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LabVIEW: An Interactive Teaching Tool for Few Concepts of Vedic Mathematics

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***Abstract*— The computer technology and internet are the powerful tools and provides effective way of learning atmosphere for engineering disciplines. Virtual instruments is one of the efficient teaching tools for students which have been incorporated by many academic institutes. LabVIEW software's application can be used to teach the concepts of Vedic Mathematics. For fast and effective learning an interactive Graphical User Interface (GUI) has been developed to demonstrate the stepwise procedure of Vedic Multiplication Concepts like Ekadhikena Purvena and Urdhva Tiryagbhyam. The paper aims to provide some background knowledge about the designed tool and to show alternative delivery methods, which may change the traditional practices. This tool is user friendly, cost effective and compatible in all working environments. The main focus of the paper is to deal with common problems faced by the institutions and the educators and also provides some guidance for choosing the most appropriate tool required. Finally, the paper contemplates the future trends and provides some discussion.**

Keywords-Vedic Mathematics, LabVIEW, UrdhvaTriyagbhyam, Ekadhikena Purvena.

I. INTRODUCTION

Mathematics is used in various fields like engineering, commerce, medical science, architecture and even humanities. It is regarded as the queen of science. Many Indian Secondary School students consider mathematics as a difficult and challenging subject. Even the basic arithmetic operations will be treated as a troubleshooting scenario. Some students face some difficulty in manipulating symbols, manage numbers and balance equations. Some students show anxiety while solving problems which may be due to underlying math–phobia. In other words, abstract thinking, rational thinking and logical reasoning are their hurdles. Many such difficulties enter into a long list, if prepared, by an experienced teacher of mathematics [1]. Volumes have been written on the diagnosis of learning difficulties related to mathematics and remedial techniques. Learning mathematics is a tedious work and an unpleasant experience to some students because it involves a lot of mental exercise. Of late, a few teachers and scholars have revived interest in Vedic Mathematics, which was developed as a system derived from Vedic principles.

Visual Basic, C, C++, C#, Java, Python etc. are some of the computer programming languages. These follow control flow model for the execution of programs. Execution order of the program is determined by the sequential order of program elements. A program written in LabVIEW uses a slightly different approach when compared to conventional method. It follows data flow model for the execution of programs[2]. LabVIEW stands for Laboratory Virtual Instrument Engineering Workbench. This powerful Graphical System Design (GSD) developed by National Instruments (NI), is a widespread teaching tool and is used in many industries for various applications. Virtual instrumentation combines PC with a flexible software and various types of measurement and control hardware. Data acquisition, motion control, machine control, instrument control are few applications where LabVIEW is used[4]. A single VI consists of two parts: front panel and block diagram. The front panel consists of controls (inputs) and indicators (outputs). Numeric and string control, numeric and string indicator, push buttons, LED, knobs, graphs, charts etc. and some of the controls and indicators present in the function palette. Block diagram consists of graphical representation of functions to control the objects present on front panel. In conventional programming model the code executed from top to bottom or line by line execution, whereas in VI the execution of code is from left to right and the functional block on the block diagram panel will be executed when all its inputs are available[3].

Education has taken on new dimensions with the advancement and development of computers and the advent of internet. This new technology incorporates the internet based research and learning and serves well as complimentary tools in education. In this paper, an interactive web based activity and a tool is developed which aims at teaching the concepts on problem solving to primary and secondary school students. Interactive web based learning environment is developed for basic Vedic Multiplication concepts like Ekadhikena Purvena and Urdhva Tiryagbhyam. The major objective of this is that, it enhances students' understanding, improves problem solving skills, instructional theories, enriches the method of solving problems, improve logical and rational thinking[5] . Primary school students find difficulty in understanding the basic concepts of multiplication, solving the problems related to it and applying them to different numerical will be a tough task. To overcome such difficulties many technologies have been employed and World Wide Web is also used to encounter such problems[6].

The basic design consists of guide, visualization/simulation, web-interaction, and help sessions. Expert opinions to the

students are provided by the guide. It guides them on topics pertinent to solving the problems. In areas such as differential equations where many method and tools are not easy to comprehend and follow, therefore Visualization and simulation is given importance. Enough chances are given to students to solve problems in our teaching method. Using graphical programming language G (LabVIEW) and Internet Developers Toolkit for G can be used for the implementation. Both virtual and remote laboratory experiments to students can be achieved easily using LabVIEW. Any computer without LabVIEW application which is connected to the internet via web browser can be allowed to access this tutoring/learning system by the password that is provided to the clients. There are numerous research groups working on computer based learning systems that employ LabVIEW [3, 8, 6, 4]. This paper presents the component of the tutoring system that involves the Internet application of LabVIEW for Virtual Lab and real-time remote laboratory experiments[9] .

II. THE DOMAIN INFORMATION OF KNOWLEDGE

In order to be a good source of the knowledge to be presented, it is necessary to have excellent expertise in the domain of instruction. For a better understanding of the concepts it is necessary to represent the concept clearly and it has to be communicated to the students easily, to achieve these the organization of knowledge is important. In the domain of Vedic Mathematics, to avoid misconception of abstract concepts, knowledge has to be conveyed to the students by showing step by step execution to arrive at the solution.

III. KNOWLEDGE LEVELS OF PERCEPTION AMONG THE STUDENTS

Students learning characteristics and the adaptability to the instructional system are affected by the behavior of the student, previous knowledge and experience of the student. Hence, it is important to understand these. Appropriate diagnostic techniques are needed for building knowledge about the students. In Vedic Mathematics for example, student's previous knowledge and experience could be assessed by using problems and questions can be used. Student's response to questions and problems can be analyzed to identify misconceptions. This will be useful in determining the level and next set of problems, simulation of concepts, and the type of visualization aids and materials presentation method. The features that are looked in for are the pupil's response in connection with the rapidity to solve the given multiplication. Another key aspect to demonstrate the effectiveness of the tool is the problem solving ability of the primary school student.

IV. PEDAGOGICAL KNOWLEDGE IN THE TOOL

Important part of the setup is Communication strategies. In Vedic mathematics, to avoid misconceptions one must be definite about the way materials are presented. Animation for visualization purposes places an important role here. One must exercise good judgment in determining how, where, and when to present virtual laboratory experiments, and real-time remote lab experiments. Good communication skills however need good understanding of available interface or means of communication, materials to be presented and the audience or recipient.

V. INTERFACES WITH THE STUDENTS

Knowledge of above three interface components is needed for the interface component. For example in this direction , the information about the student will decide if the numerical presentation will be sufficient or there will be requirement for animated JAVA applet imageries. Some other questions may contain how problems, responses and feedbacks are handled; how many interactive windows are necessary; and should a pop-up new window is required? These are few of the many issues that need to be addressed.

VI. DESIGN AND IMPLEMENTATION

The basic design includes guide, simulation/visualization, web-interaction and help sessions. The guide provides expert opinions to students via MOODLE interactive software using Virtual Lab and real-time remote laboratory.

Case (i): Design of tool for tutoring method of Ekadhikena Purvena. Now relating the sutra to the 'squaring of numbers ending in 5' we can obtain the solution.

Example: Consider the example 45^2.We have to find out the square of the number.For the number 45, the last digit is 5 and the 'previous' digit is 4. Hence, 'one more than the previous one', that is, 4+1=5.

The Sutra, in this context, gives the procedure 'to multiply the previous digit 4 by one more than itself, that is, by 5. It becomes the L.H.S (left hand side) of the result, that is, 4 X 5 = 20.

The R.H.S (right hand side) of the result is 52, that is, 25.

Thus $45^2 = 4 \text{ X } 5 / 25 = 2025$.

In the same way,

$35^2 = 3 \text{ X } (3+1) / 25 = 3 \text{ X } 4 / 25 = 1225$;

$65^2 = 6 \text{ X } 7 / 25 = 4225$;

$105^2 = 10 \text{ X } 11 / 25 = 11025$;

$135^2 = 13 \text{ X } 14 / 25 = 18225$;

A. *Implementation of tool for tutoring method of Ekadhikena Purvena:*

The number whose square has to be found is entered in the numeric control. The number is split such a way that the last digit 5 is separated from rest of the numbers using 'Quotient and remainder' block. In this the first input is the number itself and the second input is '10'. Here, remainder is 5 and the quotient is rest of the number, say it as Q1. The first part of the number (Q1) is incremented by one using the 'Increment' block. Q1 is multiplied with its increment (Q1+1) using the 'Multiplication' block. This forms the first part of the result. Last part of the number i.e. 5 is squared using the 'Square' block, which forms the second part of result. Final result is formed by multiplying the first part of the result by 100 using 'Multiplication' block and then adding it to the second part of result using 'Addition' block. The result is displayed in the numeric indicator.

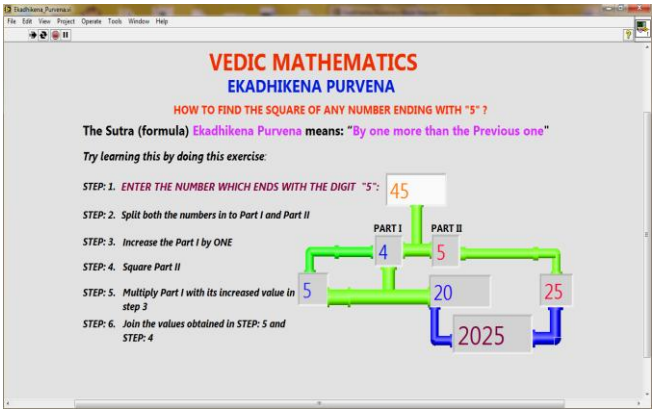

Fig. 1. Interactive tool designed to demonstrate the concept of Ekadhikena Purvena

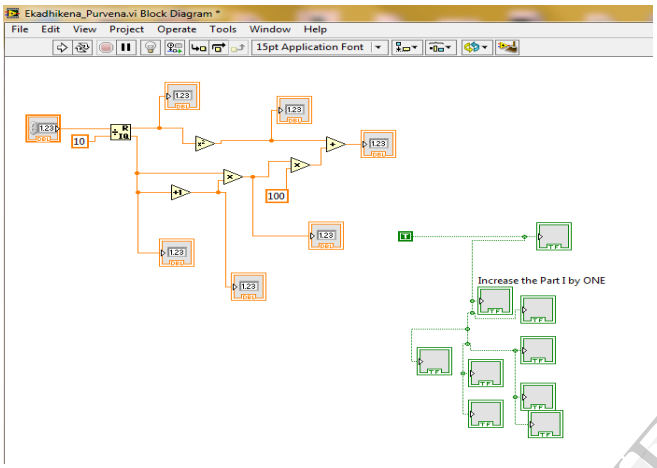

Fig. 2. The backend Graphical Programming for Ekadhikena Purvena

Case(ii): Design of tool for tutoring method of Urdhva Tiryagbhyam.

Urdhva Tiryagbhyam is the general formula applicable to all cases of multiplication and also in the division of a large number by another large number. It means "Multiplication of two 2 digit numbers".

Finding the product 32 X 41:

i) The right hand most digit of the multiplicand, the first number (32) i.e.,2 is multiplied by the right hand most digit of the multiplier, the second number (41) i.e., 1. The product 2 X 1 = 2 forms the right hand most part of the answer.

ii) Now, diagonally multiply the first digit of the multiplicand (32) i.e., 2 and second digit of the multiplier (41) i.e., 4 (answer 2 X 4=8); then multiply the second digit of the multiplicand i.e.,3 and first digit of the multiplier i.e., 1 (answer 3 X 1 = 3); add these two i.e.,8 + 3 = 11. It gives the next, i.e., second digit of the answer. Hence second digit of the answer is 11.

iii) Now, multiply the second digit of the multiplicand i.e., 3 and second digit of the multiplier i.e., 4 vertically,

i.e., 3 X 4 = 12. It gives the left hand most part of the answer.

Thus the answer is 1312.

B.Implementation of tool for tutoring method of Urdhva-Tiryagbhyam:

Two numbers that have to be multiplied are entered in the numeric controls. Both the numbers i.e. multiplicand and multiplier are split into two parts using 'Quotient and remainder' block, say r1, r2, q1 and q2. For this the first input is the number and the second input is '10'. The outputs, remainder (r1, r2) and quotient (q1, q2) will be the digit in units place and tens place respectively. Unit place digits of multiplicand (r1) and multiplier (r2) are multiplied using the 'Multiplication' block, say the result as R1. The sum of r1 X q2 and r2 X q1 and is performed by using 'Addition' block, say the result as R2. The product of q1 and q2 are performed using 'Multiplication' block, say the result as R3. R1 is checked if the value is greater than 10 using a 'Case Structure'. If R1 is less than 10, then the final result is formed by concatenating R3-R2-R1. If R1 is greater than 10, then it is divided by 10 using 'Quotient and remainder' block. Its remainder is added to R2 using 'Addition' block. Now, R2 is checked if the value is greater than 10 using the 'Case Structure'. If it is less than 10, then it is directly taken for concatenating with other parts of result. If it is greater than 10, then it is divided by 10 and it remainder is added to R3. Finally R1, R2 and R3 are converted to string using 'Number to Decimal String' and are concatenated in the form R3-R2-R1.

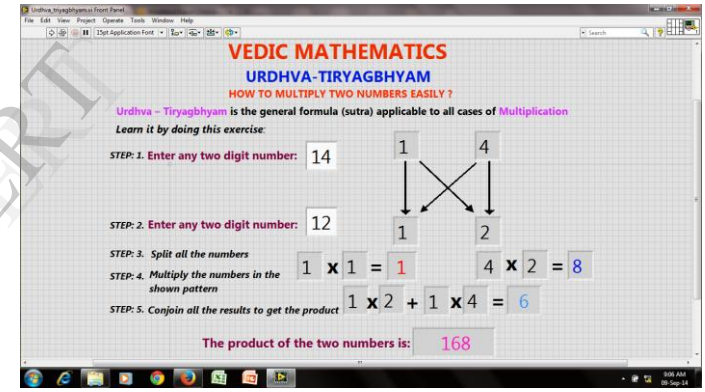

Fig. 3. Interactive tool designed to demonstrate the concept of Urdhva Triyagbhyam

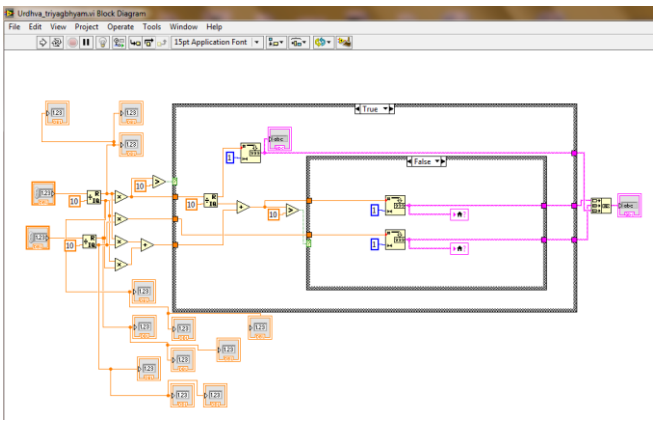

Fig. 4. The backend Graphical Programming for Urdhva Triyagbhyam.

VII. CONCLUSION

LabVIEW is a powerful and effective environment for developing simulation trainers. It offers a lot of possibilities for implementing various mathematical functions. Online help and online simulator documentation ca be included very easily without the any special tools. It has inbuilt debugging tools which is very powerful and helps in fast testing and development of the simulation software. The agenda for an internet based tutoring or learning system that uses LabVIEW to present an experiment is demonstrated. Ekadhikena Purvena and Urdhva Tiryagbhyam are the concepts of multiplication in Vedic Mathematics which have been designed and demonstrated using VI. The main component of this experiment is the hybrid of a virtual lab and a real time remote laboratory. Both the labs can be accessed by authorized user from the internet. To demonstrate how LabVIEW and its Internet Toolkit can be used to implement the virtual laboratory, the basic design of the motion of a simple pendulum has been presented. This tutoring system will serve as an excellent counterpart to classroom teaching and can learn few of the concepts of Vedic Mathematics like Ekadhikena Purvena and Urdhva Tiryagbhyam. Our ultimate goal is to design more labs focusing on Vedic Mathematics and creating a contemporary tool for all the similar concepts. The further development aims at extending this idea to other mathematics courses.

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