Formal Education and Disaster Response of Children: Evidence from Coastal Villages in Indonesia

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Formal Education and Disaster Response of Children:
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Abstract

Although children are exposed to a high mortality risk during disasters, what determines their disaster response, especially during earthquakes, remains largely unexplored. The goal of this study is to examine the association between formal education and earthquake response. Using a unique survey collected from elementary school students in the coastal villages of Indonesia, we show that students' attitude to learning science is positively associated with their risk perception, perceived coping ability, knowledge about the disaster mechanism and response, and propensity to respond appropriately. Parents' disaster experience also significantly affects these outcomes. In contrast, attitude to religious class explains none of outcomes. Locus of control is associated with perception and knowledge, but not the response. Our findings suggest that the effects of education on the disaster mortality of children could vary with the school curriculum.

Keywords: formal education, disaster response, earthquake, children, locus of control, Indonesia

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1. Introduction

Natural disasters cause immense loss of human lives. Between 1996 and 2015, 1.35 million people were killed in 7000 natural disasters worldwide, among which 56 percent were the victims of earthquakes and tsunamis (UNISDR and CRED 2016). Given the significance of the issue, the Sustainable Development Goals aim to reduce the number of disaster victims. It is particularly important for policymakers to facilitate the appropriate disaster response of children, who are exposed to the highest mortality risk (UNISDR 2007).

Nonetheless, the disaster response of children, particularly during an earthquake, is not well understood. Previous empirical studies on disaster evacuation mainly rely on evidence of adults during hurricanes and cyclones (Eisenman et al. 2007; Riad et al. 2006; Saha 2015; Shoji and Murata 2018; Smith and McCarty 2009). However, behavioral patterns may differ between disasters. Unlike a hurricane and cyclone, the timing of an earthquake is unpredictable, forcing children to react immediately. This increases the possibility of decision errors driven by cognitive biases (Kahneman and Tversky 1972).[1] Some descriptive studies and policymakers claim the importance of schools in such situations (Matsuura and Shaw 2015; Mimura et al. 2011; McAdoo et al. 2006; Shaw and Kobayashi 2001; Shaw et al. 2015; Shiwaku and Fernandez 2011; UNISDR 2005; Yamori 2014).[2] It has also been shown that the disaster preparedness and mortality of adults differ according to their education level (Frankenberg et al. 2013; Hoffmann and Muttarak 2017; Muttarak and Pothisiri 2013). However, to the best of our knowledge, no empirical evidence exists on the role of formal education in the earthquake response of children. It is particularly relevant for policymakers to

[1] A cognitive bias is defined as “a pattern of deviation in judgment that occurs in particular situations, leading to perceptual distortion, inaccurate judgment, illogical interpretation, or what is broadly called irrationality” (Kahneman and Tversky 1972).

[2] UNISDR initiated a campaign, *Disaster risk reduction begins at school*, in 2006 (UNISDR 2006). Global agreements such as the Hyogo Framework for Action and Sustainable Development Goals also emphasize the importance of education in achieving disaster risk reduction.

analyze the response of Indonesian children. In Indonesia, 180,000 human lives were lost in natural disasters between 1996 and 2015, the second highest following Haiti (UNISDR and CRED 2016).

This study bridges this gap in the literature by examining the association between formal education and the earthquake response of children in Indonesia. Specifically, we highlight the difference in the effects across subjects such as science and religious classes.

2. Conceptual Framework

How does education influence students' earthquake response? Among various psychological models, Protection Motivation Theory proposes that a high risk perception and perceived ability to cope with disaster are essential for individuals to take protective action such as disaster preparation and evacuation (Rogers 1975; Rogers and Prentice-Dunn 1997).[3] Risk perception describes how a person assesses a threat's probability and potential damage if he/she does not change behavior. It is determined based on perceived probability, perceived severity, fear, and the perceived reward for a maladaptive response.[4] Dash and Gladwin (2007) further propose that six factors—socio-economic factors, experience factors, trust of authority, disaster knowledge, home characteristics, and message—interactively determine individuals' risk perception and therefore, evacuation decision. On the other hand, perceived coping ability is characterized by three subcomponents. The first, response efficacy, refers to perceptions of the effectiveness of a protective response. The second subcomponent is self-efficacy, that is, students' perceived ability to perform or carry out protective responses. The last is protective response cost, that is, the cost of taking the response including monetary, time, and effort factors.

Education could affect a student's disaster response by changing both perceptions. On the

[3] The Protective Action Decision Model (Lindell and Hwang 2008; Lindell and Perry 2004) and Social-Cognitive Preparation (Paton 2003; Paton et al. 2005) also consider similar frameworks.

[4] Maladaptive responses including ignoring an evacuation order and staying home, cause intrinsic and extrinsic rewards such as physical pleasure and approval from community members.

one hand, students with better education might have higher knowledge about the disaster mechanism and be more aware of the probability and severity of the disaster risk (Gaillard and Mercer 2013). It also causes individuals to be more patient and risk averse (Chew et al. 2010; Oreopoulos and Salvanes 2011; Perez-Arce 2011), increasing the fear of a natural disaster. On the other hand, education could affect perceived coping ability, because it leads to higher knowledge of an appropriate disaster response, increasing response efficacy and self-efficacy.

However, it is theoretically ambiguous whether education encourages children to take an appropriate response. First, unlike hurricanes and floods, the timing of an earthquake is unpredictable, and therefore, children need to respond immediately. Decision-making is subject to various cognitive biases in this type of situation (Kahneman and Tversky 1972). In particular, normalcy bias causes children to underestimate the probability or severity of disaster damage, while an abnormalcy bias causes them to underestimate their coping ability (Drabek 1986; Omer and Alon 1994; Perry et al. 1982). Therefore, students' perceptions could temporarily decline during an earthquake. Second, Hoffmann and Muttarak (2017) show that education facilitates disaster preparedness through increasing social capital. However, previous studies find the negative effects of social capital on disaster evacuation: those with higher social capital rather rescue their neighbors (Horney et al. 2010, MacDougall et al. 2014) and underestimate the severity of the disaster (Wolf et al. 2010).

3. Methods

3.1. Study Area

Our study site is South Nias Regency in Nias Island, Indonesia. This region is ranked as one of the areas most vulnerable to earthquakes/tsunamis in the country (Badan Nasional Penanggulangan Bencana 2014).[5] In particular, it experienced severe damage in two devastating earthquakes. In

[5] The island is located 100 km east of Sunda Trench, the boundary between the Eurasian Plate (Sunda Plate) and Australian Plate (Sahul Shelf). This exposes the island to a high risk of earthquake and tsunami (Hsu et al. 2006).

December 2004, the Indian Ocean Earthquake (magnitude 9.0) and the following tsunami caused 154 deaths, and 1832 people went missing. The Nias–Simeulue Earthquake (magnitude 8.7) occurred three months after the 2004 tsunami, causing 851 deaths and 6278 missing people. Even before our survey, our study site experienced 379 earthquakes within a year, of which 6 were a magnitude 5 or larger. Nonetheless, a disaster education program has not been introduced in the island's school curriculum.

3.2. Participants

We conducted a unique survey with the students of 12 elementary schools in the regency. When determining the survey schools, we prioritized those near the coast, which are exposed to a high tsunami risk. The location and basic characteristics of the schools are presented in Figure A1 and Table A1, respectively. The survey was conducted with 4th to 6th grade students in September 2017. Therefore, all respondents were born after the 2004 and 2005 disasters. Among the 1112 sample students, 963 responses were obtained.[6]

3.3. Measures

3.3.1. Learning attitude at school

A challenge in this study is measuring students' education level. Although previous studies employ respondents' years of schooling (Frankenberg et al. 2013; Hoffmann and Muttarak 2017; Muttarak and Pothisiri 2013), this is not suitable for the analysis of children, since it is correlated with their age. One may consider the use of school performance, but this causes another issue: since it is a sensitive question, the response rate may decrease. Therefore, we elicit their learning attitude at school, which is strongly associated with school performance (Osborne et al. 2003; Singh et al. 2002).

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[6] The non-response rate is 13%. This is mainly because some students could not commute to the school on the survey day because of heavy rain.

Specifically, we asked about science and religious classes using the following question: *Do you generally have fun when you are learning science at school?* The answer options include (1) *Not at all*, (2) *Not very much*, (3) *Unsure*, (4) *Somewhat*, and (5) *Very much*.[7] In this study, a student is considered to enjoy the class if he/she answered (5).

3.3.2. Locus of Control

Locus of control is a non-cognitive trait characterizing the extent to which individuals believe that their life outcomes are within their realm of personal control (Rotter 1966). It is measured according to an internal locus (that is, a belief that outcomes are within one's control) and external locus (that is, a belief that outcomes are outside of one's control). Our scale for locus of control is based on De Minzi (1991). Her approach has two features preferable to that of Rotter (1966), who originally proposed this method. First, since it is designed for children in a developing country, it is easy even for children with poor reading ability to understand the questionnaire. Second, it is designed to distinguish the instrumental and affective modalities of the internal dimension, and powerful-others and fatalism modalities of the external dimension. Instrumental internal control refers to the perception of life outcomes as a consequence of one's own actions, while affective internal control refers to that of affective relationships with others. The other two distinguish within external control between the power attributed to others and luck/fate. Her questionnaire design has 16 short questions (4 questions for each modality) with 2 answer options: yes and no (Table A2). The value one is assigned to every item answered affirmatively, and zero to those answered negatively. The scale of each modality is characterized by the mean score of the questions.

3.3.3. Outcomes

[7] This is a modified version of the question used in the Program for International Student Assessment 2015 (PISA).

Our main dependent variables are two binary indicators for the earthquake response: (1) whether students took any reaction promptly when they felt an earthquake within a year, such as moving under the table; and (2) whether they considered the tsunami risk and evacuated to a safe place after the quake. In addition, we elicit five outcomes related to risk perception and perceived coping ability: (3) perceived severity of the disaster, (4) knowledge about the disaster mechanism, (5) perceived efficacy of preparation, (6) perceived efficacy of deepening knowledge about a disaster, and (7) knowledge about the appropriate response to a disaster. Table A3 provides the definitions of the outcome variables. Specifically, we asked six questions to capture (4), and four questions for (7). We then quantify the level of each type of knowledge based on the proportion of correct answers. These indicators are frequently used in the literature (Adiyoso and Kanegae 2012; Johnson et al. 2014; Shaw et al. 2004).

3.4. Summary Statistics

Table 1 reports the summary statistics for student characteristics and outcome variables. Column (1) shows that 54.4% and 62.0% of students enjoy science and religious classes, respectively. Furthermore, 35.2% of students report that their families were affected by the earthquakes in 2004 and 2005. Columns (2) and (3) compare these characteristics relative to the attitude to learning science. We find systematic differences among the characteristics such as attitude to learning religious classes, locus of control, disaster experience of family, and literacy of household head. Regarding the outcome variables, 73.8% of students reacted immediately when feeling a quake, and 36.2% considered the risk of tsunami after the quake and evacuated to a safe place. These proportions are higher among students with a better attitude to science.

[Table 1]

4. Analysis

Our benchmark model employs an OLS to regress disaster response on the indicators of learning attitude, locus of control, demographics, socio-economic status, disaster experience of household, and each school dummy.[8] The school dummies control for heterogeneity in the geographic and socio-economic conditions of the community, as well as school characteristics. We employ the standard error clustered at the classroom level to correct for the correlation of residuals across classmates.

A potential issue in this model is the possibility of spurious correlation. Students' learning attitude may vary according to their demographics, parents' socio-economic status, and school characteristics such as student-teacher ratio and teaching skills. While we control for these differences with the school dummies, unobserved heterogeneity in student and household characteristics may still exist. To assess the severity of this bias, we use the approach of Oster (2017). Assuming that the observed characteristics are informative for the selection on unobservable variables, she computes the degree of selection on unobservables relative to the observables that would be necessary to produce a coefficient of zero. A negative value of the degree indicates that fully controlling for unobserved variables should increase the coefficient. A large positive value suggests that it is unlikely that the omitted variable bias explains the entire effect. In particular, Oster (2017) claims that a value of "one" could be an appropriate cutoff to assess the severity of unobserved heterogeneity.[9] Following this, we interpret that the estimated coefficient would unlikely be driven by the spurious correlation if the computed parameter is negative or larger than "one." While this approach has been employed in empirical studies in various fields (Athey and Imbens 2017), to the best of our knowledge, this study is the first in the literature on disaster studies.

[8] Previous studies show the significant effect of disaster experience on disaster awareness and preparedness (Mulilis et al. 1990; Shaw et al. 2004). Those with an internal locus also have a better attitude to and higher knowledge of disaster preparation (López-Vázquez and Marván 2012; McClure et al. 1999).

[9] This means that the observable variables are at least as important as the unobservable ones.

Note that we employ the OLS even for binary dependent variables, because Oster's (2017) test is applicable only to the linear regression model. Therefore, we also estimate a Probit model for robustness.

5. Results

5.1. Earthquake Response

Table 2 presents the estimation results. Columns (3) and (6) show that attitude to learning science is positively associated with the propensity of taking immediate reaction by 7.8 percentage points, and the propensity of evacuating to a safe place by 13.0 percentage points, respectively. The coefficients are stable across the columns in magnitude and statistical significance. Given that only 36% of students consider the tsunami risk during earthquakes (Table 1), the latter effect is remarkably large. In contrast, attitude to religious class does not explain the variation in earthquake response. Parents' disaster experience is shown to have a positive effect by around 6 percentage points (Columns 2 and 3), while students' locus of control does not predict their behavioral patterns. Finally, these findings are robust to the use of a Probit model (Table A4).

[Table 2]

5.2. Sensitivity to Spurious Correlation

To what extent is the coefficient of attitude to science sensitive to the spurious correlation? Using the approach of Oster (2017), we examine coefficient stability for four types of unobserved characteristics: (1) student's demographics and learning attitude at school, (2) personality and non-cognitive traits, (3) socio-economic status of household, and (4) religious background. In the first test, we re-estimate the model without controlling for students' gender, grade, and learning attitude to religious class. Then, by comparing the coefficient of interest between the models, we compute how influential the omitted characteristics have to be to fully explain the positive coefficient relative to the observed characteristics. Likewise, the second to fourth tests examine the coefficient stability excluding locus of control, socio-economic status, and religion, respectively.

We report the results at the bottom of Columns (3) and (6) in Table 2. In the first test, the computed parameters are -1.44 for immediate response, and 1.36 for evacuation, respectively. The former suggests that the coefficient should become even larger if we fully control for the unobserved components of demographics and learning attitude. The latter indicates that while the coefficient should become smaller by controlling for the unobserved characteristics, the omission alone cannot explain the positive coefficient of learning attitude. The second to fourth tests also present the same patterns. None of the parameters range between zero and one. These tests confirm that the estimated coefficients are unlikely to be driven by the spurious correlation.

5.3. Perceived Disaster Risk and Coping Ability

As explained in Section 2, learning science could improve earthquake response through various channels. To elaborate the underlying mechanisms, we estimate the association between learning attitude and perceived severity of the disaster, knowledge about the disaster mechanism, perceived efficacy of preparing for disaster and deepening knowledge, and knowledge about an appropriate disaster response. Table 3 confirms that students who enjoy science have a higher perception and knowledge, while attitude to religious class is not correlated with these aspects. Oster's (2017) test supports the robustness of the results. These findings suggest the effects of learning science on disaster response through risk perception and perceived coping ability.

We also find significant effects of locus of control on these outcomes. Those with a higher scale of instrumental modality—that is, those who believe that their life outcomes can change with their own actions—are more likely to recognize the efficacy of deepening knowledge and have significantly higher knowledge. On the other hand, the coefficients of the remaining modalities demonstrate unstable signs across outcomes, and these are mostly insignificant. Regarding the other characteristics, children whose families have been affected by a disaster have higher risk awareness and knowledge about the disaster mechanism. Finally, the children of literate parents are more aware of disaster risk and have higher knowledge.

Finally, for robustness, we estimate an extended model, where these outcome variables are additionally controlled for in the benchmark model described in Section 5.1. Table A5 shows the significantly positive coefficients of perception and knowledge, even after controlling for the observed characteristics.

[Table 3]

6. Discussion and Conclusions

Using our unique survey data on elementary school students in the coastal villages of Indonesia, we examined the extent to which their earthquake response is attributed to learning attitude at school, disaster experience of the family, and locus of control. Our main finding is that students' attitude to learning science is positively associated with the propensity of taking an appropriate response, while that of religious class is not. One interpretation of the difference between these subjects is how they affect the development of cognitive skills. Religious class might not help students process disaster information as much as science does. In fact, we also provide supporting evidence that those who enjoy science have a higher risk perception, perceived coping ability, and knowledge about disaster risk. These findings suggest that learning science could facilitate the appropriate earthquake response by changing their risk perception and perceived coping ability.

This study also demonstrates that parents' disaster experience positively affects perceptions, knowledge, and earthquake response. This is consistent with the argument pertaining to the role of the community and family in reducing the mortality risk of children during the 2004 tsunami in Indonesia (McAdoo et al. 2006).[10] In contrast, although students' locus of control is significantly

[10] Simeulue Island has an oral history that encourages prompt evacuation to the upland when feeling

associated with their knowledge and perceptions, it does not facilitate an appropriate earthquake response.

One might be concerned that our findings are influenced by a self-reporting bias. Since the measures of learning attitude and earthquake response are self-reported, respondents pretending to be good students, for example, may answer both questions affirmatively, driving a positive spurious correlation. However, this cannot explain the heterogeneous effect between science and religious classes, or the significant association between attitude to science and knowledge about disaster risks. Thus, it is unlikely that that this type of bias affects our findings.

Admittedly, learning attitude at school may be determined by factors such as students' cognitive skills, learning achievement, and teacher's level of effort. Our dataset does not enable us to disentangle them perfectly, given the lack of this information. Therefore, the coefficients of learning attitude should be interpreted as the mixed effects of these factors. Further studies are required to decompose them. Nonetheless, it is still insightful that attitude to science has a significantly positive coefficient, while attitude to religious class does not.

We believe that this study makes four contributions to the literature. First, to the best of our knowledge, this study is the first to uncover the earthquake response of children, as mentioned in Section 1, while previous studies examine adults during hurricane, cyclone, and flood events (Eisenman et al. 2007; Riad et al. 2006; Saha 2015; Shoji and Murata 2018; Smith and McCarty 2009). This is policy-relevant given their high mortality risk.

Second, existing studies examine disaster preparedness and response to hurricanes to provide evidence supporting the Protection Motivation Theory (Baker 1991; Bateman and Edwards 2002; Becker et al. 2014; Dash and Gladwin 2007; Dow and Cutter 1998; Drabek 1999; Eisenman et al. 2007; Grothmann and Reusswig 2006; Haque 1995, 1997; Haque and Blair 1992; Lindell et al.

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earthquakes. As a result, most villagers in the coastal areas reacted appropriately during the 2004 tsunami, and only seven were killed, even though the island is located only 60 km from the epicenter (McAdoo et al. 2006).

2005; Mallick et al. 2011; Mulilis and Lippa 1990; Paul and Dutt 2010; Paul et al. 2010; Riad et al. 2006; Shoji and Murata 2018; Smith and McCarty 2009). As discussed in Section 2, decisions during an earthquake are crucially affected by cognitive biases, and therefore, it is difficult to keep risk perception and perceived coping ability high. Nonetheless, we find that the theory is still an effective tool even to predict earthquake response.

Third, previous studies show the positive effects of years of schooling on disaster preparedness and survival rate (Frankenberg et al. 2013; Hoffmann and Muttarak 2017; Muttarak and Pothisiri 2013). However, our findings on the heterogeneous effects between subjects suggest that it is what people learn, not how long they learn, that determines disaster preparedness and response. Therefore, the same years of schooling could have different consequences depending on the school curriculum.

Fourth, it has long been argued since Sims and Baumann (1972) that locus of control is a critical determinant of disaster mortality, and previous studies consistently show its effect on attitude to and knowledge about disasters (Baumann and Sims 1978; Karanci et al. 2005; López-Vázquez and Marván 2012; McClure et al. 1999; Mishra et al. 2009). However, as far as we know, this study is the first to test the association between locus of control and disaster response. It is also the first to uncover the role of locus of control in disaster preparedness for children.

The following policy implication is derived. A strand of literature claims the importance of introducing disaster education programs in schools (Codreanu et al. 2014; Johnson et al. 2014; Ronan et al. 2015), but this type of program sometimes requires expensive software and equipment (Clerveaux et al. 2010; Tsai et al. 2015; Yamori 2008). The financial burden could be a serious obstacle to introducing the program, especially for schools in areas that are poor and vulnerable to disasters. However, this study suggests that even without a disaster education program, formal education such as science classes can reduce the disaster mortality risk of children by changing their knowledge, perception, and behavior.

However, this argument does not necessarily rule out the importance of disaster education, given the possibility that students with a poor learning attitude and cognitive skills are left behind. To reduce their mortality risk, schools should introduce a program specifically designed for such students, which is easy to understand even for those with low cognitive skills.

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Table 1: Summary Statistics

Sample:	Full		Enjoy science		Not enjoy science		
	(1)		(2)		(3)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Diff.
Respondents Characteristics							
1 if enjoy science classes	0.544	0.498					
1 if enjoy religious classes	0.620	0.486	0.800	0.401	0.405	0.492	***
1 if boy	0.499	0.500	0.408	0.492	0.608	0.489	***
1 if 5th grade	0.343	0.475	0.342	0.475	0.344	0.476	
1 if 6th grade	0.330	0.471	0.332	0.471	0.328	0.470	
LOC: instrumental	0.802	0.226	0.818	0.211	0.784	0.241	**
LOC: affective	0.727	0.250	0.737	0.249	0.716	0.251	
LOC: powerful others	0.725	0.249	0.741	0.232	0.706	0.267	**
LOC: fatalism	0.695	0.260	0.713	0.252	0.674	0.267	**
1 if affected in 2004/2005	0.352	0.478	0.385	0.487	0.312	0.464	**
1 if head is literate	0.790	0.407	0.830	0.376	0.743	0.438	***
1 if agricultural household	0.560	0.497	0.573	0.495	0.544	0.499	
1 if fishery household	0.112	0.316	0.107	0.309	0.118	0.324	
1 if own boat	0.157	0.364	0.124	0.330	0.196	0.397	***
1 if own land	0.737	0.440	0.735	0.442	0.740	0.439	
1 if own car	0.142	0.350	0.126	0.332	0.162	0.369	
1 if own bike	0.773	0.419	0.773	0.419	0.772	0.420	
1 if own TV	0.697	0.460	0.714	0.452	0.677	0.468	
1 if Catholic	0.243	0.429	0.260	0.439	0.223	0.417	
1 if Non-Christian	0.134	0.341	0.111	0.314	0.162	0.369	**
Outcome Variables							
Earthquake Response							
Immediate response	0.738	0.440	0.779	0.416	0.690	0.463	***
Evacuation	0.362	0.481	0.437	0.496	0.273	0.446	***
Perceived Disaster Risk and Coping Ability							
Perceived severity of disaster	0.732	0.443	0.782	0.413	0.672	0.470	***
Knowledge about disaster mechanism	0.389	0.207	0.415	0.209	0.357	0.200	***
Perceived efficacy of preparation	0.781	0.414	0.819	0.386	0.736	0.441	***
Perceived efficacy of knowledge	0.504	0.500	0.584	0.493	0.408	0.492	***
Knowledge about disaster response	0.498	0.243	0.539	0.235	0.450	0.244	***
N	963		524		439		

* Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 2: The Impact of Learning Attitude on Earthquake Response

	Immediate response			Evacuation		
	(1)	(2)	(3)	(4)	(5)	(6)
1 if enjoy science classes	0.088**	0.079**	0.078**	0.135***	0.129***	0.130***
	(0.038)	(0.038)	(0.037)	(0.033)	(0.033)	(0.033)
1 if enjoy religious classes	-0.039	-0.044	-0.041	0.054	0.051	0.041
	(0.040)	(0.040)	(0.040)	(0.039)	(0.039)	(0.042)
1 if boy	0.042	0.040	0.041	-0.008	-0.007	-0.004
	(0.032)	(0.031)	(0.031)	(0.038)	(0.039)	(0.040)
1 if 5th grade	0.005	-0.000	-0.000	0.015	0.012	0.006
	(0.050)	(0.049)	(0.050)	(0.049)	(0.049)	(0.049)
1 if 6th grade	0.074	0.063	0.063	0.105**	0.094**	0.082
	(0.046)	(0.046)	(0.046)	(0.045)	(0.047)	(0.049)
LOC: instrumental			0.003			0.115
			(0.080)			(0.084)
LOC: affective			0.003			0.022
			(0.067)			(0.084)
LOC: powerful others			-0.114*			0.069
			(0.063)			(0.072)
LOC: fatalism			0.068			-0.027
			(0.070)			(0.070)
1 if affected in 2004/2005		0.058*	0.060*		0.072*	0.062
		(0.032)	(0.033)		(0.039)	(0.039)
1 if head is literate		0.015	0.012		0.014	0.013
		(0.032)	(0.033)		(0.033)	(0.033)
1 if agricultural household		0.022	0.023		0.014	0.015
		(0.042)	(0.042)		(0.034)	(0.034)
1 if fishery household		0.065	0.066		0.003	0.005
		(0.049)	(0.050)		(0.068)	(0.068)
1 if own boat		-0.057	-0.054		-0.011	-0.012
		(0.044)	(0.044)		(0.045)	(0.044)
1 if own land		-0.015	-0.013		0.015	0.013
		(0.029)	(0.030)		(0.037)	(0.037)
1 if own car		-0.000	0.002		0.057	0.054
		(0.048)	(0.048)		(0.043)	(0.043)
1 if own bike		0.018	0.019		-0.029	-0.035
		(0.034)	(0.036)		(0.036)	(0.036)
1 if own TV		0.023	0.023		0.045	0.040
		(0.037)	(0.037)		(0.034)	(0.034)
1 if Catholic		-0.018	-0.016		-0.033	-0.030
		(0.034)	(0.034)		(0.043)	(0.043)
1 if Non-Christian		-0.011	-0.015		-0.035	-0.022
		(0.051)	(0.052)		(0.045)	(0.044)
Oster's (2017) test for:						
Demographics and attitude to religious class			-1.44			1.36
Locus of control			34.61			-41.22
Socio-economic status of household			2.95			3.85
Religious background			-2.90			-4.80
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	963	963	963	963	963	963
R-squared	0.047	0.055	0.059	0.062	0.072	0.077

OLS coefficients are reported. Standard errors clustered at the classroom level are in parentheses. * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. In the implementation of this test, we assume Π to be 1.3, as suggested by Oster (2017).

Table 3: Perceived Disaster Risk and Coping Ability

	Perceived severity of disaster (1)	Knowledge about disaster mechanism (2)	Perceived efficacy of preparation (3)	Perceived efficacy of knowledge (4)	Knowledge about disaster response (5)
1 if enjoy science classes	0.081**	0.033**	0.064*	0.074**	0.046***
	(0.030)	(0.014)	(0.033)	(0.034)	(0.015)
1 if enjoy religious classes	0.022	0.015	-0.003	0.049	0.008
	(0.035)	(0.017)	(0.036)	(0.034)	(0.019)
1 if boy	0.054*	0.008	0.003	0.011	-0.020
	(0.029)	(0.014)	(0.027)	(0.032)	(0.014)
1 if 5th grade	0.033	0.065***	-0.016	0.086**	0.060***
	(0.039)	(0.018)	(0.042)	(0.037)	(0.022)
1 if 6th grade	0.088**	0.088***	0.028	0.133***	0.093***
	(0.037)	(0.017)	(0.038)	(0.042)	(0.018)
LOC: instrumental	0.039	0.060*	0.035	0.220***	0.122**
	(0.087)	(0.035)	(0.076)	(0.080)	(0.048)
LOC: affective	0.113	0.021	-0.027	0.163**	0.030
	(0.071)	(0.029)	(0.071)	(0.064)	(0.045)
LOC: powerful others	0.116*	-0.009	-0.002	-0.076	-0.059
	(0.064)	(0.030)	(0.062)	(0.065)	(0.037)
LOC: fatalism	-0.035	0.001	-0.035	-0.059	0.028
	(0.063)	(0.025)	(0.061)	(0.069)	(0.031)
1 if affected in 2004/2005	0.068**	0.038***	0.021	0.046	0.002
	(0.028)	(0.014)	(0.034)	(0.034)	(0.016)
1 if head is literate	0.064**	0.065***	0.017	0.037	0.038**
	(0.031)	(0.019)	(0.040)	(0.034)	(0.017)
1 if agricultural household	0.002	-0.021	-0.005	-0.081**	0.011
	(0.035)	(0.015)	(0.035)	(0.036)	(0.017)
1 if fishery household	0.018	0.011	-0.115*	-0.070	-0.018
	(0.051)	(0.021)	(0.059)	(0.060)	(0.033)
1 if own boat	-0.024	-0.029	-0.027	-0.034	-0.026
	(0.039)	(0.021)	(0.041)	(0.045)	(0.020)
1 if own land	0.025	0.023	0.070**	0.002	-0.008
	(0.036)	(0.015)	(0.028)	(0.043)	(0.018)
1 if own car	-0.067	0.044***	0.009	-0.045	-0.027
	(0.047)	(0.016)	(0.035)	(0.036)	(0.025)
1 if own bike	0.035	-0.034**	0.008	-0.037	0.019
	(0.030)	(0.017)	(0.035)	(0.037)	(0.020)
1 if own TV	0.025	0.037***	-0.024	-0.012	0.014
	(0.023)	(0.011)	(0.040)	(0.040)	(0.017)
1 if Catholic	-0.059	-0.007	-0.026	-0.069**	0.004
	(0.040)	(0.013)	(0.039)	(0.031)	(0.019)
1 if Non-Christian	-0.037	0.009	-0.027	0.079	-0.056**
	(0.044)	(0.021)	(0.053)	(0.062)	(0.023)
Oster's (2017) test for:					
Demographics and attitude to religious class	5.11	4.09	1.10	1.11	1.99
Locus of control	-257.1	-6.24	-3.61	-5.33	-11.99
Socio-economic status of household	3.26	4.29	10.66	1.83	1.64
Religious background	-8.05	-6.95	-5.88	-19.92	-21.46
School fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	963	963	963	963	963
R-squared	0.090	0.141	0.049	0.145	0.164

OLS coefficients are reported. Standard errors clustered at the classroom level are in parentheses. * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. In the implementation of this test, we assume Π to be 1.3, as suggested by Oster (2017).

Figure A1: Location of Survey Schools

Table A1: School Characteristics

School ID	Year of Establishment	Affected by the 2004/2005 Disasters	Distance to Coastal Line	Num. of Teachers	Num. of Students
A	1982	1	100	24	331
B	1975	1	875	13	223
C	1993	0	100	26	351
D	2008	0	300	24	265
E	1987	1	150	14	147
F	1961	1	400	23	279
G	1980	1	200	12	143
H	1980	1	225	17	129
I	1985	1	100	17	186
J	1952	1	1090	20	196
K	2011	0	100	14	96
L	1979	1	946	14	206
Mean	1982.8	0.75	382.2	18.2	212.7

Table A2: Questions for LOC

	Item	Internal/External	Modality
1	Many people do not do well because they are lazy.	Internal	Instrumental
2	My companions help me because I'm good to them.	Internal	Affective
3	Bad things happen when people are bad.	External	Powerful others
4	When I lose at a game, generally it's because of my bad luck.	External	Fatalism
5	You've got to be lucky to do well.	External	Fatalism
6	Some people do not love me because I do not try to be nice to them.	Internal	Affective
7	When somebody gets a good price it's been through the help of others.	External	Powerful others
8	When somebody gives me a present, it's because he is a good person.	External	Powerful others
9	People have to try hard to achieve what they want.	Internal	Instrumental
10	Many times I feel happy because I've been lucky.	External	Fatalism
11	Sometimes people don't help others because others haven't convinced them to do so.	Internal	Affective
12	When I get good marks, it's because I have studied.	Internal	Instrumental
13	Many things are achieved by being good to others.	Internal	Affective
14	When I lose something, it's because I'm untidy.	Internal	Instrumental
15	When somebody has been punished, it's because of his bad luck.	External	Fatalism
16	Most of the times when I quarrel with a companion it's he who has started the fight.	External	Powerful others

Table A3: Description of Outcome Variables

	Variable Name	Question and Answer Options	Definition
[1]	Immediate response	Since last September, have you ever taken any reaction(s) when you felt earthquakes at home? 1.Took reactions in the house (moving to a safer place in the house such as under the table, etc.) 2.Moved to a safer place outside the house. 3.Both 1 and 2. 4.No, because I thought nothing serious would happen. 5.No, because I didn't know what to do and where to go. 6. I have never experienced an earthquake. 7.Don't remember	1 if answering 1, 2, or 3.
[2]	Evacuation	Since last September, after feeling an earthquake, have you tried to evacuate a safe place considering the risk of tsunami? 1. Yes. 2. Never. Because I didn't imagine a tsunami will come. 3. Never. Because the earthquakes were small. 4. Never. Because I didn't know what to do and where to go. 5. I have never experienced an earthquake. 6. Don't remember	1 if answering 1.
[3]	Perceived severity of disaster	If a tsunami would occur, do you think the waves would hit your house? 1. Not at all 2. Somewhat 3. Very much 4. Don't know	1 if answering 2 or 3.
[4]	Knowledge about disaster mechanism		Proportion of correct answers
		What do you think is the major cause of earthquake? 1. Movement of groundwater 2. Movement of the earth's plates 3. God's wrath 4. Other reason 5. Don't know	Correct answer: 2
		Which is true about the frequency of earthquakes across the world? 1. The frequency of earthquakes is about the same anywhere in the world. 2. Some regions of the world experience earthquakes much more often than the others. 3. Don't know	Correct answer: 2
		Which is true about the frequency of earthquakes across seasons? 1. Earthquakes happen in any seasons. 2. Earthquakes happen much more often in the particular season than the others. 3. Don't know	Correct answer: 1
		What do you think is the major cause of tsunami? 1. Storm 2. Earthquake 3 Man-made activities 4. God's wrath 5. Other reason 6. Don't know	Correct answer: 2
		Which do you think is the correct statement about tsunami?	Correct answer: 3

		1. A big wave of Tsunami will come only once. 2. After the first wave, subsequent waves may come some hours later. But the first wave is always the biggest. 3. After the first wave, subsequent waves may come some hours later. They may be bigger than the first one. 4. Don't know	
		Do you think that a tsunami could occur even without you feeling a strong earthquake? 1. Yes 2. No 3. Don't know	Correct answer: 1
		Do you think that the sea water always becomes lower before a tsunami comes? 1. Yes 2. No 3. Don't know	Correct answer: 2
[5]	Perceived efficacy of preparation	Do you believe that you can mitigate the damage from disasters if you are well prepared? 1. Not at all 2. Somewhat 3. Very much	1 if answering 2 or 3.
[6]	Perceived efficacy of knowledge	Are you interested in deepening your knowledge about disasters? 1. Not at all interested 2. Not very interested 3. Unsure 4. Somewhat interested 5. Very interested	1 if answering 4 or 5.
[7]	Knowledge about disaster response		Proportion of correct answers
		Suppose a strong earthquake occurs when you are in the first floor of a building. Which do you think is the most appropriate response? 1. Curl the body under the desk to wait for it to be over, and then get out of the building with protecting your head 2. Stay just as usual and wait for it to be over 3. Get out of the building immediately with protecting your head	Correct answer: 3
		Suppose a strong earthquake occurs when you are in the second floor of a building. What is the most appropriate response for you? 1. Curl the body under the desk to wait for it to be over, and then get out of the building with protecting your head 2. Stay just as usual and wait for it to be over 3. Get out of the building immediately with protecting your head	Correct answer: 1
		Suppose you feel a strong earthquake when you are near the sea. What do you think is the most appropriate response? 1. Stay where you are and wait for the evacuation order. 2. Evacuate immediately to an upland or inland as far as possible from the sea. 3. Evacuate immediately to a riverside. 4. Go to the seashore to check if anything is happening 5. Don't know	Correct answer: 2
		Suppose you feel a strong earthquake when you stay alone in the house. Which do you think is the most appropriate response? 1. Evacuate to a safer place after waiting for your family coming back. 2. Evacuate to a safer place after making sure that the evacuation order is set off. 3. Evacuate to a safer place immediately. 4. Don't know	Correct answer: 3

Table A4: Estimation Result of Probit Model

	Immediate response (1)	Evacuation (2)
1 if enjoy science classes	0.076**	0.139***
	(0.035)	(0.033)
1 if enjoy religious classes	-0.037	0.041
	(0.039)	(0.043)
1 if boy	0.038	-0.004
	(0.031)	(0.041)
1 if 5th grade	-0.002	0.006
	(0.048)	(0.052)
1 if 6th grade	0.067	0.085*
	(0.047)	(0.049)
LOC: instrumental	0.003	0.140
	(0.079)	(0.090)
LOC: affective	0.002	0.021
	(0.066)	(0.087)
LOC: powerful others	-0.118*	0.081
	(0.063)	(0.078)
LOC: fatalism	0.068	-0.027
	(0.071)	(0.073)
1 if affected in 2004/2005	0.068**	0.063
	(0.034)	(0.039)
1 if head is literate	0.009	0.015
	(0.032)	(0.035)
1 if agricultural household	0.017	0.017
	(0.043)	(0.035)
1 if fishery household	0.060	0.003
	(0.053)	(0.071)
1 if own boat	-0.051	-0.010
	(0.042)	(0.046)
1 if own land	-0.014	0.014
	(0.030)	(0.039)
1 if own car	0.004	0.056
	(0.048)	(0.043)
1 if own bike	0.023	-0.035
	(0.035)	(0.038)
1 if own TV	0.018	0.043
	(0.036)	(0.035)
1 if Catholic	-0.017	-0.032
	(0.034)	(0.045)
1 if Non-Christian	-0.013	-0.028
	(0.048)	(0.048)
School fixed effects	Yes	Yes
Observations	963	963

Marginal effects at the mean are reported. Standard errors clustered at the classroom level are in parentheses. * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table A5: The Association between Perception and Knowledge and Disaster Response

	Immediate response						Evacuation					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Perceived severity	0.071**					0.049	0.193***					0.168***
of disaster	(0.033)					(0.032)	(0.040)					(0.041)
Knowledge about		0.152*				0.082		0.335***				0.279***
disaster mechanism		(0.078)				(0.072)		(0.069)				(0.070)
Perceived efficacy			0.051			0.044			0.110***			0.083**
of preparation			(0.035)			(0.035)			(0.032)			(0.032)
Perceived efficacy				-0.003		-0.021				0.063**		0.044
of knowledge				(0.031)		(0.030)				(0.028)		(0.027)
Knowledge about					0.292***	0.276***					-0.030	-0.107
disaster response					(0.075)	(0.075)					(0.089)	(0.090)
1 if enjoy	0.073*	0.073*	0.075**	0.079**	0.065*	0.058	0.114***	0.119***	0.123***	0.125***	0.131***	0.103***
science classes	(0.037)	(0.037)	(0.037)	(0.038)	(0.037)	(0.037)	(0.033)	(0.033)	(0.034)	(0.032)	(0.032)	(0.032)
1 if enjoy	-0.042	-0.043	-0.041	-0.041	-0.043	-0.044	0.037	0.036	0.041	0.038	0.041	0.032
religious classes	(0.040)	(0.040)	(0.040)	(0.040)	(0.039)	(0.039)	(0.040)	(0.041)	(0.041)	(0.042)	(0.042)	(0.039)
Observations	963	963	963	963	963	963	963	963	963	963	963	963
R-squared	0.064	0.063	0.061	0.059	0.081	0.087	0.106	0.095	0.086	0.081	0.077	0.127

OLS coefficients are reported. Standard errors clustered at the classroom level are in parentheses. * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.