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Looking for help on the Internet: An exploratory study of mathematical help-seeking practices among Mexican engineering students

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We report an exploratory study focused on identifying some of the Internet resources used by Mexican engineering students when they need help for their mathematics studies. The study consisted of an initial phase in which a questionnaire was designed and piloted, and a second phase in which such questionnaire was used to conduct individual and group interviews. The results show that looking for mathematical help on the Internet is a widespread practice among students and it is even preferred over traditional sources of help such as the library. Among the most widely used resources are YouTube and Facebook. These and other sites are used to find different ways to solve a problem, to clarify doubts and reinforce knowledge, to get ready-made results, to compare results, and when they skip class and need to catch up.

Keywords: Mathematical help-seeking, Internet resources, social networks.

INTRODUCTION

The phenomenon of help-seeking has captured the interest of sociologists and social psychologists for decades. Generally speaking, these studies have focused on identifying and explaining what demographic, sociocultural, and psychological factors encourage people to seek the help of others. These studies have been conducted mainly in medical, work-related, welfare and social security contexts (see, for example, Cornally & McCarthy, 2011). Early conceptualizations of the concept of help-seeking favoured a perception of it as an undesirable activity, that is, some researchers began to interpret help-seeking as an indicator of lack of independence, which can have high costs for individuals' self-esteem and sense of competitiveness

(e.g., Shapiro, 1978). The reconceptualization of the concept of help-seeking provided by Nelson-Le Gall (1985) contributed to assign a positive meaning to the concept in the field of educational research; this in the sense that seeking help can be seen as a useful skill or competence for students to address problems that otherwise would be difficult to address. Help-seeking can be seen as a useful skill for students' self-learning.

Looking for help (or help-seeking) refers to the process of trying to find support from the people and resources around us, when we have questions or need help related to our mathematics lessons. Looking for help is a basic process when studying mathematics, however, the studies addressing help-seeking practices in mathematics instruction are still scarce. Some of these studies have focused on identifying affective elements that motivate students to seek help or avoid it (Ryan & Pintrich, 1999), while other studies have characterized seeking behaviours displayed by mathematics students (Kempler & Linnenbrink, 2006), there are also studies investigating mathematics teachers' knowledge of students' help seeking behaviors when they solve mathematical word problems (Marais, Van der Westhuizen, & Tillema, 2013). A common feature of these studies is that the only considered sources of help are people – teachers, classmates – but technological resources are not considered as potential sources of mathematical help.

Contemporary students' help-seeking practices, however, are changing due to the pervasiveness of the Internet and mobile electronic devices; for instance, there are studies showing that mathematics students from different regions of the world use open online forums to find mathematical help (Puustinen, Volckaert-Legrier, Coquin, & Bernicot, 2009; van de Sande, 2011).

Both studies, by analysing students' exchanges and posts, focus on characterizing the help seeking behaviours that mathematics students manifest when they look for help in open online discussion forums. There is a need for more studies showing what other technological tools mathematics students use nowadays as sources of help and how they use them.

In this paper, we report an exploratory study focused on identifying the Internet sites and web-based tools that some Mexican engineering students use as a source of help for their mathematics lessons. In particular we explore three aspects of their Internet-based help-seeking practices:

- 1) What sites or tools do they consult when they need help in mathematics and how often do they use them?
- 2) What are the reasons that lead them to use those sites?
- 3) What are the reasons why students trust in the information provided by such websites?

The motivation for this study comes from trying to understand how Internet resources are affecting the study processes of contemporary mathematics students: how and why today's students use the Internet to support their mathematical studies? Our study is relevant to the area of research focused on students' learning of mathematics with resources and technology as it helps to expand our understanding about how students independently use the Internet (web-based tools, social networks) as a source of help for their mathematical studies.

CONCEPTUAL FRAMEWORK

As we mentioned before, help-seeking in mathematics education is usually conceptualized as the ability of a student to rely on people – teachers, classmates, relatives – to get help that could be useful to overcome the difficulties that arise when learning mathematics. Karabenick and Puustinen (2013) confirm this when they point out how educational research on help-seeking has focused primarily on interactions in the classroom where students ask for help to the teacher or their classmates. These authors raise the need to expand this area of research in order to un-

derstand how new technologies are affecting students' help-seeking practices.

Following the line of thought of Karabenick and Puustinen (2013), in this work we adopted a wider definition of help-seeking in mathematics that includes non-human elements as possible sources of help; thus, in this study, mathematical help-seeking is defined as the ability to use the people and resources around us (including technological resources such as the Internet and mobile devices) as sources of help to overcome the difficulties and doubts that arise during our mathematics learning process.

CONTEXT

The study was conducted at the Institute of Engineering and Technology of the Autonomous University of Ciudad Juarez (UACJ) of Mexico. The Institute is a public institution of higher education that is located in the city of Ciudad Juarez, on Mexico's northern border, south of the city of El Paso, Texas, in the U.S. The Institute has an approximated population of 4,500 students from this area and with socioeconomic backgrounds ranging from medium to low.

One reason for selecting this institution for developing our study was our interest in exploring the Internet-based help-seeking practices among tertiary students. An additional reason for selecting the UACJ was that the first author of this paper works as a teacher at the institution, so this gave us access to both the students and the university facilities to conduct the study.

STUDY POPULATION

Undergraduate students who met two conditions were selected for the study: first, they were taking at least one course in mathematics at the time of the study; and second, they wanted to participate in the study voluntarily. The study involved a total of 21 engineering students of both sexes, distributed into two phases: an initial-exploratory phase and the second phase of the study. More details on the structure of these phases are found in the section "procedure".

All the participants in the study were students from different engineering specialties at the UACJ. We selected students from different engineering specialties because all of them were taking several mathematics

courses (calculus, differential equations, linear algebra) as part of their engineering education. At the time of the study their ages varied between 19 and 38 years.

In the initial-exploratory phase four students from three different careers participated: industrial engineering, digital systems engineering, and electrical engineering. At the time they participated in the study, two of the students were enrolled in their first semester, one of them was in the third semester, and the last one was studying the fourth semester (engineering studies at the UACJ last eight semesters).

The second phase of the study involved the participation of 17 students from five different engineering specialties: civil, electrical, biomedical, industrial and mechatronics. For this stage we only selected students from intermediate and advanced semesters (from fourth to eighth semester).

PROCEDURE

As mentioned above, the study was divided into two phases. The study began with an initial-exploratory phase in which a questionnaire of seven open-ended questions was used to guide semi-structured interviews; these interviews were conducted between November the 19th and November the 26th, 2012. The aim of this phase was twofold: on the one hand we sought to confirm the hypothesis that some university students use the Internet when they need help or have doubts related to their mathematics lessons; on the other hand we wanted to assess how well the designed questionnaire worked to generate empirical data, this is, to assess whether the wording of the questions was understood by the students or whether the questionnaire produced the type of information needed to answer the questions raised. Examples of the questions included in the initial version of the questionnaire used in this phase were: have you ever used a website to look for help for your mathematics lessons?, if yes, how often do you use these sites?, in your opinion, what Internet sites or tools are trustworthy to look for help in mathematics and what makes them reliable?

This initial phase allowed us to refine the guiding questionnaire to conduct interviews during the second phase of the study. The questions that constituted the final version of the questionnaire are:

- 1) Have you ever used a website to find help for your mathematics lessons?
- 2) If yes, what are the websites that you have used for your mathematics lessons?
- 3) How often do you use these sites?
- 4) How do you use these sites for your mathematics studies?
- 5) Mention the benefits of using Internet sites as a source of help for your mathematical studies at the university
- 6) Mention the drawbacks of using Internet sites as a source of help for your mathematical studies at the university
- 7) In your opinion, what Internet site or tool is more reliable and what makes it reliable?

This final version of the questionnaire was used during the second phase of the study to interview 17 engineering students from the UACJ. Five of them were interviewed individually, while the remaining 12 were interviewed through two focus groups of six members each. The second phase of the study was developed on three different days: February the 13th, March the 12th, and June the 26th, 2013. The answers given by these 17 students are the main empirical data on which the results of our study are based. All the interviews, both from the initial-exploratory phase and the second phase, were audio recorded for later analysis and transcription.

To analyse the empirical data consisting of individual and group interviews, it was necessary to repeatedly listen to the audio recordings in order to locate the answers to each of the survey questions, and thus try to make a categorization of the answers. During this process it was evident that some students' responses had common elements, which effectively allowed us to produce a categorization of the data. These results are shown in the following section.

RESULTS

This part of the report refers only to the interviews conducted with the 17 students who participated in the second phase of the study, and is divided into

four sections: in the first section, the frequency with which students use Internet sites as a source of mathematical help is presented. In the second section we show the most popular sites among the engineering students who participated in the study. Then the students' perceptions of the benefits and limitations of using websites as a source of mathematical help will be described, and finally the reasons given by the students to trust (or mistrust) an Internet site or tool as a source of help are presented.

Frequency of use of websites

All the 17 respondents reported using at least one website as a source of help for their mathematics lessons. Most students are frequent users since 12 out of 17 respondents reported using these sites on a daily basis, while the remaining five students declared that they use these resources during the weekend.

Popular Internet sites and their functionality

Figure 1 shows the websites and tools most frequently mentioned as a source of mathematical help by the engineering students who participated in the study.

The website most mentioned by the students was YouTube. 12 out of the 17 respondents agree that this is the site they turn to when they need to revise and fully understand the topics covered in class.

Facebook is the second most mentioned site, 11 out of 17 students declared to have used it for their mathematics lessons. They claim that Facebook is a tool through which they can contact their classmates or the teacher to clarify questions about the homework or even logistic concerns (like finding out in which room a lesson will be taught). For example, the student number 2 from the focus group number 1 mentioned

the following (all the presented excerpts were translated from Spanish to English):

Student 2, focus group 1:

[...] I use Facebook with my classmates when I have doubts about what was explained in class, because sometimes when I come home I do not remember what I saw.

The next most mentioned site is Google with six mentions. This is the place where some students start their searches of the topics they want to investigate. Most users do specialised searches in Google Books and Google Scholar to delimit the sites or documents where they want to focus their search.

Other websites such as Wikipedia, buenastareas.com, Yahoo! Answers and Slide Share, and Internet tools such as the email, and the online calculator Wolfram Mathematica, were also mentioned because of the different features they offer, like ready-made answers to their mathematical problems:

Student 2, focus group 2:

[...] I use Wolfram Mathematica to get the results, but sometimes it is not very reliable because omits a few steps [...]

Student 4, individual interview:

[...] Sometimes you are given a problem and the answers are already uploaded ... I would use Yahoo! Answers when I am struggling and I feel like oh no [...].

In the category "Others" shown in Figure 1 are included tools such as Skype, and websites like Profesores Universia (<http://profesores.universia.es>), Vitutor (<http://www.vitutor.com>) among others. These sites

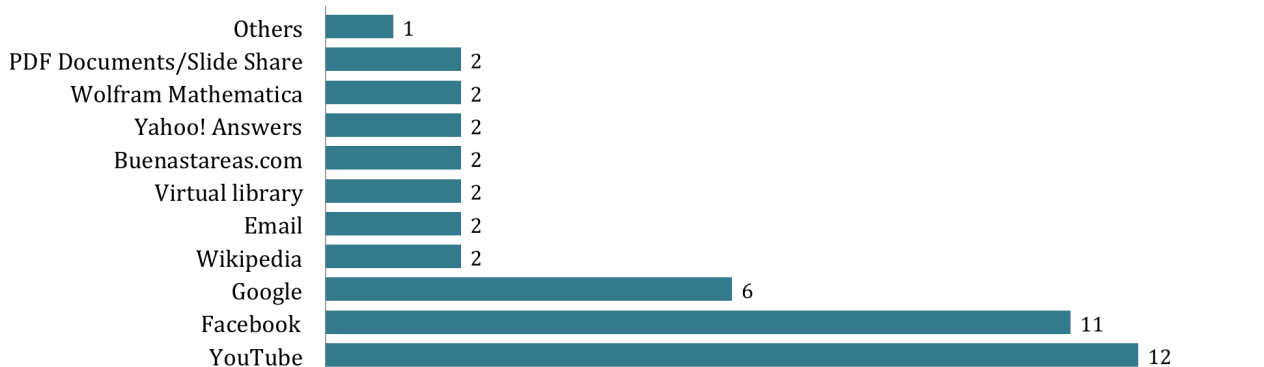


Table 1: Internet sites and tools most mentioned as a source of mathematical help-seeking among the students who participated in this study

are used to find alternate solving methods, comparing results, and finding step-by-step solutions:

Student 1, individual interview:

[...] There is one called Web Profesores (Teachers Web) which is a site where teachers upload documents or teaching techniques [...] they are written documents [...] once I put a formula that needed on Google and so I got to this page, and there is another one that it is the same... Profesores Universia.

Student 5, focus group 2:

[...] There is a page called vitutor.com, there are many exercises of many subjects... solved mathematics problems and others to be solved [...] they give you everything step-by-step.

In sum we can say that most of the sites and tools that students turn to are used to: (1) find different ways to solve a mathematical problem, (2) clarify doubts and reinforce knowledge, (3) get ready-made results or mathematical problems solved, (4) compare results, and (5) when they skip a class and need to catch up.

Benefits and limitations as perceived by the students

Students' perceived benefits in using the Internet as a source of mathematical help are diverse. Some students highlight the geographical and temporal unlimited access, making them prefer the Internet over more traditional sources of help:

Student 5, individual interview:

I think I save... for example, if I go to the library I have to drive... [by using the Internet] I save time and money.

Some students perceive the Internet as a source of help to clarify doubts that is infallible, as stated by this student:

Student 3, focus group 2:

The benefit that I find is that anything that I look for, I will find it; I get thousands of pages and I will always find something, I will never be in doubt.

Furthermore, we identified four limitations that the interviewed students expressed, these are: (1) restricted access to the sources due to copyright and/or language, (2) lack of reliability of the sources, (3)

the Internet can function as a distractor, and (4) there is too much information on the web. To illustrate these limitations, next we present a few excerpts from the interviews:

Student 6, focus group 2:

The problem is that unless you know what you are looking for, you get very vague answers, there is ambiguous information and copyrights are regulated on the Internet, if you want to read a book you can only see part of it [...] the useful material is restricted.

Student 5, focus group 2:

It happened to me once while I was studying for an exam, there was a topic that I knew nothing about [...] I found a method that had nothing to do, it was not what I needed [...] at times you put something in and you get like thousand things that are not what you are looking for.

Reasons to trust the information contained on a website

Several students who participated in this study based the reliability of the Internet sources that they consult on the authority provided by the academic degree of the author or the prestige of the institution that produces the resource:

Student 3, focus group 1:

YouTube seems reliable to me because university teachers upload the videos.

Student 5, individual interview:

SlideShare... I think is more reliable because there the doctors send [slides presentations].

Student 1, individual interview:

[...] Profesores Universia because it is supported by several Latin American universities.

Student 3, focus group 1:

For example in YouTube, well there the videos are from university teachers and themselves make the videos to clarify doubts, for me it is very reliable because they are university teachers and I think they even receive an economic benefit by making the videos [...]

DISCUSSION

In this exploratory study we investigated the Internet-based help-seeking practices among some Mexican engineering students. As other studies indicate (e.g. van de Sande, 2011), we found that the search for mathematical help on the Internet is widespread (12 out of 17 respondents reported using these sites for this purposes on a daily basis). According to the participants in our study, the most commonly used sites are: (1) YouTube, where students can find video recorded lessons to review and deepen the mathematical content covered in class; and (2) Facebook, where they can contact their peers or their teacher to clarify conceptual and logistic doubts related to their mathematical lessons. However, students also report using sites like Yahoo! Answers where they can find ready-made answers to their mathematical tasks.

The students who participated in the study look for mathematical help on the Internet to find different ways to solve a mathematical problem, to clarify doubts and reinforce knowledge, to get ready-made results or mathematical problems solved step-by-step, to compare the results that they obtain, and when they skip class and need to catch up. However, when it comes to assessing the reliability of the information they get from these sites, students seem not to pay attention to the intrinsic mathematical properties of the information obtained (Lithner, 2003), but rather base their assessment on features not related to mathematics, such as the academic prestige of the person or institution that publishes information.

The exploratory nature of this study allows us to see only the surface of a widespread practice that is affecting the way that contemporary students are studying mathematics. Next we outline future avenues of research that could be deepened in order to better understand this phenomenon.

Future avenues of research

One limitation of our study is that it is based on self-report measures of technology use, which may be less accurate than the observations of actual behaviours (Junco, 2014). A future avenue of research could focus on using more direct methods of observation as proposed by Junco (2014) in which recording software is used to document and characterize help-seeking behaviours manifested by mathematics students in

different kinds of devices such as computers, tablets and mobile phones.

Another limitation of our study is that it does not deepen into how each site or web tool are used as a source of mathematical help. It is necessary to produce detailed characterizations of how students use tools like Facebook and YouTube to find mathematical help. Also, one could delve into the selection and exclusion criteria applied by students when selecting a particular piece of mathematical information from the sea of information offered by the Internet.

Another relevant line of research would be to include the perspective of mathematics teachers about these practices of mathematical help-seeking: what do they think about these student's practices? Do they consider it a desirable practice? Do they integrate these sources of help into the mathematical instruction that they provide to their students?

We believe that mathematical help-seeking on the Internet is an emergent area of research that is not only fertile but also relevant to study because it is a widespread practice that affects the way in which contemporary students approach school mathematics.

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