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The Academic Impacts of 2015 Nepal Earthquake: Evidence from Two Secondary Schools in Sindhupalchok District

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Abstract: How do natural disasters affect academic performance? Despite numerous studies having been conducted after the 2015 Nepal earthquake, the academic impacts of this tragic event have rarely been explored. Applying the OLS estimation on the microdata collected through a questionnaire survey among 189 secondary school students of two secondary schools in one of the hardest-hit rural villages, we found that students' average annual test scores dropped by 7% after the earthquake. Human losses measured by the incidence of death or injury and economic losses proxied by the level of house damage in a respondent's family were found to be significant in the decline in the annual test scores of the respondents. Because secondary schools are usually not very close for most of the students in rural mountainous communities, we controlled for time taken to reach school, which was also found to significantly increase the magnitude of the drop in the test score. However, students' level of happiness measured using the Oxford Happiness Questionnaire (OHQ) and the mother's level of education were found to be significant in reducing the magnitude of the drop in the test score of students. The findings suggest more support is needed for students who faced higher levels of human and economic loss in their family.

Keywords: natural disasters; 2015 Nepal earthquake; academic performance; secondary schools; happiness score; Bahrabise

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1. Introduction

Nepal was hit by a 7.8 magnitude earthquake on 25 April 2015, followed by strong aftershocks of 6.8 and 7.2 magnitude on 26 April and 12 May, respectively. The death toll, injury rate and other damages were the highest caused by disasters in the country's history, claiming around 9000 lives, injuring over 23,000 people, destroying over 500,000 houses, including 9000 schools, and displacing approximately 2 million inhabitants [1]. Since then, numerous scholarly studies have been conducted to explore various aspects of the disaster and its impacts on different sectors of the economy [2,3], livelihoods of people [4,5], and the environment [6], among others. There are also many cross-country as well as country-specific studies that have assessed the impacts of natural disasters focusing broadly on education (e.g., [7,8]), and specifically on students' academic achievement (e.g., [9,10]), in other countries and geographies. However, to the best of our knowledge, the academic impacts of 2015 Nepal earthquake have rarely been explored.

Natural disasters can have very significant negative impacts on different aspects of people's lives and communities [11–16]. Education, particularly students' academic performance, is not an exception [17,18]. Hanushek [19] claimed that test scores are the most appropriate measure in formal school education, because the main goal is to optimize students' cognitive skills. Therefore, the measure of the students' cognitive performance, test scores or academic achievements is the output variable of this study.

On the one hand, natural disasters adversely affect the objective wellbeing of students, which reduces their academic achievements [9,10,15,16]. We used both economic and

human losses caused by the earthquake to account for the students' objective wellbeing. As most of the houses were wrecked or damaged in the village, we used the level of house damage as the proxy for economic loss. Any death or injury from the earthquake in the student's family was defined as human loss. On the other hand, natural disasters also adversely affect the subjective wellbeing of students, resulting their poor academic performance [13,14,20,21]. Natural disasters potentially affect students' subjective wellbeing or happiness, such as their view about their lives, families and society, which ultimately affects their learning motivation and academic performance [22,23]. The Oxford Happiness Questionnaire (OHQ) [24] is used to assess the subjective wellbeing or level of happiness of the students, which is one of the explanatory variables of the students' academic achievement.

Furthermore, as education production function suggests, student-specific and family-related variables such as age, number of siblings, level of father's education, level of mother's education, and time required to reach school potentially affect students' academic achievement. While age is a key determinant of both cognitive skills [25] and non-cognitive skills [26], a higher number of siblings adversely affects academic performance, because household resources must be divided between more members in a bigger family [27,28]. Arguably, this is more significant in less developed countries or regions where household income is limited. Similarly, parents' level of education also plays a crucial role in children's academic performance [29]. Likewise, family land holdings can significantly affect a student's academic achievement, because most people are dependent on agriculture in the village and the land holding is a key determinant of the economic wellbeing of households [30]. Thus, the land ownership, or its sufficiency to feed the family, is one of the most widely used variables to measure the household economic status in agrarian rural society [31]. As people live in widely dispersed areas on uneven geography and secondary schools are not very closely located for most of the students, the time required to reach school potentially has an adverse effect on students' academic performance [32,33]. Examining the academic impacts of natural disasters is important because damaged students' performance leads to long-term effects not only on the students themselves, but also on the exposed community and the nation [34].

This article aims to narrow down this research gap using primary data collected from two remote secondary schools, Saraswati Secondary School and Sarada Secondary School, located in one of the areas hardest hit by the earthquake, Bahrabise Municipality of Sindhupalchok district. The schools were selected purposefully, as they are representative of the rural areas. While Saraswati school is typically located in a more remote area with limited facilities and fewer students, Sarada school is located in a less remote area with more facilities and more students. A questionnaire survey was conducted among high school students on 3 September 2016. All 189 students from grade 8 and grade 9 that participated were present in class on the day of the survey in this cross-sectional study. The findings of this study are expected to be useful for education sector policymakers, school administrators, and teachers to design and implement local to national education policy during and after large natural disasters.

The rest of this article is structured as follows. Section 2 reviews the related literature. Section 3 describes the data and methods, and Section 4 presents the results. Finally, Section 5 concludes the article with a brief discussion of the results.

2. Literature Review

The literature on the academic impacts of natural disaster is limited. Since natural disasters occur unexpectedly, it is challenging to establish measurements of student performance prior to the disasters. Still, researchers have made some efforts to explore the academic impacts of big earthquakes in recent decades. For example, using the data of 407 university students six years after the 1999 Marmara Earthquake (Turkey), Ceyhan and Ceyhan [35] found that the academic achievement of earthquake survivors was significantly lower than that of individuals who were not exposed to the earthquake. They also showed the varied impacts across gender, age groups and financial difficulties of the

individual. Di Pietro [9] compared the changes in academic performance among university students before and after the 2009 L'Aquila earthquake (Italy), and found that the earthquake had reduced students' probability of graduating on time by 6.6 percentage points. Pietro also found that adverse academic impacts for female students were considerably higher than those for male students. Similarly, Kemp et al. [21] examined the impact of the 2010 Christchurch Earthquake (New Zealand) on academic performance by using the data of over 9000 undergraduate students, but found no significant impact for either men or women. The main gaps identified in the above literature are that they focused on university-level students, and most of the studies were conducted in cities and more developed countries. The literature is sparse for school students in rural areas of less developed countries.

Apart from earthquakes, some scholars also studied the impact of other natural disasters on student performance. For instance, using a semi-structured questionnaire among 515 students at the University of Texas Medical Branch (UTMB), Watson, Loffredo, and McKee [36] examined the impact of Hurricane Ike that struck Galveston Island (USA) in 2008. They found a negative impact on academic performance for almost half of the respondents. On the contrary, Krane, DiCarlo, and Kahn [37] found no impact of Hurricane Katrina that ravaged the Mississippi and Louisiana Gulf (USA) in 2005 on students' academic performance at Tulane University School of Medicine and Louisiana State University School of Medicine in New Orleans. These studies were also focused on university students in the developed world. However, Thamtanajit [10] investigated the impacts of the severe flooding in Thailand, a less developed country, in 2011 on students' achievement at school level. His assessment of the school-specific data from the Ministry of Education for the academic years 2006–2013 showed the adverse impact of severe flooding on student achievement. However, this study did not disaggregate the impacts across different socioeconomic and family backgrounds of the students.

Many scholars also explored the impact mechanism for how disasters impact students' academic performance. For example, using self-report questionnaires from 745 adolescents, Zhou, Zhen and Wu [21] examined the academic burnout after the 2008 Wenchuan Earthquake (China). They found that posttraumatic stress disorder (PTSD) symptom severity, which undermines subjective wellbeing and happiness, has a positive relationship, and control beliefs have a negative relationship with academic burnout among adolescents after the natural disaster. However, they also did not explore the differences in such relationships across the participants' socioeconomic and family backgrounds. Marcotte and Hemelt [38] found that losing school days and unscheduled closings adversely affected the academic performance. They argued that such effects are larger in lower-grade students. The 2015 Nepal earthquake also induced such closure of schools and universities for over a month. On the contrary to Marcotte and Hemelt, Goodman [39] found no relationship between school closures and achievement, but there was a strong relationship between student absences and achievement.

We found that the impacts of earthquakes on the academic achievement of high school students in rural areas of less developed countries have rarely been explored. To our knowledge, there is yet no such study in the case of the 2015 Nepal earthquake. The existing studies also missed capturing the academic impacts of disasters across various socioeconomic groups and students' family backgrounds. Based on these research gaps, this study laid out the following hypotheses.

(a) Earthquake-induced human loss and property loss adversely impact the academic achievement of school students in rural areas.
(b) The subjective wellbeing or the happiness level of the students significantly affect their academic achievement.
(c) While there is a significant relationship between students' personal as well as family background (such as age, number of siblings, parents' level of education, and land sufficiency) and academic achievement, the earthquake disproportionately impacts students from different backgrounds.

(d) As households and communities are highly dispersed in rural areas, the "time required to reach school" is a significant predictor of students' academic achievement. Similarly, the academic impact of the earthquake is greater for the students who live farther from the school.

3. Materials and Methods

3.1. The Participants and Their Demographics

The data for this study were collected through a questionnaire survey conducted among the high school students on 15 February 2017. Table 1 presents the details of the participants in each of the two schools by grade and gender. While almost half of the respondents were female, by caste and ethnicity, 8%, 37%, 10%, 37% and 2% were Brahman, Chhetri, Newar, Janajati and Dalit, respectively. This demographic composition of the participants generally reflects the demographic composition of the village population. Nepalese society is mainly based on the Hindu caste system, which has four hierarchies of caste, namely: Brahmin, Chhetri, Baisya and Sudra. According to the Population Census of Nepal 2011, the first two, Brahman and Chhetri, are the ruling class, the so called "high caste". Baisya, the common caste group of Newar and Janajati, is composed of various endogenous ethnic groups with their own unique language, culture, and tradition. Sudra, also called Dalits, is the lowest caste group, which is often considered as "untouchable", meaning that they are not allowed to visit temples, public water resources, or enter houses of so-called high-caste people.

Table 1. Respondents in the questionnaire survey by school, grade, and gender.

	Grade 8		Grade 9		Total
	Male	Female	Male	Female	
Saraswati Secondary School	13	13	14	10	50
Sarada Secondary School	44	36	38	35	139
Total	57	49	38	45	189

3.2. The Questionnaire Used

We used the questionnaire survey method to collect the necessary data, because it allows us to collect a wide range of information in a short period of time with a low cost. We need information about students' families and the household-level impacts of the earthquake to examine the objective wellbeing of the participants. Information on subjective wellbeing is also essential because students' academic achievements depend also on their experience of mental and behavioral conditions such as depression and anxiety, as well as expectations [9]. Similarly, we need data on students' academic achievements before and after the earthquake. With the help of the questionnaire survey given to the students, we were able to collect all the required data with a single visit to the purposefully selected schools.

The questionnaire was designed to obtain the aforementioned information, with three sections as presented in Appendix A. Questions related to students' basic information and the socioeconomic background of their family were included in Section 1. The question items were designed following the common practice of obtaining such information through questionnaire surveys.

Questions related to the earthquake and its impacts on their living conditions were covered in Section 2. As most of the houses were wrecked or damaged in the village, we used the level of house damage as the proxy for economic loss. The levels of damage were categorized from "no damage", "damaged a little", "damaged normally", "damaged enormously", to "destroyed completely". As for human losses, we asked about deaths or injuries caused by the earthquake in their family. Although students needed to fill in the information about their final test scores before and after the earthquake, we used the schools' official record for all respondents, because many students said they forgot their test

scores. The final exam is held around late February or early March, and the new academic year starts around mid-April in Nepal.

Most parts of Section 2 of the questionnaire were designed with the Likert scale [40]. The Likert scale is a psychometric scale widely used to scale responses in research. In a Likert questionnaire, respondents express their level of agreement or disagreement for a series of statements. The agreement or disagreement range captures the intensity of their feelings or perceptions for a given question.

3.3. The Use of OHQ

Section 3 of the questionnaire was designed to assess the subjective well-being of the respondents after the earthquake. For this purpose, we used the Oxford Happiness Questionnaire (OHQ) developed by Hills and Argyle [24] at Oxford University with some modification to fit in the local context. OHQ is widely used to assess personal happiness, which asks questions concerning sociability, sense of control, physical fitness, positive cognition, mental alertness, self-esteem, cheerfulness, optimism, empathy, feelings, life satisfactions, and life evaluations to account for the current level of happiness. These questions were structured into statements on a six-point Likert scale, with "1" being the "most unhappy" and "6" being the "happiest" [24].

To calculate the overall happiness score of each respondent, first, the score of each of the negatively phrased statements was reversed. For example, one was changed to six, two was changed to five, four was changed to three, and so on. Finally, the average score for each respondent was calculated, which represents their level of happiness. Although the highest and lowest possible scores are six and one, respectively, obtaining such scores is rare. Many studies show that most people might register a score around four. A brief interpretation of the happiness score is given in Table 2. As the score of 3.5 is the exact numerical average of the possible answers, people recording a score higher than 3.5 are considered happy.

Table 2. The interpretation of the happiness score from Oxford Happiness Questionnaire (OHQ).

Score	Meaning	Brief Interpretation and Advice
1–2	Not happy	Respondent probably see their situation as worse than it really is. The person might have depression.
2–3	Somewhat unhappy	The respondent may need counselling.
3–4	Not particularly happy or unhappy	A score of 3.5 is the exact numerical average of the range of the possible answer, 1 to 6. People in this group can improve their happiness level significantly with some mental exercise.
4	Somewhat happy or moderately happy	Satisfied. An average person's score remains around 4.
4–5	Rather happy; pretty happy	The person is happy.
5–6	Very happy	Such people are more likely to receive benefits such as better health, better relationships and achieving life goals.
6	Too happy	This is not a likely score.

Notes: The interpretation is slightly revised to match the local context. Interpretation for scores 4 and 6 is removed, as no respondent obtained this exact score. Source: Steve Wright's blog, Oxford Happiness Questionnaire, available online: http://www.meaningandhappiness.com/oxford-happiness-questionnaire/214/ (accessed on 17 January 2021).

3.4. Methods of Administering the Questionnaire

All the students who were present on the day of the survey were included in the survey. A total of 189 questionnaires were distributed to the students and all of them returned the questionnaires as soon as they finished answering all the questions. Therefore, the questionnaire return rate was 100%. A 30-min introductory session was conducted in each class to familiarize students with the research and how to fill out the questionnaire. All the students were asked whether they were clear about the instructions or not and were also asked to use their own judgment to fill in the questionnaire without consulting their friend. After the introductory session, each of the students was given a questionnaire set including a cover letter and a pen to fill out the questionnaire. The students were asked to read the cover letter carefully before starting to fill in the questionnaire. The respondents were asked to read each of the OHQ statements (questions) more carefully, because some

statements were phrased positively and others negatively. The researcher remained in the classroom while the students filled in the questionnaire and clarified questions about unclear words, difficult vocabulary, or phrasing of questions. The students filled out their questionnaire individually, taking an average of 35 min to complete it.

The questionnaire was initially developed in English. However, it was translated into Nepali for distribution in the field so that the students could understand the question and answer them more accurately.

3.5. Method of Analysis of the Data

The data from the questionnaire survey were statistically analyzed to find out the impacts of the earthquake on students' academic performance. Because the education production function in a multiple regression model is widely used in the empirical literature on students' school performance, we utilized this approach with some modification so that our model captured the impacts of the earthquake in a local sociocultural context.

In our model, the measure of the students' cognitive performance, test scores, is the output variable. We used students' test scores in percentage form after the earthquake as one of the dependent variables. Another important dependent variable is the difference in test scores before and after the earthquake. This helps us to understand how much the students' test score declined or increased after the earthquake and what the major factors are that affect the difference. Thus, Y represents the dependent variables in the following ordinary least square (OLS) regression model used in this study.

$$Y_i = \beta_0 + \beta_1 EQ_i + \beta_2 C_i + \in$$

where beta (β) is the main parameter of interest in the regression analysis, i represents the sample identifier (i.e., 189 respondents), and ∈ is the error term. Similarly, EQ represents the set of explanatory variables and C represents the set of control variables. We used both economic and human losses caused by the earthquake as explanatory variables. As most of the houses were wrecked or damaged in the village, we used the level of house damage as the proxy for economic loss. The levels of damage are categorized from "no damage" to "damaged a little", "damaged normally", "damaged enormously", and "destroyed completely". As for human losses, we used a dummy variable of 1 if the student's family faced any death or injury from the earthquake and 0 otherwise.

Regarding the control variables, as education production function suggests, we controlled for student-specific and family-related variables such as age, number of siblings, level of father's education, level of mother's education, and time required to reach school. Similarly, we controlled for parents' level of education, family land holdings, the time required to reach to school, and the level of happiness of the respondents. Furthermore, some dummy variables were added to the regression analysis to account for the effects of gender, caste/ethnic groups, and school.

4. Results

4.1. Descriptive Analysis

Table 3 presents the summary statistics with the effect size of academic scores and its potential moderators. The correlation matrix of the dependent and independent variables is given in Appendix B. Some categorical independent variables, such as gender and caste/ethnicity, are not included in the table. The means of the average test scores before and after the earthquake were found to be 55% and 47.9%, with a standard deviation of 11 and 12.5, respectively. The average test score dropped by 7.1% after the earthquake, with a standard deviation of 4.6. This indicates that there is a large variation among students' academic performance as well as the impact of earthquake on them. The effect sizes of test score measured by Cohen's d before and after the earthquake were −0.32 and −0.12, respectively.

Table 3. Summary statistics and differences in academic scores and potential moderators.

Variables	Obs	Mean	Std. Dev.	Std. Error	Effect Size: *Cohen's d* Value
Academic scores					
Average test score (%) before the earthquake (EQ)	189	55.0	11.0	0.81	−0.32
Average test score (%) after the earthquake (EQ)	189	47.9	12.5	0.91	−0.12
The difference in average test score (%)(Pre EQ score–Post EQ score)	189	7.1	4.6	0.33	0.13
Potential moderators (dummy variables are not included)					
Damage level of house	189	3.4	1.1	0.10	−0.01
Age of respondent (student)	189	14.6	1.1	0.10	0.12
Level of happiness	189	3.9	0.6	0.04	−0.11
Number of siblings	189	3.4	1.8	0.13	−0.08
Level of father's education	189	2.7	1.2	0.09	−0.18
Level of mother's education	189	2.0	1.1	0.08	−0.39
Land sufficiency	189	2.6	1.2	0.09	0.25
Time required to reach school	189	1.8	0.9	0.07	−0.11

A major economic loss caused by the earthquake among households comes in the form of house damage. We categorize the damage level of houses from 1 to 5 based on students' response, 1 for "no damage" to 5 for "full damage". The mean damage level is recorded as 3.4 with standard deviation of 1.1. While only 4% and 8% of respondents replied that their house had received "no damage" and "minor damage (repairment needed)", respectively, the remaining 88% faced major damage (retrofitting is needed), "huge damage" (not fully collapsed but reconstruction is needed) or "full damage" (reconstruction is needed). The mean, standard deviation, and Cohen's d measure of the damage level of houses of the respondents were 3.4, 1.1 and −0.01, respectively.

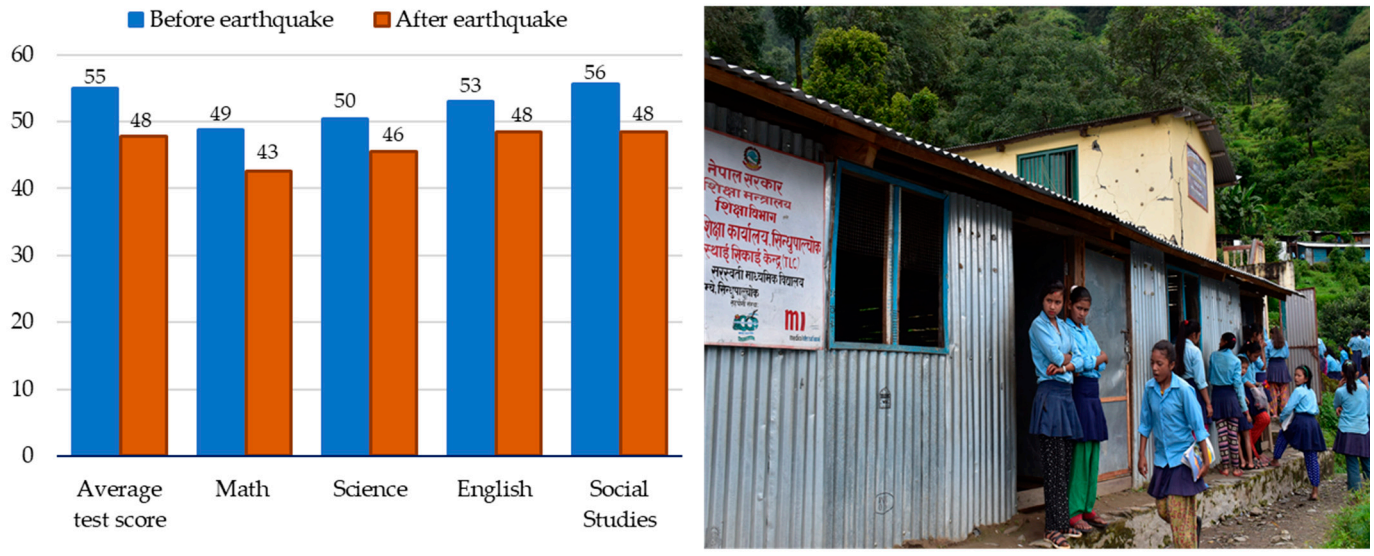
The mean age of the respondents was 14.6 years, ranging from 12 to 18 years. The standard deviation, standard error, and Cohen's d measure were 1.1, 0.1 and −0.01, respectively. Similarly, the mean score of happiness measured by using OHQ in a one to six Likert scale was recorded as 3.9, with a standard deviation of 0.6. The standard error and the Cohen's d measure were 0.04 and −0.11, respectively. The average number of siblings of respondents was 3.4, with a standard deviation of 0.6. The standard error and the Cohen's d measure were 0.13 and −0.08, respectively.

The levels of parents' education were grouped into five categories as follows: (1) illiterate, (2) just literate, (3) primary level, (4) secondary level, and (5) university level. While fathers' mean level of education, standard deviation, standard error, and Cohen's d measure were found to be 2.7, 1.2, 0.09 and −0.18, respectively, these statistics of mothers' education were found to be 2.0, 1.1, 0.08 and −0.39, respectively. Similarly, 43% and 27% of mothers, and 22% and 23% of fathers of the respondents were found to be illiterate and just literate, respectively. Only 21%, 7% and 3% of mothers and 25%, 28% and 3% of fathers had primary, secondary and university education, respectively.

Regarding the land ownership or its sufficiency to feed the family, we accounted for the land sufficiency based on how sufficient the production is for the family. The respondents were asked "how much agricultural produce does your family make within a year?" The four alternative answers were given as (1) enough for 6 month or less, (2) enough for 6 to 9 months, (3) enough for 9 months to 12 months, and (4) enough for the family and we sell the remaining produce. The mean, standard deviation, standard error, and Cohen's d measure were found to be 2.6, 1.2, 0.09 and 0.25, respectively. Similarly, walking time required to reach school was grouped into four categories as follows: (1) less than 30 min, (2) between 30 min and 1 h, (3) between 1 and 2 h, and (4) more than 2 h. We found that students need 30 min to 1 h of walking to reach school on average. The standard deviation, standard error, and Cohen's d measure were found to be 0.9, 0.07 and −0.11, respectively. Disaggregated data show that nearly half (48%) of the students need less than 30 min, 32% need 30 min to 1 h, 13% need 1 to 2 h, and 7% need more than 2 h to reach school.

4.2. Students' Academic Performance before and after the Earthquake

Figure 1 shows students' test scores for their final annual exam before and after the earthquake for the selected four subjects, Math, Science, English and Social Studies, together with the overall average test score. The figure also shows a picture of the Temporary Learning Center (TLC) of Saraswati Secondary School. While the overall average test score dropped by 7% from 55% before the earthquake to 48% after the earthquake, the test scores in Math, Science, English, and Social Studies dropped by 6%, 4%, 5% and 7%, respectively.



(**a**) (**b**)

Figure 1. Students' annual exam test scores (%) before and after the earthquake (**a**), and the Temporary Learning Center (TLC) of Saraswati Secondary School (**b**).

4.3. Impacts of the Earthquake on Academic Performance

Table 4 shows the results of the OLS estimations together with the robust standard errors given in parentheses. Column 1 presents the results for the average test score after the earthquake as the dependent variable. Column 2 presents the results for the reduced test score after the earthquake. While the values of the coefficients quantify the magnitude of the effect, the positive or negative signs of the coefficients indicate the direction of the effect. Similarly, the number of asterisks (*) indicates the level of significance (* = 10%, ** = 0.5%, and *** = 1%). No asterisk means that there was no significant effect. Hence, the coefficient matters only if the effect is significant.

To measure the level of impacts of the earthquake, we assessed two aspects—human loss in the family and damage level of the house of the respondents. Human loss is a dummy variable, with a value of 1 if there was any death or injury due to the earthquake and 0 if no death or injury occurred in their family. We found that families of half of the total respondents faced death or injury. Among them, 5.5% of respondents faced both death and injury, 3% faced only death, and 41.5% faced only injuries in their family. If students faced any death or injury in their family, their overall average test score was more likely to be 2.43% less than those students who did not face such human loss. This effect is significant at the 10% level (Column 1). Such human loss was also found to be significant at 10% to reduce the test score by 0.43% from before to after the earthquake (Column 2). The economic loss, proxied by the damage level of the respondent's house due to the earthquake, was found to be even more significant at the 5% level to reduce the test score of the respondents by 0.89%.

Table 4. Factors affecting academic performance after the earthquake.

Dependent Variables / Independent Variables	[1] Average Test Score after the Earthquake (EQ)	[2] Drop in Av. Test Score (Pre EQ Score–Post EQ Score)
Human loss dummy variable (1 if someone died or injured within the family of the respondent, 0 otherwise)	−2.426 * (0.677)	0.432 * (0.292)
Damage level of house	−0.119 (0.907)	0.892 ** (0.184)
Age of respondent	0.917 (0.888)	0.152 (0.324)
Level of happiness	1.497 * (0.482)	−0.147 * (0.185)
Number of siblings	−1.213 *** (0.329)	0.0562 (0.193)
Level of father's education	−0.636 (0.976)	0.122 (0.356)
Level of mother's education	2.178 ** (1.037)	−0.568 * (0.178)
Land sufficiency	0.623 (0.788)	0.062 (0.287)
Time required to reach school	−1.272 (1.042)	0.623 * (0.18)
Dummy if respondent is from Sharada school	1.437 ** (0.520)	3.122 *** (0.846)
Dummy if respondent is female	3.767 ** (1.845)	−0.644 (0.672)
Dummy if respondent is Chhetri	−4.45(3.522)	0.517 (1.283)
Dummy if respondent is Newar	0.848 (4.379)	0.192 (1.596)
Dummy if respondent is Janajati	−4.083 (3.587)	0.134 (1.307)
Dummy if respondent is Dalit	−10.99 (7.963)	0.852 (2.902)
Constant	32.15 ** (16.03)	0.631 (5.843)
Observations	189	189
R-squared	0.132	0.133

Notes: Standard errors are in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Interestingly, subjective wellbeing of the respondents, measured by the happiness score using OHQ, was found to be significant at the 10% level to increase the overall test score and to reduce the score of the respondents after the earthquake. Similarly, the mother's level of education was found to be significant at the 5% level to increase students' test scores by 2.13%, as well as being significant at 10% to reduce the drop in score by 0.57% after the earthquake.

The time taken to reach school was also found to be significant at the 10% level to increase the difference in test score before and after the earthquake. Similarly, the number of siblings was found to be very significant at the 1% level to decrease the overall test score after the earthquake by 1.27%, but insignificant for the drop from the pre-earthquake score.

The coefficient of the dummy variable for Sharada school revealed that the overall test score and the drop in the test score were significantly higher by 1.44% and 3.12% for the respondents in Sarada school than in Saraswati school, respectively. Interestingly, there was no significant difference in the average test score and the drop in the score after the earthquake across caste and ethnic groups.

5. Discussion

To our knowledge, this is the first study to analyze the academic impacts of the 2015 Nepal earthquake using first-hand data. The primary data were collected through a questionnaire survey of students in two secondary schools in one of the hardest-hit rural villages. The annual test score of the students dropped by 7% on average after the earthquake. This drop in students' academic performance is not surprising, because many students' family members were killed or injured, and almost all of them lost their houses. Moreover, schools remained closed for more than a month, and when they returned to their school on 30 May 2015 amid continued aftershocks with varied strength, they had to study in a temporary classroom with minimal facilities [36]. It took not just months but years to gain a visible improvement in their educational infrastructure and family housing. As the literature suggests, such traumatic experiences lead to various psychiatric and behavioral problems that can persist for a long period. Consequently, the current functioning and the future potential of the adolescent individuals deteriorate significantly [14,21,35].

The OLS estimation revealed that both human and economic losses in the family had a significant effect on the decreased test score. Therefore, the first hypothesis regarding the adverse impact of the earthquake on academic achievements is accepted. Similarly,

the second hypothesis regarding the significant positive relationship between subjective wellbeing or happiness and students' academic performance is also accepted. Both findings are in line with the existing findings. In the middle of adolescence, there is a high likelihood of developing depression and PTSD, leading to greater adverse impacts on the academic performance of secondary school students [41,42]. While such a positive relationship between happiness and academic performance was documented in many studies in more developed countries or regions in normal situations [22,43], our results reconfirm the importance of subjective wellbeing in a disaster-hit remote society as well. Arguably, subjective wellbeing is more important in such rural areas where the social support system is weak compared to urban areas [44].

Interestingly, only 3% respondents were found to be "not happy" or "somewhat unhappy" despite the tragic disaster. Among the remaining participants, 57%, 3% and 32% were found to be "not particularly unhappy", "rather happy" or "pretty happy", respectively. This finding is somewhat contradictory compared with other studies, as they found PTSD in adolescents in several other districts in Nepal after the earthquake [38,45]. One reason might be the focus of the study itself. While this study focuses on overall life satisfaction covering personal, family, as well as social aspects of life, the previous studies were highly focused on stress and behavioral disorders. Another reason could be driven by the rural–urban difference in people's perception in their life, because past studies showed that people in more rural areas have better subjective wellbeing than that of people in less rural or urban areas [46].

We found mixed results in the case of the third hypothesis related to personal and family background. Only the level of mother's education is found to have a significant positive effect on students' average test score after the earthquake and a negative effect on the drop in test score. Indeed, more educated mothers are more likely to provide better care and support to their children and manage household resources more efficiently, which ultimately positively affects their children's academic performance [47–49]. Although many other studies suggest that father's education is also a significant predictor of children's academic performance [47,48], our results show no significant impacts of father's education on both dependent variables. A possible reason for this result might be the surge in migration, both rural to urban and abroad [50], which has left a negligible role of fathers in children's daily activities. We also found many households in the research site where adult males were working in Kathmandu city, and many others were working abroad.

Similarly, the number of siblings showed a significant negative effect on the average post-earthquake test score, but was insignificant for the drop from the pre-earthquake test score. This implies that family size is a strong predictor of academic performance; however, a bigger family can provide more resilience against disasters. The age of respondents and land sufficiency were found to be insignificant for students' academic achievements.

Regarding the fourth hypothesis of this study, time required to reach school appeared to be significant in increasing the difference in test score before and after the earthquake. However, it is not significant for overall test score after the earthquake. This indicates that the earthquake affects those who live farther from the school to a greater extent. Past studies also showed that travel time to secondary school in Nepal is associated with drop out [51] and poor academic performance [52]. Thus, more schools are needed in villages to provide better access and quality education.

Furthermore, the overall test score of the students of Sharada school was found to be significantly higher than that of the students of Saraswati school. Similarly, the drop in the test score was also higher in Sharada school than in Saraswati school. As Sharada school is in a less remote area, which is very close to the bazar area where the municipal office, banks and other service centers are located, it is intuitive that we find a higher average test score in Sharada school.

Interestingly, there was no significant difference in the average test score and the drop in the score after the earthquake across caste and ethnic groups. This indicates reducing caste and ethnic gaps in academic performance on one hand and, on the other hand, that

the earthquake affected all sociocultural groups similarly. This finding contradicts the results of various qualitative studies and theoretical arguments which claim that natural disasters harm socially marginalized groups to a greater extent, such as ethnic minorities or lower-caste people [46,53]. The reason for our contradictory findings signals the weaking discrimination across caste and ethnicity in Nepalese society. Although this finding is not enough to confirm the extent and speed of weakening caste and ethnic discrimination, Nepal's recent transformative structural changes are worth noting here. For instance, Nepal abolished the Hindu Monarchy, making the nation a secular republic, in 2008, promulgated the new Constitution of Nepal in 2015, and now has a highly decentralized administrative structure with powerful local governments. Notably, there are various constitutional commissions for social inclusion and social justice, such as the National Women Commission, the National Dalit (the lowest cast group) Commission, the Madhesi (indigenous group in Terai area) Commission, the Tharu (one of the disadvantaged ethnic minorities) Commission, and the National Human Rights Commission. There has also been a rapid increase in targeted programs for marginalized groups [49,54].

The results of this study should be interpreted with caution due to several limitations in the study. First, the sample size is small, covering only two schools, which reduces the generalizability of the findings. In particular, the situation in large cities, such as the capital city Kathmandu, could be very different. Second, the survey was conducted one year and four months after the earthquake, but it is worthwhile to observe the transition of the students' academic progress over a longer period. Therefore, further investigations are needed to understand the long-term academic impacts of the earthquake. Despite these limitations, the findings of this study are useful for policymakers, doners and educators who support or manage the education sector after a large-scale disaster, particularly in remote areas.

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Appendix A. Student Questionnaire (Translated from Nepali into English)

Appendix A.1. Background Information of Respondents

1. Please write your name: _____ Today's date: _____
2. Your school's name: _____ Grade: ____ Age: ____ Gender: ____
3. Which caste/ethnic group do you belong to?

   (1)Brahman (2)Chhetri (3)Tamang (4)Newar (5)Thami
   (6)Pahari (7)Dalit (8)Magar (9)Others: _____

4. What language do you speak at home?

   (1)Nepali (2)Tamang (3)Newari (4)Thami
   (5)Pahari (6)Magar (7)Others: _____

5. How many brothers and sisters do you have?

   (a) Brothers: _____ (b) Sisters: _____

6. What are your parents' main job/occupation? (In case of others, please specify).

(a) Father's Job/Occupation	**(b) Mother's Job/Occupation**
(1)Agriculture	(1)Agriculture
(2)Service	(2)Service
(3)Own business	(3)Own business
(4)Foreign employment	(4)Foreign employment
(5)Unemployed	(5)Unemployed
(6)Others: _____	(6)Others: _____

7. What is the highest level of education your father and mother has completed?

(a) Fathers' Education	**(b) Mothers' Education**
(1)Illiterate	(1)Illiterate
(2)Only literate	(2)Only literate
(3)Primary level	(3)Primary level
(4)Secondary	(4)Secondary
(5)University level	(5)University level

8. (a) Does your family own land?

   (1)Yes (2)No

   (b) If yes, how enough is your own agriculture production to consume for your family?

   (1)more than enough for whole year (2)just enough for 9 months to one year

   (3)enough for 6 to 9 months (4)enough for 6 months or less

   (c) How does your family earn unmeet consumption? (In case of others, please specify).

   (1)Work for other as daily wage (2)Lease other's land

   (3)Service (job) (4)Others: _____

9. Please circle the items that your family own. (You can circle more than one item.)

   (1)Television (2)Radio (3)Rice cooker (4)Pressure cooker

   (5)LP cooking gas (6)Bio-gas plant (7)Land phone/Mobile phone

10. How long does it take to you to get to your school from your home?

    (1)Less than 30 min (2)Between 30 min to 1 h

    (3)Between 1–2 h (4)More than 2 h

11. For your study, are you staying in rented room?

    (1)Yes (2)No

12. In general, what is the average number of hours per night you spend to study/do assignments?

    (1)Less than 1 h (2)Between 1 to 2 h

    (3)Over 2 h but not more than 3 h (4)Over 3 h but not more than 4 h

    (5)Over 4 h

13. How long do you involve in household chores in a day in average?

    (1)Less than 1 h (2)Between 1 to 2 h

    (3)Over 2 h but not more than 3 h (4)Over 3 h but not more than 4 h

    (5)Over 4 h

14. (a) Do you want to go abroad for work? If yes, when?

    (1)No (2)Yes

    (i) If I get an opportunity, sometime soon. (ii) After graduating from high school

    (iii) After completing university education. (iv) After gaining some experience in Nepal

15. What do you want to be in the future?

(1)Farmer (2)Teacher (3)Government employee (4)Doctor
(5)Nurse (6)Engineer (7)Political leader (8)Businessman/Businesswoman
(9)Do not know (10)Others: _____

16. What level of education do you want to achieve?

(1)Secondary Education (2)Higher Secondary Education (3)Technical Diploma
(4)Bachelor's Degree (5)Master's Degree (6)Doctoral Degree (Ph.D.)

Appendix A.2. Questions Related to 2015 Nepal Earthquake

Below are some statements about the impact of the 2015 earthquake. Please respond based on your experience.

1. Please specify the human loss in your family. ____ injured. ____ died.
2. What was the damage level of your house?

1. No Damage	2. Little Damage (Minor Repairment)	3. Some Damage (Major Repairment)	4. Huge Damage (Retrofitting Needed)	5. Full Damage (Reconstruction Needed)

3. After the earthquake, an idea of establishing common settlement had been discussed. Do you think it is a good thing for your community?

1. Perfect 2. V. Good 3. Good 4. Bad 5. Worse 6. Do not know

4. Are there any adverse effects of the earthquake in your and your family's health?

1. No 2. Yes (please specify: _____)

Below are some statements about your home, family, school, and community related to the 2015 Nepal earthquake. Based on your experience, please indicate how the lowered (worsen) or increased (improved) pre- and post- earthquake situation on the scale of 1(gone worst) to 5 (improved at best). Please put a check (✔) mark to the corresponding number from 1 to 5.

	Statements	1	2	3	4	5
5	Your family's agricultural production.					
6	Your family's income from employment and or business.					
7	Your family's daily expenses.					
8	School's physical facilities and environment.					
9	School's educational environment.					
10	Study environment at home.					
11	Condition of social harmony.					
12	Anti-social activities such as looting and theft.					
13	Your family's ability to cope with disasters.					
14	Love and affection to your own life.					
15	Your love and respect to your parents.					
16	Love and care from your parents to you.					
17	Your love and care to your siblings.					
18	Your siblings love and care to you.					
19	Emotional connection with your neighbors and community.					
20	Your sense of community service.					
21	Your sense of patriotism.					
22	Your interest in study or learning (education).					

Appendix A.3. Oxford Happiness Questionnaire (OHQ)

Some statements are given below about you and your family. Please answer to what extent you agree or disagree with the statements. Please note that there are three level of agreement and three level of disagreement. The statements are both positive and negative. So, please read it very carefully and give your answer. There is no right or wrong answer.

	Statements	Fully Disagree 1	Generally Disagree 2	Somewhat Disagree 3	Somewhat Agree 4	Generally Agree 5	Fully Agree 6
1	I am satisfied with myself.						
2	I give more attention to other people.						
3	I think I had gained many things in my life.						
4	I feel friendship to most of all people.						
5	I do not feel bad while I wake up in the morning.						
6	I have no hope about my future.						
7	I like most of the things.						
8	I always work hard to gain something in my life.						
9	Life is good.						
10	I do not feel that this place is good for human.						
11	I laugh a lot.						
12	I am satisfied with most parts of my life.						
13	I do not think I can achieve any significant progress living in this place.						
14	I could not achieve most of my desired works.						
15	I do not think that I have control on my life.						
16	I always feel good and happy.						
17	I do not feel easy to make a decision.						
18	I do not think that my life has any purpose.						
19	I feel unlimited power within myself.						
20	I have good effect in the society.						
21	I cannot get along with other people easily.						
22	Mostly, I do not feel myself healthy.						
23	I do not have much memory of happy experiences.						
24	I am happy with my other family members.						
25	I think children will achieve big successes in their life.						
26	I am not so hopeless despite the last earthquake.						

Source: Steve Wright's blog, Oxford Happiness Questionnaire, Available online: http://www.meaningandhappiness.com/oxford-happiness-questionnaire/214/ (accessed on 17 January 2021).

Appendix B. Correlation Matrix of Dependent and Independent Variables

		1	2	3	4	5	6	7	8	9	10	11
1.	Average grade score after the earthquake	1										
2.	Difference in grade before and after the earthquake	−0.47	1									
3.	Human loss dummy	−0.10	−0.01	1								
4.	Level of house damage	−0.02	0.06	0.23	1							
5.	Age of students	0.02	0.11	−0.13	−0.08	1						
6.	Happiness level based on OHQ	0.06	−0.10	0.05	0.09	−0.12	1					
7.	Number of siblings	−0.13	0.07	−0.10	−0.07	0.12	0.04	1				
8.	Father's education level	0.08	−0.06	0.04	0.00	−0.21	−0.01	−0.24	1			
9.	Mother's education level	0.19	−0.09	0.01	−0.01	−0.23	0.06	−0.10	0.56	1		
10.	Land sufficiency	0.01	0.05	0.03	0.08	0.07	0.03	0.06	0.04	−0.03	1	
11.	Time required to reach school	−0.10	0.19	0.05	0.09	0.11	−0.07	0.14	−0.07	−0.08	0.13	1

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