Innovations in

Mathematics

Education and

Research in

Elementary

Mathematics

Project IMEREM

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Summary:

IMEREM is going to be the ultimate reference and tool for all educators and students and teachers in math for all levels from elementary to undergraduate. Here we only explain the new features and this should be enough for description of the whole project.

A: Introduction

Online setup has provided everyone in mathematics education discipline the ability to provide services to students worldwide and also join forces of educators to offer a better service with higher standards. The scope we offer services, both in terms of the number of students and the material, can not be easily matched, because we intend to bring together the efforts of experts worldwide.

B: Written material

We provide web-based text material which teaches mathematics from elementary to undergraduate level based on "Problem Solving" method of mathematics education. Even introducing new concepts is done using problem solving only. Although this method of teaching mathematics in by no means new, and has already appeared in ancient text of "Nine Chapters" in Chinese civilization in third century AD, there has never been an A to Z educational system in mathematics, covering all topics from elementary to undergraduate level. This will be particularly useful if we develop such texts for service courses in university level. For many topics in undergraduate level there has never been such textbooks made available to students to challenge themselves if they could develop the material themselves from base to borders through problem solving. Our platform can be used for online teaching and in fact,

we will offer online courses using the written and pictorial material and available software in our platform.

C: Videos and animations and apps and other pictorial material

Our methodology in mathematics education is conscious to diversity of students in cognitive skills of learning. That is why we offer the material in verbal, pictorial and kinesthetic approaches from elementary to undergraduate level. In some countries which are advanced in mathematics education in school level, this sensitivity is implanted. But in math education in university level, this is a new idea and we proudly offer such an education in all levels worldwide. Pictures are not a perfect tool to communicate with pictorial minds. Videos and animations and apps provide the students the chance to see pictures moving and in fact their motion being in control of students. This is a chance for students to hand-manipulate the pictorial material which makes learning deeper. As will be explained later, we use our atlases of concepts and skills to make sure apps and videos cover all the material to be learned by students. Many interactive videos will be provided so that we avoid one-sided learning. We will actually make interactive videos, which provide a group of students the discuss the material with each other.

D: Problems and Competitions

Not only we provide a large and complete list of problems previously used in or proposed for national and international completions, but we provide the students chance to compare several solutions and learn from this comparison even after solving the problem. As it in customary now, students stop working on the problem when they finish solving it. But using our material the main process of learning starts actually after solving a problem. Asking what the different solutions are, and what their common features are, and how can one get motivated to find those solutions looking at the problem posed, and which solutions can help us generalize the problem, and so on. This way, we treat competition problem as elementary level research problems and try to understand the depth of the material better and sometimes being able to propose new problems or prove more general results. The setting of problems and solutions in our platform provide these new innovations in preparing students for competitions like IMO and IMC in high school and undergraduate level.

E: Mathematics education software

Software like GeoGebra and Mathematica and Maple provide a rich platform to write codes for apps within the software. Many such apps are already written for these software, but we make them available for the teachers to use them for their online courses using the material in our platform. We will guide our student and

teacher associations to complete these collections so that the material of elementary and undergraduate mathematics be fully covered. This job needs thousands of voluntary teachers to join forces to complete this task. It will take a few years, but the result will be a revolution in teaching and learning mathematics. Having in mind variance of different learning skills, there is a map of all different apps which should be designed to fully cover the material in undergraduate level mathematics using our atlases of concepts and skills.

F: Atlases of Mathematics

We provide the map of totality of concepts and their relations in elementary mathematics, another atlas of skills and also an atlas of perspectives towards mathematics and cognitive contributions complement our universal atlas of concepts. These atlases help us cover the whole material and also they are our main tool for our recommendation system which we will mention at the end of this proposal. Using executive atlases of concepts and skills and perspectives towards math applications and its cognitive contributions is our main innovation in the educational system which we face students to. Our monumental research papers on practical philosophies of doing mathematics and their implications on mathematics education has been our motivation for providing these advanced tables and diagrams.

G: Mathematics Associations

Part of the role of IMEREM is organizing meetings and lectures in three mathematics associations for teachers, high school students, and undergraduate students. Introducing students with common mathematical interests to each other, and helping volunteers to coach students of lower classes. All three associations are encouraged and supported to perform research in topics in elementary mathematics. Students are helped in writing down their research and our platform provide means of sharing these papers with peer students. Recording and organizing events in these communities will have positive effects on the mathematical community. For example, activities of many students will be recorded and these will be available when some of them become great mathematicians. Teachers could help each other to educate themselves and that will raise the standards of mathematics education worldwide. Success of these activities will motivate teachers and students in other languages to record their activities.

H: Mathematics Library

AMS has a collection of books introduced for different entries in mathematics subject classification. Reviewing these books and recommending these to particular users according to their mathematical interests and abilities would be the job of our mathematics library. Since we have access to students' activities, it is possible to

guess if they are interested in certain books and then by providing them a summary of the book and an appropriate review we can motivate them to study the material. Students and teachers can write reviews and these reviews will help other readers to make better use of the material. Complementary libraries in elementary mathematics in high school level and books introduced in different languages in their corresponding libraries will help students not familiar in English to have access to material in high school level in their own language.

I: Assessment

Our monumental innovation in assessment will be one of the main reasons of success of IMEREM. Using our extensive atlases of concepts and skills, we provide assessment which cover the whole material in each topic and the results of assessment will be in the form of a checklist which describes the abilities of students very precisely. These report cards will be of interest of schools and universities which cease to have information about students who are applying for admission. Online assessment has flexibilities which cannot be matched by traditional methods. Assessment could take several hours and be made through the process of learning and show all ups and downs in students' abilities and skillfulness.

J: Games, Puzzles, Riddles

Even if we insist to show students application of mathematics to sciences and everyday life, it still looks dry to students. Games, Puzzles and Riddles helps educators to make the process of learning smooth for all students. But not all games, puzzles and riddles are educational and it is not the case that for all concepts and skills, appropriate games and puzzles are designed to help students to understand the material. It is the goal of IMEREM that overtime, with the help of experts in mathematical games and joining the forces worldwide, expand the educational scope of games and puzzles and riddles in a way that around all concepts of elementary mathematics at least a few appropriate educational games are designed to serve the purpose of educating students mathematically and helping students enjoy the process of learning.

K: Our Mathematics Journals

IMEREM in supposed to create a pool of papers written by high school students, undergraduate students and mathematics teachers. These papers are organized in three journals serving the purpose. But there is a difference between this concept of journal and the well-known one. In this journal, papers are organized not according to their date of being written, but according to the subjects. AMS subject classification is by no means detailed enough to serve our purpose. This is why we have the idea of doing the same classification for all papers written in existing

mathematics journals up to now which will be a new asset to the mathematical community. This classification also serves the purpose of our recommender system which we will described afterwards. This way we can suggest papers of journals to readers whom we know their interests and background.

L: Selected Expository Papers from Mathematics Journals

There already exist a number of expository mathematics journals and a large sum of expository papers written in the levels of elementary and undergraduate mathematics. In order to collect the papers and recommend them to students, we need to make a pool and select appropriate tags to them from our atlases of concepts and skills. IMEREM needs to buy access to these papers so that there is no copyright issue on availability of this material to all students interested in learning mathematics. Collecting the available papers in mathematical journals will also guide us in leading students and teachers how to complete this collection by papers they present to our own IMEREM journals. In fact, we will give suggestions to students and teachers in which titles related to their interest, we need new material to complete our collection and we provide them with relevant references.

M: Recommender Systems

This is the main feature of our platform, to provide appropriate tags for educational material including texts, videos, apps, software and other forms, and then recommend them to students and teachers according to their learning needs. Machine learning will help us to provide the relevant material in a way an educated and experiences teacher or mentor would. This will help in time to replace the human role of teaching mathematics with artificial intelligence techniques, which we call artificial intelligent teaching. This is the main reason why IREMEM can make new contributions to mathematics education and has new things to say in the crowded world of online learning.