

E-Trainer for People with Learning Disabilities

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‘Situation Word Problems’ are applied to daily life situation during their early stage of learning. Learners in elementary level may solve basic addition,

Abstract – In general, people with learning disabilities have trouble in understanding concepts and applying skills during their course of learning process. Learning disability problem can only be overcome by appropriate training. In this direction, word problems in mathematics are taken into consideration for discussion. There is very little scope in getting exercises from the text books for improving their skills. By using automatic question generation techniques, training for the same type of questions in all categories can be given to the students. This paper addresses students learning difficulties in mathematics and provides solution for generating varieties of questions for students with learning disabilities.

Index Terms - Learning Disability, Word problem, Automatic question generation, Training.

I. INTRODUCTION

Learning disability is a term that describes specific kind of learning problems. A learning disability can cause a student to have trouble in learning and using certain skills. While a learning disability cannot be cured, its impact can be reduced through instructional and compensatory strategies [2]. In general, a variety of instruction modes can be thought of to enhance learning for students with learning disabilities. During primary school, if deep learning troubles are prematurely detected, children are given the benefit of additional training and different strategies to learn and solve the problems.

Word problems are integral components of mathematics education at school levels. They are applied to daily life situation which are complicated and changeable. Situation word problem are difficult to learn for normal students [6]. When considering learning disability students, it is still more complicated. Mathematics learning difficulties are common and to be given more importance in school education. Significant math deficits can have serious consequences on the everyday life. A serious instructional attention is needed in both regular and special education classes. Math learning problems range from mild to severe. Most common are difficulties with efficient recall of basic arithmetic facts and with interpretation of given problem statement. Learning of any new subject or mathematical concepts is closely tied to the teachers and the manner in which these concepts are taught. Improving children problem solving skills is an important aim of mathematics education. In mathematics education the

subtraction etc, without knowing how to implement in real life applications. If the Learners are not able to understand the meaning of the problem, they will simply list all the numbers in the problem and will add or subtract them without knowing what to do or find difficulty in solving.

The meaning of operations stem from the student strategies that reflect the semantic structure of the word problem [5]. Up to now, eleven different meanings of addition and subtraction have been defined, representing math word problems [4]. Word problems are critical for helping learners to connect different meanings, interpretations and relationships to mathematical operations (Van de Walle, 2004). Children with learning disabilities often find difficulty to interpret the semantics of the sentences in the word problems or unable to find out the right operations to solve them. A list of keywords would be of great help to train them to identify the type of the problem. In this paper, keywords related to math word problems are collected which will form a prime part of most of such problems. The motivation behind this approach is to assist children with learning disabilities to solve the word problems of those types easily.

II. WORD PROBLEMS

Math word problem comprises of keywords involving arithmetic operations such as Addition, Subtraction, Multiplication and Division. We focus on carefully chosen such problems that characterize most of the mathematical word problems [1].

Sample problems with keywords are shown in Table 1.

Table 1. Sample Problems

Problem Statement	Keyword /Arithmetic operation
George ran 4 miles on Thursday. George walked for 2 miles on Friday. How many <u>total</u> miles did George run or walk <u>all together</u> ?	All together Addition
A Stationery store sold 116 pencils on Monday, 67 on Tuesday, and 135 on Wednesday. What is the <u>total</u> number of pencils sold?	Total Addition
Ram bought 28 cartoon stickers. He gave 7 of the stickers to his friend, Raja. How many stickers does he have <u>left</u> ?	Left Subtraction
The cost of 5 pens is 35 rupees. What is the cost of <u>one such</u> ?	One such Division
Joy has 12 books. John has <u>taken away</u> 5 books. How many books are remaining?	Take away Subtraction
Mala got 20 pens. Sheela has got 14 pens. What is the <u>difference</u> between them?	Difference Subtraction
In a city there are 59 bicycles and 81 bikes. How many vehicles are there <u>totally</u> ?	Totally Addition
The price of 18 bags cost rupees 230, What is cost <u>per</u> bag?	Per Division
The cost of 1 bottle is 50.What is <u>product</u> of 8 bottles?	Product Multiplication

III. KEYWORDS CLASSIFICATION

Keywords play a vital role in identifying the problem type in math word problems. The following figure (Fig.1) shows the keyword categories under addition subtraction, multiplication and division. These keywords will be useful for students to identify the problem type to solve them.

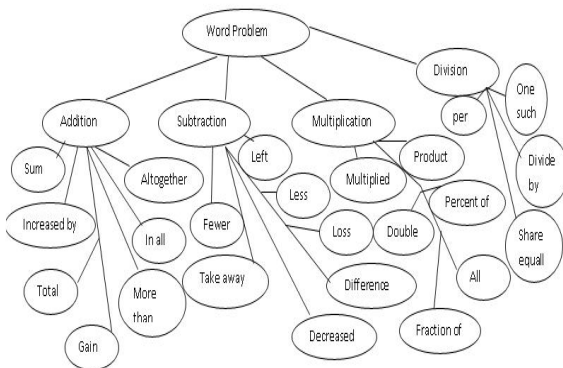


Figure 1. Keywords in Word Problems

IV. TRAINING METHODOLOGY

The proposed work focuses on two major modules based on E-learning environment.

1. Identifying problem areas
2. Generating exercises based on problem areas.

Various stages of the above modules are shown in Fig 2.

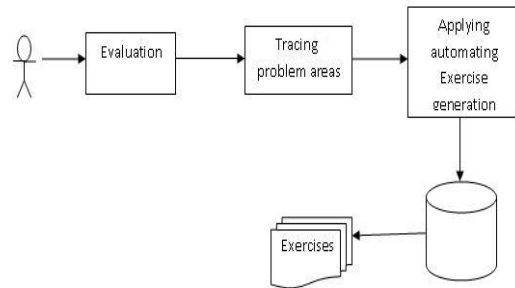


Figure 2. Trainer

The learning difficulty can be lessened by giving set of exercises of same type of problem in all categories.

A. Provide a Test Sheet

Before the training process, learners may be exposed to a general test. The questions available in this test belong to all types of problem models.

B. Identify the Problematic area

Understanding of arithmetic operation is must for every math learner as they form the base for any further level of solving problems. Ausubel's theory of meaningful learning stresses that learning new knowledge is dependent on what is already known [1, 3]. Before learning a new concept, the prerequisite for learning the new concept is trained thoroughly. So, that the learning of new concept is made easier. The test result will inform the system about the status of a learner. The problematic area can be identified to train the learners in the appropriate levels.

For example a sample test sheet consisting of all types of questions is given to a learner to test his/her level. The results obtained from the test are shown using the following graph (Fig. 3). It is clear that the user feels comfortable in addition and subtraction type of word problems than multiplication and division.

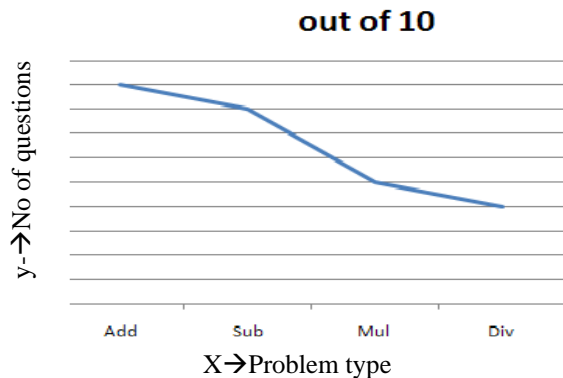


Figure 3. Performance graph

The results obtained from the sample test are used to identify the prior or base knowledge of the users to decide upon where further training to be given.

C. Generate questions

After evaluating the student where he/she actually lacks, different types of questions can be generated.

The automatic question generation module is used to get different questions of same type. Every question belongs to a question Template. A question template has fixed components, variable components and keywords. The fixed components will be remaining same for all questions of that particular type. Variable components come under two categories namely one numeric and the other a list of possible string values applicable for the question.

A question template and its various components are shown in Table 2.

Here {W1, W2, W3, W4} are fixed components in the template. {C1, C2, C3, C4} are variable components for which different values have to be generated from a list of possible values.

{N1, N2} are numeric values.

K is the Math operation Keyword.

Table 2. Template and Components

W1	N1	C1	W2	N2	C2	C3
There are	Numeric	Boys	And	Numeric	Girls	In the class

(Template continued)

W3	C4	W4	C3	K
How many	Students	Are there in the	In the class	Totally

The Templates are stored in template table (TT). The Algorithm for Automatic Question Generation is as follows

Algorithm

Procedure question-generation ()

Begin

Choose a template from the table TT

1. Generate numeric values for N1 and N2
2. Values for W1, W2, W3, and W4 & K are taken as such
3. Select values for C1, C2, C3, C4 from a list of stored values

End;

The procedure *question-generation ()* is used to generate questions from a table where the question templates are stored.

Possible values of C1, C2, C3 and C4 may be as follows:

- boys, girls, students and 'in a class'.

- pen, pencil, items and 'in a box'.
- biscuits, cakes, snacks and 'in a tray'.

Keywords may be any one from the list of words shown in Fig 1. (E.g. totally, sum, etc).

Using the above template following type of questions will be generated.

1. *There are 23 boys and 34 girls in a class. How many students are there in the class totally?*
2. *There are 32 pens and 18 pencils in a box. How many items are there in the box totally?*
3. *There are 14 biscuits and 13 cakes in a tray. How many snacks are there in the tray totally?*

The questions are generated automatically by replacing the values for the variable components. By having more values for C1, C2, C3 and C4 in a suitable data store more number of questions can be generated which in turn can help the students to get trained in similar type of problems.

CONCLUSION

This paper focuses on Automatic questions generation for the learners with learning disability problem related to math word problems. By giving more training on the similar type of questions learning disability problem can be reduced. In future, design of generic framework for template is thought of.

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