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Predictive Analytics Aiming to Increase the Educational Quality for Street Children with Hearing Impairment

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Abstract: ***Still in the 21st century due to various reasons including poverty, separation of parents, death of parents, unconsciousness of parents, etc. countless children spend their childhood in the street in Developing, Least Developed, and underdeveloped countries. Among them a big number faced different disabilities including hearing impairment. There is no substitute for education to improve the social condition and future security for these street children. In our article, we have focused on Predictive Analytics with the aim of formulating the equitable education system for street children with mainly hearing impairment, preventing various social taboos, and identifying the interrelationships between learning abilities and learning methods.***

Keywords: Street children, Least Developed Countries, Hearing Impairment, Children Education

1. Introduction

Hearing loss, also known as hearing impairment, is a partial or total inability to hear [1]. Sign language is a brilliant tool that will help bridge that communication gap that might exist when there is a hearing impairment and even in situations where there is no hearing impairment present [2]. Although sign languages are used primarily by people who are deaf, they are also used by others, such as people who can hear but can't speak, Autism Spectrum Disorder, etc. [3]

In the least developed countries, sign language lacks official recognition and support. The least developed countries (LDCs) are developing countries that, according to the United Nations, exhibit the lowest indicators of socioeconomic development, with the lowest Human Development Index ratings of all countries in the world. The concept of LDCs originated in the late 1960s and the first group of LDCs was listed by the UN in its resolution 2768 (XXVI) of 18 November 1971 [4]. Bangladesh is one of these countries, though, in 2015, it crossed the threshold of the World Bank-defined lower middle-income country. In March 2018, after a 43-year journey as a least developed country, Bangladesh became eligible for graduation into the developing country bracket after it had met all the three criteria [5].

Still, street children are visible in every corner of the country. It is estimated that there are more than 600,000 street children living in Bangladesh, 75% of them live in the nation's capital, Dhaka [6]. The most common definition of a street child or youth is "any girl or boy who has not reached adulthood, for whom the street (in the broadest sense of the word, including unoccupied dwellings, wasteland, etc.) has become her or his habitual abode and/or sources of livelihood, and who is inadequately protected, supervised or directed by responsible adults" (Inter-NGO, 1985) [7].

Among those street children, there are big numbers who are having physical disabilities, autism, mental disabilities, learning disabilities, etc. We are focusing on only hearing impairment. Because of our limited resource, and the small number of participants, we decided to focus only on street children of Bangladesh, aiming to increase the development of education quality for street children with hearing impairment in the least Developed Countries by proposing methodology related to predictive analytics.

Predictive analytics encompasses a variety of statistical techniques from data mining, predictive modeling, and machine learning that analyze current and historical facts to make predictions about future or otherwise unknown events [8], [9].

We also proposed a methodology to develop the quality of education and continue further researches with large participants from different countries and different age groups.

2. Research Methodology

To ensure a better future for street children there is no alternative to education. For our research, we only get participants from Bangladesh. Our research methodology includes eight steps in the first phase.

At first, we are focusing on factors that are influential to education. Then in the next step, we will choose some criteria, which are considered as best for educational development especially related to our research. Then we are focusing on expert evaluations of these criteria for finding three best criteria.

We have three experts who will not only help us during criteria evaluation but also will help us to teach our participants.

Three street children at the age of six will participate, among them two not having any difficulties with learning, and one is having a hearing impairment.

We will teach each of the participants' Russian alphabets for the first month and will analyze the results based on factors related to influence the motivation in education. The participant with hearing impairment will learn sign language. We are using the Russian language for avoiding already learned materials. As Russian is a very uncommon foreign language for Bangladesh, there is almost no chance that our participants already knew the study materials that we are going to use. In the second month, participants will learn thirty Russian words. In the third month, participants will learn three Russian rhymes. At the end of every month, there will be an assessment.

Figure 1: Steps of predicting outcome for street children

For this article, we will use three selected factors related to influence the motivation in education, and for all three months, the hearing impaired participant will get overall learning factors in an excellent form. For the other two participants, we will change the learning environment and analysis the results using different assessment methods focusing on linear regression. After that, we will predict future learning outcomes. Next month all three participants will get the same learning environment and overall learning factors in an excellent form, to compare the prediction with actual learning outcomes.

3. Implementation

After researching [10] [11] and talking with experts, students, and teachers from different schools, we got the suggestion of following factors that influence education:

1) Teaching methods
2) Family issues
3) Peer relationship
4) Learning environment
5) Assessment process
6) The role of economy
7) The impact of culture
8) Curriculum structure
9) Learning strategies
10) The role of technology
11) Teacher behavior
12) Motivation of learning

We are using expert evaluation for selecting best criterions in order to continue our research. Expert evaluation is also called heuristic evaluation. Compared to other user studies, expert evaluation is often easier to arrange. It is mainly utilize the knowledge of user experience professionals in evaluating UX of the system [12]. Here we are using this to figure out best three factors related to influence educational system. We are modifying this method with our proposed methodology to make it easier and more effective.

Description of experts:

Expert 1, Sheikh Raisul Islam, a young University Lecturer, is also involved in different social activities for the educational development of street children with hearing impairment.

Table 1: Details about Expert 1

Full Name	Sheikh Raisul Islam
Occupation	University Lecturer
Qualification	In-depth knowledge of teaching methods and legal educational procedures.
	Outstanding written and verbal communication skills.
	Well-organized with excellent leadership abilities.
	Exceptional interpersonal and presentation skills.
	Master's Degree in social science
	Trained about different learning methods

Expert 2, Mrs. Kona Al-Amin, High School teacher (IT), along with her job, she is currently working with the development of Digital classroom for rural students' education.

Table 2: Details about Expert 2

Full Name	Mrs. Kona Al-Amin
Occupation	High School teacher (IT)
Qualification	Outstanding knowledge of planning for lessons in the subjects
	Assessment of students to evaluate their abilities, strengths, and weaknesses
	Excellent communication skill with parents about students' progress
	Working with individual students to challenge them, to improve their abilities, and to work on their weaknesses
	Preparing students for standardized tests required by the state
	Supervision of students outside the classroom.

Expert 3, Mrs. Ismat Mitul has vast experience of teaching primary school students especially from rural areas and poor families.

Table 3: Detail about Expert 3

Full Name	Mrs. Ismat Mitul
Occupation	Primary School Teacher
Qualifications	Experience of working with street children
	Good Communication skill with parents
	Excellent ability to Teamwork
	Trained with Technological skills
	Ability of Conflict resolution

All Experts will provide point for each criterion in a range of 3 to 5. Here,$j = 1 \dots 3$ representing experts, and$i = 1 \dots 12$, representing factors

Table 4: Showing the relation of [i,j]

i/j	j_1	j_2	j_3
i_1	$[i_1, j_1]$	$[i_1, j_2]$	$[i_1, j_3]$
i_2	$[i_2, j_1]$	$[i_2, j_2]$	$[i_2, j_3]$
i_3	$[i_3, j_1]$	$[i_3, j_2]$	$[i_3, j_3]$
i_4	$[i_4, j_1]$	$[i_4, j_2]$	$[i_4, j_3]$
i_5	$[i_5, j_1]$	$[i_5, j_2]$	$[i_5, j_3]$
i_6	$[i_6, j_1]$	$[i_6, j_2]$	$[i_6, j_3]$
i_7	$[i_7, j_1]$	$[i_7, j_2]$	$[i_7, j_3]$
i_8	$[i_8, j_1]$	$[i_8, j_2]$	$[i_8, j_3]$
i_9	$[i_9, j_1]$	$[i_9, j_2]$	$[i_9, j_3]$
i_{10}	$[i_{10}, j_1]$	$[i_{10}, j_2]$	$[i_{10}, j_3]$
i_{11}	$[i_{11}, j_1]$	$[i_{11}, j_2]$	$[i_{11}, j_3]$
i_{12}	$[i_{12}, j_1]$	$[i_{12}, j_2]$	$[i_{12}, j_3]$

$S_j = \sum_{i=12}^{i=1} f[i,j]$Eq. (1),
Where, Eq. (1) is the summation of experts' points/markings.

Table 5: Expert evolution of criterions

Factors related to educational development	*Points from Expert1*	*Points from Expert2*	*Points from Expert3*	*Total Points*
Teaching Methods	5	5	5	**15**
Family Issues	4	4	5	13
Peer Relationship	4	3	4	11
Learning Environment	5	5	5	**15**
Assessment Process	5	4	5	14
The role of economy	3	3	4	10
The impact of Culture	4	4	4	12
Curriculum Structure	5	3	4	12
Learning Strategies	4	4	5	13
The role of technology	4	5	3	12
Teacher behavior	5	5	5	**15**
Motivation of learning	4	4	3	11

From this table we get three best factors related to educational development: teaching methods, learning environment and teacher behavior. For our further research, we will work with only these three factors.

Table 6: Description of Participants

Participants	*Variables*	*Descriptions*
Participants 1	Name (nick name)	Mukta
	Age	06 years
	Sex	Female
	Family Size (members)	Mother and younger brother
	Hearing Impairment	no
Participants 2	Name (nick name)	Hena
	Age	06 Years (approximately)
	Sex	Female
	Family Size(members)	n/a
	Hearing Impairment	yes
Participants 3	Name (nick name)	Nahid
	Age	06 years
	Sex	Male
	Family Size	n/a
	Hearing Impairment	no

For making this research less complicated, we are considering fewer variations of factors related to educational development. However, for future work, we are looking forward to working with more probabilities to increase accuracy.

Table 7: Relation between Factors related to educational development and Participants in different months

Month				
March	Factors	P 1	P 2	P 3
	Teaching Methods	Good	Excellent	Satisfactory
	Learning Environment	Good	Excellent	Satisfactory
	Teacher behavior	Good	Excellent	Satisfactory
April	Factors	P 1	P 2	P 3
	Teaching Methods	Excellent	Excellent	Good
	Learning Environment	Excellent	Excellent	Good
	Teacher behavior	Excellent	Excellent	Good
May	Factors	P 1	P 2	P 3
	Teaching Methods	Satisfactory	Excellent	Excellent
	Learning Environment	Satisfactory	Excellent	Excellent
	Teacher behavior	Satisfactory	Excellent	Excellent

Where, P represents Participant,
Excellent consider as 5, good 4, and satisfactory 3.
X, as factors related to educational development, and Y is representing learning outcomes for each participant.

Table 8: Linear regression values from assessments of participants

Month	*Participants 1*		*Participants 2*		*Participants 3*	
March	X_1	Y_1	X_2	Y_2	X_3	Y_3
	4	70	5	100	3	58
April	X_4	Y_4	X_5	Y_5	X_6	Y_6
	5	90	5	94	4	68
May	X_7	Y_7	X_8	Y_8	X_9	Y_9
	3	51	5	98	5	89

Calculation Summary
Sample size: 9
Mean x ($\bar{x}$): 4.3333333333333
Mean y ($\bar{y}$): 79.777777777778
Intercept (a): -8.8148148148146
Slope (b): 20.444444444444
Regression line equation: $y = 20.444444444444x - 8.8148148148146$

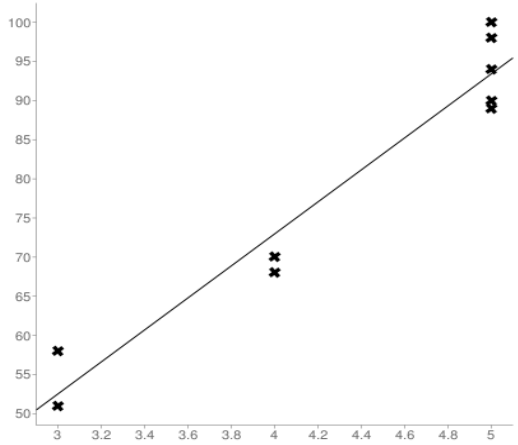

Figure 2: Linear Regression graphs from our collected data

Correlation coefficient (r): 0.96924028607527

The correlation coefficient or Pearson product-moment correlation coefficient (PMCC) is a numerical value between

-1 and 1 that expresses the strength of the linear relationship between two variables. When r is closer to 1 it indicates a strong positive relationship. A value of 0 indicates that there is no relationship. Values close to -1 signal a strong negative relationship between the two variables.

Correlation coefficient formula:

There are many formulas to calculate the correlation coefficient (all yielding the same result). This calculator uses the following:

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{\left(n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2\right)\left(n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2\right)}} \quad \text{Eq. (2)}$$

Where, n is the total number of samples, x_i (x_1, x_2,… x_n) are the x values and y_i are the y values [13]. For$x = 5$, we predict$y = 93.4074074074054$, using linear regression.

4. Result

From our collected data and expert's analysis regardless of one participant with hearing impairment, we predicted that all participants with an excellent learning environment, teaching method, and friendly behavior from teachers will get above 90.

Table 9: Results of final assessment

Month	*Participants 1*		*Participants 2*		*Participants 3*	
June	X_1	Y_1	X_2	Y_2	X_3	Y_3
	5	100	5	98	5	91

Prediction of learning outcomes based on factors related to influence students' motivation in the education of street children tends to approximate towards reality regardless of individual students' learning capabilities. That means street children even with hearing impairment can show excellent learning outcomes if factors related to influence students' motivation in education favors him or her.

5. Conclusion

The descriptions of implementations are not explained briefly, to avoid excessive information in this article. Also, we had an opportunity to work with only three participants and a few professionals and experts. We understand that with such a small amount of data, it is quite impossible to predict error-free learning outcomes. A big amount of data can make our proposed methodology more accurate. For future work, we are looking forward to working with more participants from various countries and compare the results to predict the learning outcomes correctly.

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