

FROM SOCIAL COMMUNICATION TO MATHEMATICAL DISCOURSE IN SOCIAL NETWORKING: THE CASE OF FACEBOOK

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Abstract

Though some studies describe attempts to integrate Facebook in education, little is known about using it in mathematics education. This paper describes an attempt to populate Facebook with mathematicians from the past as well as strategies to involve friends with the mathematics of the mathematicians. The experiment shows that Facebook can attract friends to content knowledge, beginning with social talk, and transitioning gradually and smoothly to mathematics content knowledge through cultural discourse. The experiment implies that Facebook, representing social networks not intended from the beginning for education, can be adopted successfully for mathematics education.

Introduction

Web 2.0 tools have been suggested for some years now for social life, communication, and work in various disciplines, especially in education (Alexander, 2006; Glogoff, 2005; Pempek, Yevdokiya, & Calvert, 2009). Some of these tools are the wiki, the blog, Facebook, Twitter, Second Life, and Wiggio. Among those who suggest these are tools for education are researchers in various international conferences. For example, Gorg Mallia, Henk Eijkman, and Asher Rospigliosi at the International Conference on Information Communication Technologies in Education 2010 suggested these as tools for instruction, learning and student engagement. Being attendants at the conference, we were part of the discussions moderated by Gorg Mallia and Henk Eijkman in two workshops about the possibilities that the Web 2.0 social networks and tools, especially Facebook, can afford to education. There our idea to use Facebook in mathematics education began.

Research Background

School students use social networking sites to support their educational activities. The NSBA (2007) reports that nearly 60% of the respondents who use social networking sites discuss education-related topics online and more than 50% specifically discuss schoolwork. The popularity of the social networking sites and the beginning of their use as educational tools indicate that these sites have the potential to motivate students to engage more actively in their learning through utilizing the sites' various technical options. The most important of these options are the sites' communication tools (e.g., chat, e-mail, comments, and 'likes' in Facebook). These options and potentials meet the requirement of the National Science Teachers Association (2003) in the standards for science teacher preparation that science teachers should attempt to guide their students' learning by encouraging their conversations about scientific ideas. The communication tools of the social networking sites can help build learning environment rich with students' conversation and discussions, and thus fruitful for building the scientific knowledge of students. Schroeder and Greenbowe (2009) say that one goal of the NSTA requirement is to help students articulate how they know, what they know, and how their knowledge connects to larger ideas, other domains, and the world beyond the classroom. These ideas were behind our intention to experience social networking sites, in our case Facebook, in our pre-service teachers' preparation. We intended that our pre-service teachers enrich their knowledge about mathematics, historical mathematicians, and mathematical concepts and procedures through conversing and discussing these concepts and procedures and through solving mathematical problems. This intention agrees with Smith and Peterson (2007) who describe knowledge as constructed not in the individual vacuum but in the communication and exchanges enabled in social networks.

Recently researchers attempted to use the Facebook environment to enable collaborative learning (English & Duncan-Howell, 2008), as well as to treat content knowledge in different disciplines (Schroeder & Greenbowe, 2009; Selwyn, 2007). English and Duncan-Howell (2008) reported that pre-service teachers used Facebook during their teaching practicum placements to facilitate mutual support, encouragement, and the sharing of stories and anecdotes. Using Facebook enabled the pre-service teachers to direct their learning through creating, sharing, and commenting on others' contributions and by allowing them to choose from multiple forms of support. Further, the Facebook environment enabled collaboration as the pre-service teachers assisted each other, shared digital artefacts, and exchanged constructive feedback.

Schroeder and Greenbowe (2009) describe an experiment that involved using Facebook as an additional tool for their university students' learning. They point at the Facebook feature of enabling the upload of images to have an impact on their students' learning. Their students responded to comments, explanations, or observations with relevant diagrams, figures, or other graphics, while the instructors used the image uploading to draw chemical structures or step-by-step

reaction mechanisms, as well as to post spectral data that could be used to discuss questions posted earlier. Another Facebook feature used was the “Post Item” feature which was used mostly by instructors to post Internet links to relevant Web sites.

Selwyn (2007) analyzed the content of the Facebook pages of all undergraduate students who were studying at the School of Social Sciences in Coalsville University during the 2006/7 academic year. He found that when the education-related postings were analyzed, five main themes emerged from the data: 1.) recounting and reflecting on the university experience; 2.) exchange of practical information; 3.) exchange of academic information; 4.) displays of supplication and/or disengagement; and 5.) exchanges of humor and nonsense.

The previous initiatives that attempted to encourage collaborative learning and to treat elements of content knowledge in different subjects in the Facebook environment indicate that social networking environments can be fertile land in which students are motivated to engage actively in their learning. Specifically for mathematics education, these environments can make the students enjoy the learning of mathematics and thus help them change their negative perception of mathematics and raise their motivation. This would expectedly increase the students’ understanding of mathematical concepts and procedures and consequently might improve their achievement in mathematics.

Research Rationale and Goals

Gray, Annabell, and Kennedy (2010) conclude from their study of how effectively university students may be using Facebook to support their learning that using Facebook as part of learning and teaching is as much of a challenge for many students as it may be for most educators. This made us want to experiment, together with our pre-service teachers, in using Facebook for the teaching and learning of mathematics. This experiment, we hoped, would open our eyes and those of our pre-service teachers to the educational potentialities of social networking environments. Further it would make us and our pre-service teachers aware of useful methods and strategies for using these environments for their own needs and to implement them as teachers with their pupils. So, our main goal was to probe the potential of Facebook, as representative of social networking environments, to enable the learning of mathematical concepts and processes, the hosting of historical mathematicians, and the discussion of mathematical issues.

Research Questions

How can we move gradually from a social communication in Facebook to a more educational and content directed discourse? What actions are needed to make this move smooth and efficient?

Research Setting

We carried out, together with our pre-service teachers, three experiments using Facebook to involve the users in mathematics history, phenomena, and concepts. One pre-service teacher initiated a fan group for the poet and mathematician Omar Al-Khayyam. Another pre-service teacher created a page on the golden ratio, while a third pre-service teacher created a Facebook character of the great historical mathematician Mohammad Al-Khwarizmi. We directed and assisted the pre-service teachers to gradually move the communication with the friends from social talk to mathematical discourse that involves analysis of mathematical concepts and procedures.

In this paper we will describe only the experiment regarding the Facebook character of Al-Khwarizmi. This experiment lasted for three months and attracted 335 friends. We will describe the various actions which the pre-service teacher performed in the Al-Khwarizmi Facebook site. These actions are representative of the major actions performed in the other two sites, i.e., the Al-Khayyam group and the golden ratio page.

Findings

To analyze the data in the Al-Khwarizmi site we used grounded theory (Strauss & Corbin, 1990) to categorize in themes the actions and interactions carried out by the moderator and friends of the site. Afterwards we will describe the Facebook tools and options used by the pre-service teachers throughout the experiment.

Initiating the Character

The pre-service teacher started an account under the name “Mohammad Al-Khwarizmi” and provided basic information in the “info” section about Al-Khwarizmi: date of birth, gender, location of work, and fields of scientific activity. She also uploaded a picture of Al-Khwarizmi in the profile section.

The pre-service teacher moderated the page under the name of Al-Khwarizmi and began the communication by sending messages to her friends from her real account, including to the pre-service teachers in the practical training course inviting them to be friends with Al-Khwarizmi. As a result, many friends accepted the invitation and became Al-Khwarizmi’s friends. A special group of friends

were students at An-Najah National University who were required by their instructor (the second author of this paper) to friend with Al-Khwarizmi and participate in the interactions and activities occurring at the Facebook site.

Socializing with the Friends and Getting to Know the New Modern World

The Moderator played the role of Al-Khwarizmi and socialized with the friends: wished happy birthday for one of them; wondered about the language (Hebrew) of the name of another friend, a language he is not familiar with; and talked about ordinary daily activities. One of the friends wrote that he was going to give a lecture in economics for a group of women, and Al-Khwarizmi was amazed of the fact that modern women are interested in such advanced field as economics.

Moving to a Cultural Talk

Al-Khwarizmi, who was exposed to the culture of the friends through their social comments, inquired about the exact cultural characteristics of his successors. This led the friends and Al-Khwarizmi to argue about the present culture of Moslems and Arabs and to compare it to the culture at the Al-Khwarizmi era.

Connecting the Past with the Present

Al-Khwarizmi wrote a status to the friends that he is looking through the time tunnel to see his past in their present time wondering about the life style and progress of his successors. He also expressed his pride in their friendship.

The number of friends at this stage already exceeded 100 friends. As for Al-Khwarizmi's wish, some of the friends (4) checked "like" and 34 commented. Most of the comments were social, welcoming Al-Khwarizmi and expressing their will to get to know him. Some asked about his mathematics. Others asked about his emotions regarding his period, and few wondered about meeting a person like Al-Khwarizmi in such a modern environment as Facebook.

Connecting to the Home Town of Al-Khwarizmi

Al-Khwarizmi stated that he misses his home town Khwarizm (Khiva) and asked to see its picture in the present time. Four of the friends responded with "like" and 16 commented. Some comments were political ones, for some of the friends were refugees who also missed their home town and identified with Al-Khwarizmi. Others asked for more information about Al-Khwarizmi and expressed their meagre knowledge about his home town. One friend posted a link to a video about Khiva and hoped that Al-Khwarizmi would be happy to see it. This comment got 4 likes and 63 comments, where many were social expressing their feelings about the video, while other comments expressed pride in the Islamic empire in the period of Al-Khwarizmi and hoped that the glorious period would return. Some friends wrote information about the life of Al-Khwarizmi and his scientific contributions. Others inquired about his mathematical work, writings and books.

Some friends stated that they did not know how to find information about Khiva and some did not know how to upload a picture or a video to the Facebook. The friends helped each other overcome the obstacles, and as a result many pictures and links to sites about Khiva were uploaded to the site.

Connecting to Countries Visited by Al-Khwarizmi

The moderator posted a status about the cities and countries visited by Al-Khwarizmi and stated that Al-Khwarizmi expects that some of the friends might belong to his nation.

The friends responded with 3 likes and 6 comments. Some friends mentioned some countries that Al-Khwarizmi visited in his life. Others stated that they are proud for being his successors and belonging to the same nation. They related their pride to Al-Khwarizmi being a mathematical legend in the glorious past of the Islamic civilization. These comments were followed by other comments of the friends which led to exchange of information about the countries visited by Al-Khwarizmi, especially old and new names of the countries. One of the friends indicated that Al-Khwarizmi wrote a book about the countries he visited. The friend added that the book included also a map of Al-Khwarizmi trips and inquired what the friends know about this book.

Discussing Al-Khwarizmi's Contributions

Al-Khwarizmi asked the friends if they know about the books written by him. The friends uploaded pictures and links to videos and sites related to Al-Khwarizmi books and contributions. Other friends asked Al-Khwarizmi about his life, events in his period, books he wrote, fields of study and research, and problems he solved. The moderator answered some of the questions in the name of Al-Khwarizmi and directed the friends to related sites to search for answers to their questions.

Discussing Al-Khwarizmi's Opinion of a Good Woman

One of the friends wrote a comment about how Al-Khwarizmi perceived the qualities of a good woman. He wrote that Al-Khwarizmi gave the value of 1 for the ethics of the woman, then added a zero for her beauty to get 10, followed by other zero for her wealth to get 100 and additional zero for her origin and affinity to get 1000, but if the woman loses her ethics she loses the 1 and stays with the value of three zeros.

Congratulating the Friends on the Al-Adha (Sacrifice) Feast

The moderator posted a picture with congratulations to the friends on the occasion of Al-Adha feast, and made a "poke" to the friends. Five friends liked the picture, while 13 wrote comments. Most of the comments were social, congratulating Al-Khwarizmi on the feast.

Posting a Video about Al-Khwarizmi Method for Solving a Quadratic Equation

The moderator posted a video which she prepared with one Facebook friend using the program of MovieMaker. The video presented a conversation between two friends of Al-Khwarizmi about the method he used to solve a quadratic equation.

It is important to note that the Arabic language used in the video and in all the comments on the video (and in all the communication in the site for that matter) was the spoken language. This was done through using Arabic letters in general and sometimes English letters. The moderator intended to use this type of language to avoid stepping out of the routine social interaction used regularly between Arab friends in Facebook. Using classical language could have discouraged some friends from participating in the discourse as they would consider it too sophisticated for them.

Some of the friends liked the video (10) and others (27) wrote comments. Most of the comments were social and educational indicating that the video was a cool teaching idea, especially learning through conversation between the two girls and using a video to explain a mathematical problem and its solution. An argument also was initiated, following this activity, about using Facebook to expose pupils to mathematicians such as Al-Khwarizmi and mathematical concepts such as “equation.” Some wondered and even questioned if this is possible, and some encouraged this idea emphasizing the importance of using new modern technologies in the learning process. They claimed that this might add a lot of fun and joy to the learning environment and reminded the friends that this is actually the new regular daily environment of our kids (Facebook, SMS, cellular phone, etc.).

Asking Friends to Explain the Method of Al-Khwarizmi

The moderator posted a picture presenting Al-Khwarizmi with a text stating the same mathematical problem solved by him in the video. In the picture, Al-Khwarizmi asked the friends to explain his method for solving the quadratic equation using algebra and geometry.

Most of the comments in this stage were mathematical. Some friends attached to their comments pictures taken using a cellular phone of a handwritten geometrical explanation of Al-Khwarizmi method for solving a quadratic equation. Other friends used the same way to present an algebraic explanation of Al-Khwarizmi’s method. Some friends typed their work using a word processor, converted the document into a picture and attached it to their comments. Others prepared a presentation of their work, uploaded this presentation to a site, and posted a link to the presentation in Facebook. This was necessary because Facebook does not allow uploading a file to the site except for pictures and videos.

Asking the Friends to Find other Methods for Solving a Quadratic Equation

A week after posting the picture, the moderator posted a “note” that included a video presenting an explanation of the Al-Khwarizmi method and which was prepared by one of the friends. The moderator asked the friends in this stage to find other methods, especially modern ones, for solving quadratic equations.

The main mathematical part was done by the students of An-Najah National University, which implies that mathematical discourse will be more successful and efficient if it is done in the frame of a real class.

The Facebook Tools and Options Used by the Pre-service Teachers

The pre-service teacher and the friends used different tools and options which the Facebook environment enables: image uploading, video uploading, links uploading, Facebook applications, tagging to an album or image, sharing a friend’s video or image (using the via option), post uploading, comments, notes, pokes, and expressing likes. Table 1 describes the participants’ targets of this use.

Table 1: The Facebook Options Used and Targets behind the Use

Tool/ option	Target	Number of uses	
		Al-Khwarizmi: The pre-service teacher	The friends
Image uploading	Socializing; showing Al-Khwarizmi home town, statue, face, front cover of one of his books, interior pages of one of his books; showing a postage stamp related to Al-Khwarizmi; showing a solution of a mathematical equation as solved by Al-Khwarizmi and explanations on the solution method, and giving mathematical problems for the friends to solve	5	29
Video links	Describing Al-Khwarizmi home town or mathematical contributions	—	5
Video uploading	Describing mathematical topics in which the Al-Khwarizmi worked	1	—
Facebook applications	1 (The Truth application which enabled the friends to express their ideas about Al-Khwarizmi)	—	29
Tagged in album	Tagged to home town image, to an image of a book front cover, to a statue image, to an image of a mathematical text, to a video, to an image of social content.	1	12

Sharing	Sharing a friend's video, image or link	8	—
Text posts	Social talk, cultural talk and mathematical talk	10	65
Comments	Social talk, cultural talk and mathematical talk	98	206
Notes	Mathematical talk	1	—
Pokes	Social talk	1	—
Expressing likes	Social talk, cultural talk and mathematical talk	27	20

Discussion

Iiyoshi and Richardson (2008) say that “the personal, contextual, and accretive nature of knowledge of teaching and learning, with its complex interaction of people, tools, and resources, makes it difficult and time-consuming to capture and examine, either in verbal or other modes” (p. 339). We tried in this paper to capture and examine in written text the complex interactions occurring in Facebook and which involved the great mathematician Al-Khwarizmi and his mathematics. Looking at the interactions occurring during the experiment which attempted to catch history and mathematics in the Facebook, we found that three main interactions occurred: social, cultural, and mathematical. The cultural interactions were the steering component which moved the friends from the social into the mathematical, while the social was the glue which hooked the friends to Al-Khwarizmi and to his mathematics. The social interaction spread through the whole discourse and attracted the friends again and again to Al-Khwarizmi. This importance of the social talk is emphasized in other studies — for example, DeAnda (2007) found that developing a sense of comfort with group members was often perceived by the members as a precursor to progressing on mathematical work. Here, the social made the friends comfortable and ready for the transition to the cultural and afterwards to the mathematical. What made the friends feel comfortable with the transition from social issues to mathematical content knowledge was the smoothness of the transition through the cultural interests of the friends. To move from the cultural to the mathematical, the pre-service teacher shifted the focus of the conversation to the achievements of Al-Khwarizmi (especially his books), then she presented one of his main contributions — solving quadratic equations. Getting just admiration comments, the pre-service teacher posted a more mathematically oriented request for the friends to explain Al-Khwarizmi method and find other methods. This was a successful move which was followed by many comments, pictures and links to presentations that involved mathematical talk and work done by the friends.

Various actions were carried out to arrive at the mathematical content knowledge: socializing with the friends; connecting the past to the present; connecting to

places: the mathematician hometown and the countries visited by him; connecting to Al-Khwarizmi's contributions, etc. So, the transition to the mathematical was not all of a sudden, but through different actions most of which were not related to mathematics, but to social, historical, cultural, and real life. The ability of Facebook to attract the participants to learn content knowledge has been reported in the literature, but for other subject matter (Schroeder & Greenbowe, 2009; Selwyn, 2007).

Another strategy of the pre-service teacher which attracted and motivated the friends was connecting the ancient history of the friends to their present. This made the friends feel proud of Al-Khwarizmi and his contribution to mathematics and humanity, and thus motivated them to act and interact. This connecting to students' life and feeling is known to better the teaching and learning of mathematics (Lin, 2005).

Using the Facebook environment to represent a famous mathematician who relates to the friends motivated the friends and was an important reason for them to feel proud in identifying with the Facebook character and his mathematics. This implies that the choice of the great mathematician Al-Khwarizmi who lived in a glorious period relating to the history of the friends added nostalgia and pride to the friends' feelings which were present in their comments. The use of the life and contributions of a great mathematician was done through the various technological options available in Facebook. The friends mostly used the "comment" option — maybe because they were mostly engaged in commenting on Al-Khwarizmi and on each other. The high number of comments indicates that the friends' interactions prevailed in the historical mathematical Facebook environment. The second option mostly used by the friends was the text posts, where these posts enabled the friends to ask Al-Khwarizmi questions about his home town, cities that he visited, or his mathematics. The posts also enabled the friends to describe various issues associated with Al-Khwarizmi — for example his contributions to mathematics, his solution of mathematical equations, and his importance as mathematician.

The above discussion implies that Facebook can be used for mathematical study and discourse, but has the limitation that learners can not keep on learning mathematics without social and cultural talks. Therefore, the moderator whose goal is to keep the mathematical discourse as the objective should remember that persistence on this discourse might pull some of the friends out of the continuous study mode. To avoid that, the moderator should always integrate social and cultural talk into the mathematical one, so the friends might be interested further and motivated to keep engaged in mathematics learning.

Looking at Table 1, we see that the friends used the various options (except the "like" option) more than the Al-Khwarizmi, which implies that the pre-service teacher encouraged the friends to initiate actions and interactions. The friends' actions/interactions were performed by the friends due to the Facebook options

and tools. The friends used an option which Al-Khwarizmi did not use, that is the Truth application which enabled them to express their ideas about the great mathematician. This use points to Facebook as a rich environment that encourages the users to initiate actions not implied by a higher authority like the teacher.

Though the “like” option was an “easy to perform” option, the friends did not use it more than text posts, comments, image uploads, or the applications. This implies that the friends preferred to use options which enabled them to express themselves more clearly and comprehensively. So, we can conclude that the friends were deeply involved in Al-Khwarizmi’s life, contributions and mathematics.

The above arguments imply that successful actions to use Facebook as representing social networking sites are: connecting to the friends’ identity and lives, encouraging the friends to act and interact, sometimes requesting them explicitly to do so; using the different options of Facebook, especially text posts, comments and video link; beginning with the social and using it throughout the experiment to keep the harmony of the community; and moving to the cultural which relates to the mathematics. The gradual and smooth transition to the mathematical topics ensures the continuing involvement of the friends.

The friends of Al-Khwarizmi can be divided into two parts: 1.) actual friends who dwelled in Facebook before the experiment; and 2.) university students who were asked by their instructor to participate in the activities of the Al-Khwarizmi site. All of the friends were active at the social and cultural level, but most of the mathematical work was done by the university students. This implies that Facebook was useful for everyone in learning about mathematics and mathematicians but doing mathematics there may require a more formal frame in the process.

Conclusions

We here describe Facebook as a communicational educational tool which participants can use to articulate what they know about the history of mathematics, about mathematics, and about mathematical concepts like the solution of quadratic equations in our case. Various reasons met to make the experiment a successful one: choosing an important mathematician from the friends history; starting the Facebook site with social talk; transitioning to the mathematical discourse through cultural discourse; juggling between the social, the cultural, and the mathematical; connecting the past to the present; giving friends the opportunity and encouraging them to act and interact; and using the various option of the Facebook. This experiment implies that Facebook, representing social networks not originally intended for education, can be adopted for education in general and for mathematics education in particular.

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