

A Survey of Math Doctors

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Abstract

A number of Math Doctors who participate in the “Ask Dr. Math” service provided by the Math Forum volunteered to advise on the planned development of software tools that could be used to improve their ability to interact with their “patients,” and provide for better understanding of math. To this end a group of Math Doctors reported on several aspects of their working environments and their general needs while engaged in their math tutoring activities.

A Survey of Math Doctors

Introduction – About the Math Forum and *Ask Dr. Math*

The Math Forum is an interactive digital library that consists of over a million and a half pages. As such, it is both, a content site with extensive archives and links to information, and an interactive site that promotes information exchange, discussion, and community building.

The site includes several interactive services: Ask Dr. Math, with its archive of previously answered questions; Problems of the Week (PoW), with its non-routine challenge problems that are archived along with explanations and answers to the problems; and Teacher2Teacher, a question and answer discussion forum that is also archived. In addition, the site includes lessons, projects, games, discussions, an Internet archive, and a weekly newsletter.

Math Forum participants include a mix of teachers, students, parents, software developers, mathematicians, math educators, scientists, engineers, professionals, tradesmen (for example roofers or pipe-fitters), and so forth, many of whom also volunteer their time as mentors for the site. These participants differ in their experience with mathematics, their level of expertise, and their interests within mathematics.

From the Ask Dr. Math service participants receive advice about how to approach the questions they pose. The goals of the service include helping participants who ask questions to think about underlying mathematical concepts, how to rephrase questions in ways that makes the solution easier to find, how to locate resources that might be helpful, and so on. Ask Dr. Math is not designed to be a homework help service. As a general rule, participants do not receive answers to questions. If a participant asks, "How can I solve this problem?" the mentor is likely to respond by providing information and insight (which might take the form of rephrasing or simplifying the problem statement) that the participant would need in order to solve the problem (and others like it) on his own.

Students and teachers of all levels come to Dr. Math in order to ask questions, solve problems, and pursue interests in mathematics. Ask Dr. Math receives as many as 9,000 questions a month. Close to 4000 of these are answered directly within a few hours of submission by volunteer "Math Doctors." More than 10,000 of these exchanges have been published in a public archive. Another 400,000 questions and 120,000 answers have been stored for research and future use. Currently the Math Forum receives about 1.7 million visits a month, and approximately 450,000 of those include the Dr. Math area.

Ask Dr. Math receives about 300 questions a day despite a submission process that is intended to help participants to find answers to their own questions instead

of submitting them to the service. One full time and two part-time staff members provide infrastructure support for the volunteers: editing responses for the archives, maintaining the office scripts, training new mentors, facilitating discussions between mentors, and between mentors and participants. They also respond to participant questions. Of the more than 400 registered volunteer mentors, between 30 and 50 will actively respond to participant questions in any given month.

Ask Dr. Math is a vital service and a unique digital library program combining mathematics content development with mentoring and community building. Facilitating mathematical communication should significantly increase the productivity of the Math Doctors, allowing them to answer more questions, and increase the impact of their answers. The large number of stored questions and answers, along with the large volume of continuing user traffic and activity offers many resources for understanding and evaluating the effectiveness of Ask Dr. Math tools. From [Renninger 2003]

The Survey of Math Doctors

In 2003, researchers at Drexel University received funding from the National Science Foundation ITR program for a project, “Tools for communication in mathematics education,” that proposed to build software tools to facilitate the work of the Math Doctors. In order to help understand the constraints that need to be imposed on design of the appropriate features and delivery of such software, a survey was made of a set of Math Doctors who had volunteered to consult on their needs and working environments. The results of the survey are presented in the following sections.

Since Math Doctors are located in several widespread geographical locations, twenty-one Math Doctors who had volunteered to consult and advise on their software development needs were “interviewed” based on their willingness to participate and the Math Forum’s judgment that they were regular participants in the Math Doctor activity. After extensive deliberation it was decided to conduct the “interviews” with the Math Doctors through development of an online questionnaire that a Math Doctor could fill out at his or her convenience. The questionnaire focused expressly on a Math Doctor’s working conditions in order to get a sense of the environment in which these consultants do their work. The questionnaire was administered in the month of Nov, 2003, and the results collected via a web site dedicated to collection of the answers. This first round of consultation with Math Doctors is essential in understanding the “typical” working environment and which tools might and might not be worth developing.

Survey results – questions with free form responses

What kinds of hardware/OS the Doctors use:

Mac OS X or higher (2)
Mac (older) (2)
Windows 98 (1)
Windows ME (2)
Windows 2000 (1)
Windows XP (1)
Windows other unspecified (12)

A list of the kinds of software the Doctors use for their work

Web browsers

IE (several); Safari (Mac); Opera; Mozilla/Galeon; Camino

Math Tools:

Matlab
custom-programmed C, C++, Scheme
Sketchpad (Geometer's)
Mathematica (2)
“Dr. Scheme” (for calculations)
Adobe Illustrator
Wolfram Integrator web site
Isoptikon (for drawing)
Maxima (Macsyma)
Excel
Win32Forth
MathCAD
PariGP
Maple
Photoshop

What people think about the present set up for Dr. Math

- a) Satisfied (2)
- b) Want a way of using more than one canned answer or FAQ to reply – present software just replaces first by second. [This has been implemented.]
- c) Want non-admins to be able to kill 100 duplicate message, spam, and other clearly junky inputs. As opposed to mail by cranks which at least has math content.
- d) Frustrated by lack of standard for math notation in text. (5)
- e) Wants a form letter menu [This already exists, and indicates that the math doctors aren't always aware of all the functions provided by the office.]

- f) Wants to be able to move a thread into “trash area” so that everyone else won’t have to look at it. [Currently these can be flagged for removal by administrators.]
- g) Ability to send and receive graphics (geometric figures) more easily (8)
- h) Want to save partially written answers. With an expiration date.
- i) Slow text box in composed answers in Camino. [This isn’t really something that we can control.]
- j) No filter for truly stupid questions.
- k) the typeface in the answer space is too small, for example, its design makes it difficult to distinguish f, f', and f'' [This is something that can be configured within the browser, so it’s not something under our control.]
- l) the copying algorithm is very, very touchy, sometimes I copy one thing and end up deleting the main message [Again, not under our control.]
- m) Improved search: (3) “The search engine used to sort through the archives seems slow and klunky to me. Very rarely does it turn up something useful for me.”
- n) If I answer a question and then find that another Math Doctor has also answered, I’m a bit put off. (2 – want to see that someone else has already answered the question, or has an answer in process.) [This has been implemented.]
- o) Tools not that user-friendly (but they are free). [Which tools?]
- p) Want a symbolic algebra package available.
- q) Feels that some questions wouldn’t have been asked if the user was more motivated to search the Dr. Math archives first.
- r) Uses IE for most composition – complained about inconsistency across machines -- it worked differently at home and in the office but now that son has reinstalled Win98 at home it is more consistently across locations.

What people like about the Dr. Math site:

- a) FAQ (4): specifically noted – Ward’s formulas for areas and volumes, history references, Eric’s treasure trove, Euclide
- b) triage (4)
- c) ability to send memos to other doctors (3)
- d) archives/search (5)
- e) quick response templates (3)
- f) universality of text interface
- g) Ease of use of answering system – one click/compose/send (2), quick cite of FAQ or previous answer
- h) Knowing the age of the person asking the question (for composing an appropriate answer)
- i) “Everything”

How do the MathDoctors answer a question:

Almost all of them gave a variation of “I try to do it in a way to get them to understand math better”. For kids with homework problems, rarely do they give the answer directly, rather they give the method and get them to try to work it out themselves.

What other sources of information besides the Math Forum do the Math Doctors look to?

Mathworld web site (<http://mathworld.wolfram.com/>), sometimes also known as Eric Weisstein’s World of Mathematics (9)
Personal collection math textbooks at hand – no particular titles given (8)
Google (4)
The MacTutor web site(2)
Dictionaries
Apple Calculator
My own calculator
”I talked to Dr. Roy a lot”
Other mathematicians
How Many? web site¹
wolfram.com
Convertit.com
John Conway’s World of Numbers
Hofstadter Godel Escher Bach
TEOMA search engine (?)
CRC Concise Encyclopedia of Mathematics [This is the printed version of the MathWorld site.]

What the Math Doctors use paper for

For calculations (“usually faster than a computer program”)
For calculations that he/she hasn’t quite gotten yet (otherwise use Maple or a calculator)
For checking calculations (not accustomed to working long formula answers on a computer)
Simple algebra, drawing geometrical figures (difficult to draw on a computer)
Scratchwork (almost nothing – usually just type math into the computer)
Can do algebra faster on paper than typing things out.
Scratchwork (10% of the time) – quick diagrams, notes, ideas
For math (for answers that can’t be done in head) – does almost all math on paper.

Survey results – multiple choice answers

1. Where do you answer Dr. Math questions? Of the time that you spend working as a math doctor, what percentage do you spend in each of the following types of places?

Averages (all times for all doctors)

In an office	In a public place	At home	other
24%	3%	73%	1%

11	1	0	4
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“Other” responses: by instinct (1), if person is 18 or over (1), “a mix” (1), “whether or not I think I can give a good answer” (1).

7. Are there questions that you avoid because of the difficulty of composing an answer? If so, please give examples of such questions.

11/16 said “yes” there are such questions. The others said “no” or did not give a response.

Examples: open-ended or ill-posed questions or questions with lengthy explanations such as “how do I do fractions” or “explain how to do synthetic division” (6), questions of philosophy (1), questions from very confused people (2), long logic questions (1), questions where I find it difficult to translate from my point of view to the point of view of a much younger less knowledgeable person (1), “questions whose answers involve trying to align something like a system of equations make me uneasy” (1), questions not explicitly stated (1), questions from very unknowledgeable people (requiring a long explanation) (1), questions from very young students (because the doctor feels that there are others who are better at composing answers to youngsters),

Conclusions

Not surprisingly the majority of the Math Doctors work on Windows machines and tend to have access to a wide variety of software which is used to assist them. In addition they were able to offer a set of useful suggestions for general improvement of the “Ask Doctor Math” procedures and web site facilities. Even though the Math Doctors tend to work predominantly with Windows machines, the single most striking thing that stands out in what the Math Doctors who are consulting with this project have told us about their working environments (e.g., hardware and software) is the diversity of those environments. Clearly any tools shaped to assist them must be web based and compatible with the full range of web browsers currently available.

A second finding in the “interviews” with the Math Doctors is not particularly surprising since Math Doctors are pre-selected for certain characteristics, but is particularly important from a pedagogical perspective. Each of them reports taking quite seriously the goal of working with their “patient” to help improve understanding of math. Their goal is not to simply provide answers but also to develop the “patient’s” understanding of math.

The Math Doctors clearly seem to have specialty topics on which they like to work. They tend to report selecting questions by topic and avoiding questions on other topics. They also tend to avoid questions which are ill formed or which do not seem to be worth investing their time. Usually this is based on a judgment that the person asking the question hasn’t provided a question that can be dealt with a reasonable amount of effort. There is clearly a threshold of tolerance for how well-formed a question must be before they are willing to spend time on it. Many Math Doctors are eclectic in the use of auxiliary materials that they refer to in developing their replies to the questions with

which they deal. It is also possible to see in their reported use of paper that their computer-based working environments do not support certain critical aspects of their work.

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References

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