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The effect of different educational interventions on schoolchildren's knowledge of earthquake protective behaviour in Israel

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Knowledge of appropriate behaviour during an earthquake is crucial for prevention of injury and loss of life. The Israeli Home Front Command conducts a yearly earthquake education programme in all Israeli schools, using three types of educational interventions: lectures, drills and a combination of the two. The aim of this study was to evaluate the effectiveness of these interventions in providing students with knowledge. We distributed a questionnaire to 2,648 children from the 5th and 6th grades in 120 schools nationwide. Knowledge scores for both 5th and 6th grades were increased, regardless of type of intervention, compared to the non-exposure group. A combined intervention of lectures and drills resulted in the highest knowledge scores. Our findings suggest that for the age group studied a combination of lectures and drills will likely prepare students best for how to behave in the event of an earthquake.

Keywords: earthquake, education, children, knowledge

Introduction

A major goal of civil defence agencies utilising hazard education programmes is to promote personal, familial and community safety by decreasing vulnerability to injury and possible death. Disaster education should provide participants with greater knowledge of the threat itself, and of the appropriate protective actions that can be taken. This knowledge should, in turn, result in an appropriate adaptive behaviour (Finnis et al., 2004).

In order to inform the public adequately and encourage them to comply with the hazard preparation recommendations required to prevent injury and death during a disaster, education programmes have been advocated (Rodriguez et al., 2007; Slovic et al., 1982). However, it is essential that steps be taken to ensure that these programmes achieve their stated goals. Failure to do so may in fact be highly problematic for the populations exposed to these interventions. Many public information programmes appear to assume that by the mere act of presenting information on hazard risks and protective measures, the desired behaviour will occur (Smith, 1993). Studies have shown that only well-designed education programmes will obtain public support for hazard prevention (Slovic et al., 1982; Smith, 1993). A poorly designed or executed exercise or one that does not include a well planned evaluation of the

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intended outcomes may do more harm than good, in that it may lead to a false sense of security, which could result in poor performance during an actual emergency (Gebbie et al., 2006).

We are unaware of studies that have been carried out to determine the effectiveness of educational interventions for prevention of injury and death in the event of an earthquake and no studies were found that evaluated the effectiveness of different education interventions on knowledge acquisition, awareness of preventive measures or protective behaviour.

There is some evidence to suggest that exposure to educational materials may increase knowledge and awareness of a threat (McKay, 1984; Mileti and Darlington, 1995; Ruch, 1978; Ruch and Christensen, 1980; Waterstone, 1978; Sattler and Marshall, 2002). Other studies have questioned how important disaster education programmes are in providing knowledge and changing beliefs about disasters. Roder (1961), for example, found that the distribution of flood plain maps had no effect on citizen awareness of flood plain zones in Topeka, Kansas. Likewise, Haas and Trainer (1973) found no significant differences in knowledge regarding tsunamis following an educational programme. Furthermore, Wenger et al. (1980) report that of those respondents who had received information from public education programmes, only about one-third mentioned them as a source of information. Similarly, Sorensen (1983) found that most of his respondents did not regard educational information obtained through formal channels such as schools and brochures very useful.

This study addresses these issues by evaluating the effectiveness of different types of educational interventions for providing both theoretical and practical knowledge to 5th and 6th grade students, the aim of which is the prevention of injury and death during and following an earthquake.

Method

Sample and data collection

In November–December 2005 the Home Front Command of the Israeli Defense Forces (IDF) conducted a survey of a sample of 5th and 6th grade students in 120 elementary schools. Information obtained from the Ministry of Education was used to create an opportunity sample of schools located in all six geographical areas of the country. There are a total of 1,770 elementary schools in Israel, and the sample selected represented 6.8 per cent of these schools. The survey instrument was developed by the IDF Home Front Command and was designed to assess the level of students' factual knowledge with regard to earthquake preparedness. Knowledge level was assessed by means of eight multiple choice items. In addition, two questions were used to assess the student's prior participation in educational preparedness programmes provided by the IDF Home Front Command, such as lectures, drills and a combination of the two. These interventions are designed to increase awareness, knowledge and preparedness to deal with earthquakes and their aftermath.

Home Front Command personnel administered the survey during regular school hours, under examination conditions. Students were not required to record their names on the questionnaire and at the completion of the test were requested to place their tests in an envelope located in the classroom. The length of the test was 45 minutes. We distributed a questionnaire to 2,648 children. Of these, 2,544 questionnaires were filled out completely and were analysed in this study, and 104 questionnaires (3.9 per cent) were missing or incompletely filled out and were excluded from the analysis.

Educational interventions

Three types of educational intervention were used in the programme to provide earthquake related information to students: 1) attending an earthquake lecture; 2) participation in an earthquake drill; 3) a combination of a lecture and a drill. The three interventions were provided by the Home Front Command.

Lectures: The lecture dealing with earthquakes was one in a series of ten lectures that dealt with emergencies and preparedness given to all 5th grade students in primary schools. The lecture series is given throughout the year. The lectures were given by qualified instructors who were soldiers in the Home Front Command and had studied a course in emergency preparedness, qualifying them as Home Front Command population emergency instructors by the IDF. The lectures lasted 45 minutes. The earthquake lecture was scheduled as the third in the series. The content of the lecture focused on what constitutes an earthquake, how an earthquake occurs, the manner in which the intensity of an earthquake is measured, the type of damage that may be expected, and how best to respond in the event of an earthquake. Every student was exposed to one earthquake lecture prior to the study. All the lectures were on the same academic level and were given by a number of instructors using standardised teaching materials that were prepared by the population education branch of the Home Front Command. This branch is composed of officers who have expertise in emergency preparedness and in emergency education.

Drills: A total of three drills were carried out; the first drill was held at the start of the educational year, and was part of a large scale drill in which all grades participated, on the same day, in all schools in the country. This large scale drill was carried out in November 2004, one year prior to the knowledge test given to students who participated in this study. The students were instructed briefly by their school teachers on the proper behaviour during and immediately after an earthquake in the morning prior to the drill. The second and third drills were conducted for individual 5th grade classes, with the second drill being held at the completion of the earthquake lecture, and the third and final drill taking place three days later. All drills start with announcement of an earthquake scenario, and students are required to take preventive action. The Home Front Command was in charge of the drills together with the emergency division of the Ministry of Education. The drill lasted three hours

and included taking shelter inside a building during the earthquake, evacuation of the building immediately after the earthquake, gathering the small children in groups lead by their teachers and high grade students, search and rescue, first aid and evacuation of casualties from the building to the playground area of the schools by teachers and high grade students, a damage control survey conducted by teachers and high grade students, and marking and isolating dangerous areas from the crowd.

A combination of lecture and drill: Most of the students attended both lectures and drills prior to the survey. This was the pre-planned educational strategy of the Home Front Command. Only the students who were not at school because of illness or another reason on the day of the earthquake lecture or the drill did not attend the combination of both educational modalities.

Scoring of the knowledge tests

A theoretical knowledge score was calculated using five multiple choice questions. The first three questions evaluated the student's general knowledge about an earthquake threat in Israel; the fourth and fifth questions respectively evaluated knowledge about the duration, and the concept of aftershocks. The theoretical knowledge score ranged from 0 to 5.

The **practical knowledge** score was derived from three behavioural knowledge items: 1) what the student should do when an earthquake occurs; 2) whether the student should stay inside or go outside a building; and 3) what the student should do shortly after an earthquake has occurred. The score ranged from 0 to 3.

The two scores were standardised on a scale of 0 to 10.

Statistical analysis

The results of the survey were entered into a data file and analysed using SPSS (SPSS, 2001). Descriptive statistics were calculated for the theoretical and practical knowledge scores for the 5th and 6th grade students, and the type of educational interventions they were exposed to. Gender differences and differences in scores for theoretical and practical knowledge scores were analysed using independent sample t-tests ($p<0.05$). ANOVA and the Kruskal-Wallis test were used to test for differences between the educational interventions, for the theoretical and practical knowledge levels ($p<0.05$).

Results

Characteristics of the sample

As can be seen from Table 1, a total of 2,544 students—1,280 from 5th grade and 1,264 from 6th grade—participated in the study. Of these 1,123 were male and 1,421 female. There was no significant difference for gender in the theoretical knowledge and the practical knowledge: $t(2542) = 1.42$, NS, and $t(2542) = -.45$, NS, respectively. A

Table 1 Overall number and percentage of students participating in the study, number and percentage of males and females, and number and percentage of students exposed to each type of intervention

		5th grade		6th grade		Total	
		N	(%)	N	(%)	N	(%)
Students		1,280	(50.30%)	1,264	(49.70%)	2,544	(100.00%)
Gender	Male	588	(45.90%)	535	(42.30%)	1,123	(44.10%)
	Female	692	(54.10%)	729	(57.70%)	1,421	(59.90%)
Participation*	Drill	1,070	(83.60%)	1,153	(91.20%)	2,223	(87.38%)
	Lecture	761	(59.50%)	1,052	(83.23%)	1,810	(71.15%)

Note: * Numbers exceed 100% because 1,664 students attended both interventions.

total of 87.4 per cent of the students indicated that they had participated in an earthquake drill and 71.1 per cent in a lecture. In all cases a higher percentage of 6th grade students indicated that they had been exposed to drills and lectures. This difference can be explained by the fact that the educational intervention commences when students enter the 5th grade and continues into the 6th grade.

Type of educational intervention to which the 5th and 6th grade students were exposed

Table 2 provides the distribution of 5th and 6th grade students in relation to the type of educational intervention they were exposed to. As can be seen from the table, only a small percentage of both 5th and 6th grade students indicated that they had been exposed to only one type of intervention. A majority of both 5th and 6th grade students (53.3 per cent and 77.7 per cent respectively) indicated that they had been exposed to a combination of both lectures and drill. Overall, only 6.9 per cent of students indicated that they had had no exposure to either of the intervention modalities or to a combination of them (10.2 per cent of 5th grade, and 3.5 per cent of 6th grade).

Table 2 Number and percentage of students who participated in a combination of educational interventions

Intervention	5th grade		6th grade		Total	
	N	(%)	N	(%)	N	(%)
Drill only	388	(30.3%)	171	(13.5%)	559	(22.0%)
Lecture only	79	(6.2%)	67	(5.3%)	146	(5.7%)
Drill + lecture	682	(53.3%)	982	(77.7%)	1,664	(65.4%)
No interventions	131	(10.2%)	44	(3.5%)	175	(6.9%)
Total	**1,280**	**(100.0%)**	**1,264**	**(100.0%)**	**2,544**	**(100.0%)**

Table 3 Mean score, standard deviation and t-tests for theoretical, practical and overall knowledge scores for 5th and 6th grade students

	5th grade		6th grade				
	Mean	SD	Mean	SD	t	df	Sig.
Theoretical knowledge	4.66	2.59	5.37	2.60	–6.89	2,542	0.000
Practical knowledge	6.72	3.05	7.80	2.77	–9.31	2,542	0.000

Level of knowledge of 5th and 6th grade students

Table 3 presents the mean scores, SD and results of the t-test for the theoretical and practical knowledge scores for the 5th and 6th grade students. There was a significant grade effect for the two scores, with 6th grade receiving higher scores than 5th grade on both the theoretical and practical questions: theoretical score $t(2,542) = -6.89$, $p<0.000$, practical score $t(2,542) = -9.31$, $p<0.000$. It is interesting to note that the scores of the 6th grade students are higher than those of the 5th graders even though they received their lecture on earthquakes when they were in the 5th grade—one year previously. Furthermore, it can be seen in Table 3 that for both 5th and 6th grade students the practical knowledge score is higher than the theoretical knowledge score.

Knowledge scores in relation to type of educational intervention

Tables 4 and 5 present the results of a one-way ANOVA. The analysis reveals a significant effect of the type of intervention on the levels of knowledge for both theoretical and practical knowledge for 5th and 6th grade students. Students in both grades who had no exposure to either type of intervention had lower scores on both the theoretical and practical tests compared to students who had been exposed to one of the intervention modalities. It can also be seen that a combination of the drill and lecture modalities resulted in higher scores for the theoretical and practical knowledge for both 5th and 6th graders. There was a significant effect for type of intervention on the theoretical knowledge for students from both grades: $F(3, 1276) = 9.99$, $p<0.000$, and $F(3, 1260) = 10.17$, $p<0.000$ respectively. Scheffe post-hoc comparisons for the theoretical knowledge score in 5th grade students revealed significant differences between the non-intervention group compared to the drill group and the drill plus lecture group. In 6th grade students significantly different scores were found between the intervention modalities for theoretical knowledge for the drill plus lecture modality compared to the other three groups.

Levine's test of homogeneity of variance revealed non-equal variances for the practical knowledge scores for both 5th and 6th grade students, and thus the Kruskal-Wallis test was used to investigate practical knowledge level. Significant differences were found in practical knowledge scores between the three types of intervention groups and the non-exposure group for both 5th and 6th grade students ($p<0.000$). In both 5th and 6th grade the combined drill/lecture modality resulted in the highest practical knowledge scores followed by the drill only group, followed by the

Table 4 Intervention impact on knowledge for 5th grade students

5th grade		Drill only (1)	Lecture only (2)	Drill + lecture (3)	No intervention (4)	Total	F	x^2	df	P	Scheffe post-hoc
	N	388	79	682	131	1,280					
Theoretical knowledge	Mean	4.5	4.5	5	3.7	4.7	9.99		3, 1276	0.000	1>4
	SD	2.6	2.6	2.6	2.5	2.6					3>4
Practical knowledge	Mean	6.6	5.7	7.3	4.6	6.7		79.8	3	0.000	
	SD	2.9	2.9	2.8	3.4	3					

Table 5 Intervention impact on knowledge for 6th grade students

6th grade		Drill only (1)	Lecture only (2)	Drill + lecture (3)	No intervention (4)	Total	F	x^2	df	P	Scheffe post- hoc
	N	171	67	982	44	1,264					
Theoretical knowledge	Mean	4.8	4.6	5.6	4.2	5.4	10.17		3, 1260	0.000	3>1 3>2
	SD	2.5	2.4	2.6	2.8	2.6					3>4
Practical knowledge	Mean	7.1	6.6	8.1	5.1	7.8		58.2	3	0.000	
	SD	3.1	3	2.5	3.8	2.8					

lecture only group. The group of students who had no exposure to any of the intervention modalities had the lowest score.

Discussion

The findings of this study suggest that either of the interventions used in the earthquake education programme will help students acquire earthquake related knowledge. The highest knowledge scores for both the theoretical and practical knowledge in both grades were achieved by students who indicated that they had been exposed to a combination of lecture and drills. These findings support earlier studies such as those of Ruch (1978) and Waterstone (1978) who found that availability of educational programmes contributed to an increase in knowledge and awareness of the threat of disasters.

One surprising finding is the retention of knowledge by the 6th grade students even though there was a time lapse of at least a year between the lecture they received and the test. The results revealed that students in the 6th grade achieved higher scores on the theoretical knowledge and practical knowledge test than the 5th grade students. This finding contrasts with the findings of Waterstone (1978) who found that while respondents who received educational material that dealt with the

risk of flooding were more aware of the threat than those who did not, they apparently failed to retain the knowledge. Within four to six weeks only 62 per cent of the participants remembered receiving the information and after a year only 37 per cent remembered receiving the information.

Our data suggest that higher performance might be a function of age. Students in the 6th grade who had no exposure achieved higher knowledge scores than 5th grade students who similarly had no exposure to any of the interventions.

It also appears that an intervention of either a drill or a lecture alone can be effective as an educational intervention and result in higher knowledge level, though not as effective as the combined intervention of a lecture and drill. An additional surprising finding is that, while the lecture format only improved the theoretical knowledge of the students, as might be anticipated, it also contributed to improved practical knowledge scores. This might be explained by the fact that the information provided during the lectures relating to protective behaviour required during and after an earthquake may have a greater impact on the students compared to the theoretical facts provided, and as such is more likely to be retained. This finding is encouraging in that in the final analysis what is most likely to result in the saving of lives is the information retained by students in relation to the protective behaviours required during and after an earthquake. The theoretical knowledge it would appear may be interesting, but not essential to the goal of preventing injury and saving lives.

The study has a number of limitations, primarily the fact that the design did not randomise students to the different types of educational interventions used to provide the relevant information. Therefore, the sample size of the groups was uneven and the single treatment groups were smaller compared to the group that attended a combination of lecture and drill. Nevertheless, we believe the relatively large number of students and the geographical distribution of schools that participated in the study may overcome the design limitation.

Conclusion

The results of the present study demonstrate the importance of an educational intervention for enhancing knowledge about the threat of earthquakes in general and the practical knowledge concerning the recommended self-protective behaviour during and immediately after a large scale earthquake.

Our data suggest that earthquake education in 5th and 6th grade, especially if it consists of combined lecture and drills, will contribute to the level of preparedness of children by improving their knowledge of life-saving behaviour required to prevent injury and death.

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