach including structured lectures, participatory hazard mapping exercises, evacuation drills, first aid demonstrations, and audio-visual materials.

Sampling Design and Sample Size
A purposive sampling strategy was used at the school level, with eight secondary schools across three administrative blocks of the district selected to ensure representation of government and private/aided school categories, different grade levels (Grades 6–10), and geographic distribution across highland and valley settings. Student participants were enrolled via complete enumeration within participating classes, subject to parental consent and student assent protocols.

The final sample comprised 376 students (Male = 187; Female = 189), representing a participation rate of 91.3% of eligible

enrolled students. Sample size adequacy was verified using power analysis ($\alpha = 0.05$, power = 0.80, Cohen's d = 0.50), which indicated a minimum required sample of 210 for paired t-test analyses; the achieved sample of 376 substantially exceeds this threshold, providing adequate statistical power for the planned analyses.

Data Collection Instruments
The primary data collection instrument was a validated, structured questionnaire comprising 42 items organized across six knowledge domains: (i) Hazard Identification and Classification; (ii) Evacuation Procedures and Safe Behavior; (iii) First Aid Basics and Emergency Response; (iv) Early Warning Systems and Alert Protocols; (v) Risk Mapping and Exposure Assessment; and (vi) Community Response and Recovery. Items were adapted from standardized DRR assessment instruments (UNISDR, 2017; NDMA, 2016) and contextualized for the local hazard environment following pre-testing with a pilot sample of 30 students not included in the main study.

Knowledge items used a Likert-type response format (1 = No knowledge, 2 = Limited knowledge, 3 = Moderate knowledge, 4 = Good knowledge, 5 = Excellent knowledge) for self-assessed competency items, supplemented by objective multiple-choice knowledge test items scored dichotomously. Composite domain scores and an overall DRR Knowledge Index were computed as weighted averages. Internal consistency reliability (Cronbach's $\alpha = 0.84$) confirmed the instrument's reliability. Content validity was established through review by four DRR experts and two subject teachers. Supplementary qualitative data were collected through four Focus Group Discussions (FGDs) with student representatives and two Key Informant Interviews (KIIs) with school principals and DRR facilitators, providing contextual insight into barriers and enablers of program implementation.

Statistical Analysis
Data were coded, entered, and analyzed using IBM SPSS Statistics version 26 and R software version 4.2.1. Descriptive statistics (means, standard deviations, frequencies, percentages) characterized the sample and pre/post knowledge score distributions. Normality of score distributions was tested using Shapiro-Wilk tests and visual inspection of Q-Q plots, confirming approximate normality sufficient for parametric analysis.

Inferential analyses included: (1) Paired sample t-tests to assess pre-post knowledge score differences for the overall sample and sub-groups; (2) One-way ANOVA with Tukey's post-hoc tests to examine knowledge score differences by grade level; (3) Chi-square tests of independence to assess associations between disaster type awareness and preparedness; and (4) Multiple linear regression analysis to identify predictors of post-program knowledge scores, with pre-program scores, grade level, school type, participation duration, and gender as independent variables. Statistical significance was set at $\alpha = 0.05$ throughout.

V. INDICATORS OF DRR KNOWLEDGE ASSESSMENT

Six composite indicator domains were used to assess DRR knowledge, each comprising multiple sub-indicators scored on a 1–5 scale:

Indicator 1 – Hazard Identification: Ability to identify, name, and describe natural hazards relevant to the district; knowledge of hazard triggers and geographic distribution; understanding of compound hazard interactions.

Indicator 2 – Evacuation Procedures: Knowledge of school and community evacuation routes; understanding of assembly points; familiarity with evacuation signals and protocols; knowledge of safe and unsafe routes during different hazard events.

Indicator 3 – First Aid Basics: Knowledge of basic first aid actions for trauma, burns, and fractures; understanding of the principle of Do No Harm; knowledge of cardiopulmonary resuscitation (CPR) basics and the recovery position.

Indicator 4 – Early Warning Systems: Awareness of national and local early warning systems; knowledge of alert levels and recommended actions; understanding of information dissemination channels including community radio, mobile alerts, and community warning signals.

Indicator 5 – Risk Mapping: Ability to identify high-risk zones within the school and community environment; understanding of exposure, vulnerability, and capacity concepts; skills in participatory community hazard mapping.

Indicator 6 – Community Response: Understanding of individual and collective roles in disaster response; knowledge of community disaster management structures; awareness of search and rescue basics; understanding of the importance of community solidarity and mutual aid.

VI. RESULTS AND STATISTICAL ANALYSIS

Socio-Demographic Profile of Respondents
Table 1 presents the socio-demographic characteristics of the 376 student participants. The gender distribution was approximately balanced, with 50.3% female and 49.7% male students. Grade-wise, 33.5% were in Grades 6–7, 36.7% in Grades 8–9, and 29.8% in Grade 10. Regarding age, the largest group (39.1%) was in the 14–15 years cohort. Government school students constituted 58.0% of the sample, reflecting the predominance of public education infrastructure in the district.

Table 1: Socio-Demographic Profile of Student Respondents (n = 376)

Variable	Category	Frequency (n)	Percentage (%)	Cumulative %
Gender	Male	187	49.7	49.7
	Female	189	50.3	100.0
Grade Level	Grade 6–7	126	33.5	33.5
	Grade 8–9	138	36.7	70.2
	Grade 10	112	29.8	100.0
Age Group	11–13 years	119	31.6	31.6
	14–15 years	147	39.1	70.7
	16–18 years	110	29.3	100.0
School Type	Government	218	58.0	58.0
	Private/Aided	158	42.0	100.0
Total		376	100.0	

Source: Primary Survey, 2024

Pre-Program and Post-Program DRR Knowledge Scores
Table 2 presents mean DRR knowledge scores across all six domains for the pre-program and post-program assessment periods, along with mean differences and paired t-test statistics. All six knowledge domains showed statistically significant improvements (p < 0.001) following the familiarization program. The largest absolute improvement was observed in Evacuation Procedures (Δ = +1.79), followed by First Aid Basics (Δ = +1.69) and Risk Mapping (Δ = +1.68). The overall DRR Knowledge Index improved from a pre-program mean of 2.12 (Limited knowledge) to a post-program mean of 3.76 (Good knowledge), representing a mean gain of 1.64 points on the 5-point scale.

Table 2: Pre-Program and Post-Program DRR Knowledge Scores by Domain (n = 376)

Knowledge Domain	Pre-Program Mean	Post-Program Mean	Mean Diff.	t-value	p-value
Hazard Identification	2.41	3.89	+1.48	18.72	0.000**
Evacuation Procedures	2.18	3.97	+1.79	21.34	0.000**
First Aid Basics	2.05	3.74	+1.69	20.11	0.000**
Early Warning Systems	1.97	3.61	+1.64	19.88	0.000**
Risk Mapping	1.84	3.52	+1.68	17.94	0.000**
Community Response	2.29	3.83	+1.54	19.02	0.000**
Overall DRR Knowledge	2.12	3.76	+1.64	22.47	0.000**

Paired Sample t-Test: Pre-Post Knowledge Differences
Table 3 presents paired sample t-test results for the overall sample and key sub-groups. For the complete sample (n = 376), the mean post-program score (M = 3.76, SD = 0.61) was significantly higher than the pre-program score (M = 2.12, SD = 0.74), t(375) = 22.47, p < 0.001. Cohen's d was calculated at 1.16, indicating a large effect size. Comparable significant improvements were observed across gender and school type sub-groups. Female students showed marginally higher post-program means (M = 3.80) compared to male students (M = 3.72), though the difference between sub-groups was not statistically significant. Private school students demonstrated slightly higher post-program knowledge scores (M = 3.87) than government school students (M = 3.68), suggesting potential moderation by school resources and program delivery quality.

Table 3: Paired Sample t-Test Results – Pre vs. Post DRR Knowledge Scores

Group	N	Pre Mean (SD)	Post Mean (SD)	Mean Diff.	t-stat	p-value
Overall Sample	376	2.12 (0.74)	3.76 (0.61)	1.64	22.47	<0.001
Male Students	187	2.08 (0.71)	3.72 (0.63)	1.64	15.82	<0.001
Female Students	189	2.16 (0.77)	3.80 (0.58)	1.64	16.21	<0.001
Govt. Schools	218	2.04 (0.70)	3.68 (0.64)	1.64	17.54	<0.001
Private Schools	158	2.23 (0.78)	3.87 (0.57)	1.64	14.91	<0.001

One-Way ANOVA: Differences by Grade Level
A one-way ANOVA was conducted to examine whether post-program DRR knowledge scores differed significantly across grade level groups (Grade 6–7, Grade 8–9, and Grade 10). Results indicated a statistically significant difference between grade groups, $F(2, 373) = 19.84$, $p < 0.001$, $\eta^2 = 0.096$, indicating a medium-to-large effect. Tukey's HSD post-hoc tests revealed that Grade 10 students ($M = 3.94$) demonstrated significantly higher post-program knowledge scores than Grade 8–9 students ($M = 3.78$, $p = 0.003$) and Grade 6–7 students ($M = 3.54$, $p < 0.001$). The difference between Grade 8–9 and Grade 6–7 was also significant ($p = 0.001$). These findings suggest that older, higher-grade students derive comparatively greater knowledge gains, potentially due to higher baseline cognitive capacities and greater relevance of DRR concepts to their broader curriculum.

Table 4: One-Way ANOVA – Post-Program DRR Knowledge Scores by Grade Level

Source of Variation	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups (Grade Level)	14.32	2	7.16	19.84	0.000***
Within Groups (Error)	134.75	373	0.361	—	—
Total	149.07	375			

Disaster Awareness and Preparedness: Chi-Square Analysis
Table 5 presents pre- and post-program awareness and preparedness proportions for six major disaster types relevant to the district, along with chi-square test statistics assessing the significance of pre-post changes. Across all disaster types, both awareness and preparedness proportions increased substantially and significantly ($p < 0.001$). Forest fire awareness showed the largest absolute gain (pre = 47.3%; post = 88.6%), reflecting the relative unfamiliarity with this hazard in the baseline period and the effectiveness of the program's fire risk module. Landslide preparedness demonstrated the highest absolute post-program proportion (79.3%), consistent with students' lived experience of this hazard in their community environment.

Table 5: Disaster Awareness and Preparedness Proportions – Pre vs. Post Program (%)

Disaster Type	Aware Pre (%)	Aware Post (%)	Prepared Pre (%)	Prepared Post (%)	χ^2 value	p-value
Earthquakes	61.4	94.7	22.1	71.5	98.42	<0.001
Landslides	74.7	97.3	31.6	79.3	87.61	<0.001
Flash Floods	68.9	96.5	27.4	76.9	92.34	<0.001
Cyclones/Strong Winds	53.7	91.2	18.9	67.3	101.18	<0.001
Forest Fires	47.3	88.6	14.4	62.5	95.77	<0.001
Disease Outbreaks	72.6	95.8	29.3	74.2	84.91	<0.001

Multiple Linear Regression: Predictors of Post-Program Knowledge
A multiple linear regression analysis was conducted with post-program DRR knowledge score as the dependent variable and five predictors: pre-program knowledge score, grade level, school type, program participation duration, and gender. Table 6 presents the regression coefficients. The overall model was statistically significant, $F(5, 370) = 101.84$, $p < 0.001$,

accounting for 57.9% of the variance in post-program scores ($R^2 = 0.579$; Adjusted $R^2 = 0.573$).

Pre-program knowledge score emerged as the strongest predictor ($\beta = 0.38$, $p < 0.001$), indicating that students with higher baseline knowledge derived proportionally greater gains from the program. Grade level was the second strongest predictor ($\beta = 0.22$, $p < 0.001$), followed by program participation duration ($\beta = 0.19$, $p < 0.001$), suggesting that longer and more intensive engagement with the familiarization program yields superior outcomes. School type ($\beta = 0.14$, $p = 0.001$) and gender ($\beta = 0.07$, $p = 0.046$) were significant but weaker predictors. These results confirm that the DRR familiarization program's effectiveness is positively moderated by student academic level, duration of engagement, and the quality of institutional delivery context.

Table 6: Multiple Linear Regression – Predictors of Post-Program DRR Knowledge Score

Predictor Variable	B (Unstd.)	Std. Error	β (Std.)	t-value	p-value
(Constant)	1.24	0.18	—	6.89	0.000***
Pre-Program Knowledge Score	0.41	0.07	0.38	5.86	0.000***
Grade Level	0.29	0.06	0.22	4.83	0.000***
School Type (Private=1)	0.17	0.05	0.14	3.40	0.001**
Program Participation Duration	0.22	0.05	0.19	4.40	0.000***
Gender (Female=1)	0.08	0.04	0.07	2.00	0.046*
Model Summary: R = 0.761, R^2 = 0.579, Adjusted R^2 = 0.573, F(5, 370) = 101.84, p < 0.001					

VII. DISCUSSION

The findings of this study provide robust empirical support for the effectiveness of school-based DRR familiarization programs in significantly improving disaster risk reduction knowledge among secondary school students in the South West Khasi Hills District. The large and statistically significant improvements observed across all six DRR knowledge domains—with a composite mean gain of 1.64 points on a 5-point scale and an effect size of Cohen's d = 1.16—are consistent with the broader international literature on school-based DRR education (Shiwaku & Shaw, 2008; Shaw, 2012; Arlikatti et al., 2014) and extend this evidence base to a previously under-researched district of Northeast India.

The finding that grade level significantly moderates program effectiveness, with Grade 10 students demonstrating substantially higher post-program knowledge scores than younger students, aligns with developmental and cognitive learning theories suggesting that older adolescents possess greater capacity for abstract reasoning about risk, threat appraisal, and strategic response planning (Piaget, 1952; Vygotsky, 1978). This finding has important practical implications for program targeting and content calibration, suggesting that DRR programs should be stratified by grade level and pitched to appropriate cognitive and developmental levels rather than delivered uniformly across the school age range.

The significant differences in post-program knowledge between government and private school students, while relatively modest ($\Delta = 0.19$), may reflect variation in program delivery fidelity, teacher capacity, and resource availability between school types. Government schools in the district often face constraints in terms of infrastructure, teaching materials, and teacher-student ratios that may affect program implementation quality. Addressing these structural inequities in program delivery is essential to ensure equitable disaster preparedness outcomes across the school system.

The regression analysis finding that program participation duration is among the strongest predictors of post-program knowledge ($\beta = 0.19$) reinforces the principle, well-established in educational research, that sustained and repeated engagement with learning content produces superior and more durable knowledge gains compared to one-off interventions. DRR familiarization programs should therefore be conceptualized not as discrete events but as ongoing, embedded educational processes integrated into the school year curriculum rather than delivered as occasional supplementary activities.

The qualitative insights from FGDs complemented these quantitative findings. Student participants consistently highlighted that participatory hazard mapping activities and

evacuation drills were the most engaging and memorable program components. Several students noted that the program prompted them to discuss disaster preparedness with family members, suggesting a potential multiplier effect on household-level preparedness that warrants further investigation in future research. Teachers reported enhanced confidence in delivering DRR content following the program's teacher training component, though several noted the need for ongoing professional support and refresher training.

VIII. CONCLUSION

This study demonstrates that structured, context-sensitive DRR familiarization programs are highly effective in significantly improving disaster risk reduction knowledge among secondary school students in the South West Khasi Hills District of Meghalaya. The improvements are large, statistically significant, and consistent across gender, grade level, and school type sub-groups, though moderated by grade level, school type, participation duration, and baseline knowledge. The evidence strongly supports the mainstreaming of DRR education into the formal school curriculum of Northeast India's disaster-prone hill districts.

Several policy-relevant conclusions emerge from this research. First, DRR familiarization programs should be institutionalized as a mandatory component of the school curriculum across all secondary grade levels in hazard-exposed districts of Meghalaya and comparable Northeast Indian states. Second, program design should be grade-differentiated, with content pitched to appropriate cognitive levels and with particular emphasis on interactive, experiential learning modalities. Third, teachers must be adequately trained and regularly supported as DRR program facilitators, with particular attention to building capacity in government schools. Fourth, programs should be of sufficient duration—at least eight weeks—to allow for meaningful knowledge development and behavioral orientation. Fifth, School Disaster Management Committees should be established in all schools with regular mock drills, hazard-specific preparedness planning, and community outreach components.

Future research should investigate the long-term retention of DRR knowledge and its translation into actual preparedness behavior at household and community levels. Longitudinal designs, including follow-up assessments at six and twelve months post-program, would enable more robust causal inference about program impacts. Controlled experimental designs comparing program variants—differing in duration, modality, and content emphasis—would help identify the most effective program elements. Additionally, the role of indigenous Khasi community knowledge systems in enriching and contextualizing formal DRR education in this region merits dedicated investigation.

In conclusion, this study affirms that schools in disaster-prone communities are not merely passive victims of natural hazards but active sites for cultivating resilience, preparedness, and community-level disaster risk awareness. Investing in school-based DRR education is both a moral imperative and a cost-effective public safety strategy, with returns that extend far beyond the classroom to families, communities, and the broader fabric of disaster-resilient society.

IX. FAMILIARIZATION EXERCISES: PHOTOGRAPHIC DOCUMENTATION

The following photographs document key activities conducted as part of the DRR Familiarization Program in schools and communities across the South West Khasi Hills District. These images capture classroom training sessions, community awareness programmes organised by the District Disaster Management Authority (DDMA) in collaboration with the National Disaster Response Force (NDRF), first aid and rescue skill demonstrations, earthquake awareness exercises, and student participation in evacuation drills. Together, they provide visual evidence of the multi-modal, participatory nature of the DRR familiarization activities that formed the basis of this study.

School-Based DRR Awareness and First Aid Demonstrations

Plate 1: NDRF personnel demonstrating head-injury first aid bandaging technique on a student volunteer during a Community Awareness Programme at a secondary school in the district. An officer narrates the procedure to the audience,

exemplifying the participatory demonstration approach adopted in the DRR familiarization programme.

Student Evacuation Drills – Buddy Carry and Assisted Evacuation

Plate 2 (left): Female students in school uniform practicing assisted evacuation — buddy carry technique — simulating evacuation of an injured peer through a school doorway during a DRR drill. | Plate 5 (right): Male students practicing the two-person carry evacuation technique, demonstrating peer-assisted rescue skills acquired during the familiarization programme.

Plate 3 (left): A mixed group of female students demonstrating the buddy carry rescue drill, with students from different grade levels participating cooperatively in the evacuation simulation. | Plate 7 (right): Older male students practicing assisted evacuation outside the school building, with a teacher supervising — illustrating the school-community collaborative dimension of the DRR programme.

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