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► To cite this version:

Yaniv Biton, Ruti Sege, Olga Fellus. Students' perceptions of learning mathematics in the WhatsApp environment through the "Bagroup" project. Twelfth Congress of the European Society for Research in Mathematics Education (CERME12), Feb 2022, Bozen-Bolzano, Italy. hal-03745590

HAL Id: hal-03745590

<https://hal.science/hal-03745590>

Submitted on 4 Aug 2022

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Students' perceptions of learning mathematics in the WhatsApp environment through the "Bagroup" project

Yaniv Biton¹, Ruti Sege^{1,2} and Olga Fellus³

¹Shannan Academic College of Education, Israel; YanivB@cet.ac.il

²Oranim Academic College of Education, Israel; rutisegal@gmail.com

³University of Ottawa, Canada; ofellus@uottawa.ca

This paper is part of a larger quantitative and qualitative study that focuses on how teachers and students perceive learning of mathematics via WhatsApp. The main objective of the program is to allow for both teacher-student and student-student contributions of knowledge and to boost students' sense of self-confidence and authorship in the discipline. The research participants of this study comprise 152 Grade 11 and Grade 12 students who responded to a questionnaire distributed during the 2018 program. We present a quantitative analysis of the factors that students perceive to be pertinent in the WhatsApp Bagroup learning environment.

Keywords: Social media, communication, WhatsApp in mathematics education.

Introduction

The fact that technological social platforms can be useful for the purpose of schooling and education is increasingly recognized and studied (Greenhow & Lewin, 2016). Online social networking platforms have become highly popular virtual meeting places for youth and adults (Boyd, 2010; 2014; Greenhow & Askari, 2017).

It is not surprising then that, recently, there has been an influx in research focusing on the pedagogical benefits of using social media as productive sites for promoting learning. Having said that, an examination of recent studies shows that focus has been put on post-secondary settings (e.g., Dyson et al., 2015) or teacher education (e.g., Sendurur et al., 2015). Research on the use of social media for subject-specific learning purposes, such as mathematics, among K-12 remains understudied. Given the prevalence of the use of social media in everyday life especially among teenagers, we conjecture that the use of these platforms can potentially increase student-teacher and student-student interactions. These interactions around mathematical ideas may allow almost instantaneous response and feedback from others and surface mathematical misconceptions and misperceptions that can be directly addressed in follow up posts (Biton & Segal, 2021; Freeman et al., 2016).

Literature review

Recent studies have explored the use of social media platforms such as Twitter (Carpenter & Krutka, 2014), Pinterest (Hertel & Wessman-Enzinger, 2017), and Facebook (Biton et al., 2015). These studies have suggested that interaction over social media contributes to socializing (Madge et al., 2009) and increased self-esteem and social capital (Steinfeld et al., 2008). Such affordances need to be further investigated within mathematics education. With respect to learning and instruction, Asterhan et al. (2013), and Asterhan and Bouton (2017) for example, discussed how social media can be used to develop innovative, collaborative forms of online learning that extend beyond the traditional classroom. Students perceive learning through social media to be very intensive and highly

collaborative in nature (Meishar-Tal et al., 2012). From the students' standpoint, social media platforms have been found to also allow for the manifestation of learners' emerging conceptual understanding in mathematics (Baya'a & Daher, 2013; Freiman, 2008).

Relatively little research focused on students' perspectives on learning mathematics through WhatsApp. A case in point is a recent study by Rosenberg and Asterhan (2018). The researchers looked into teacher-student interactions; students' evaluation of the efficacy of contact with their teachers; the social dynamics in these groups compared with that in in-person classrooms. It was found that teachers used WhatsApp not only to manage housekeeping-related matters but also for instructional and learning purposes that were initiated either by them or by students in the group. Some of the drawbacks identified revealed issues regarding information overload, social pressure due to the public nature of the communication, and accessibility to WhatsApp. Drawing on this research, it still remains to be surfaced how students perceive the use of WhatsApp as a means to learning school mathematics, which is where our research aims to contribute to knowledge.

Methods

The study presented herein is part of a larger research project that focuses on exploring how students and teachers perceive learning over a social network—specifically WhatsApp—and identifying learning opportunities to eventually inform pedagogical approaches and instructional strategies. This paper particularly aims at identifying and characterizing students' perceptions of the WhatsApp “Bagroup” program learning environment. We formulated five overarching research questions for our larger research study. In this paper, we focus on the following: What factors do students perceive to be important when learning in the WhatsApp “Bagroup” program environment?

The “Bagroup” initiative.

The “Bagroup” is a state-wide program that was set up for the Ministry of Education by the Center for Educational Technology. The purpose for this initiative was to offer the use of the WhatsApp application to high school students throughout the country and across grade levels in preparation for their mathematics matriculation exams (*Bagrut* in Hebrew). Approximately 4,000 high school students joined the mathematics WhatsApp groups 2018. (This was an increase of more than 100% with respect to the two preceding years, which had less than 2,000 registrants.) Forty groups were set up with 100 students in each. An experienced teacher of mathematics was assigned for each group. Group members are generally not acquainted with each other at the outset. Learning is divided into various topics each of which are studied over a set time period and led by a teacher. Once every few days, the teacher introduces a topic or answers questions raised by the students and uses various digital means. The lessons are accompanied by a repository of materials in the accompanying site that are available for use by the students. Learning in the group takes place in a variety of ways: text messages, voice messages, photos and video-clips, question repositories, presentations, and more.

The groups ran between two to four months up to the exam date during which hundreds of thousands of messages were sent that included mathematical content, questions, and explanations to solutions. The Bagroup project offers the following to its students: [1] Support: Students can get an (almost) immediate response from a teacher or another student from the group. [2] Equal access: Using the freely available WhatsApp technology made it possible for anyone to join at no cost. [3] Use of

mobile technology: Students' digital devices supplemented classroom instruction and extended learning to anywhere and anytime. [4] Capacity building: The program is aimed at enhancing understanding of mathematical concepts and, by extension, affective dispositions towards mathematics. [5] Variety: Students shared multiple approaches to solving mathematical problems.

The program was launched in 2015 on Facebook for mathematics only and then in 2016, was moved to the WhatsApp platform. The program saw a growth from 614 students in 2015 to 8,500 students in 2019 (unpublished figures). Also, the 2019 program added the subjects of English and Hebrew.

Participants and data collection

Participants comprised 152 students in Grades 11 and 12 who answered a questionnaire that was distributed to the students in the 2018 program. Nonprobability sampling was used based on participants' availability and willingness to reply to the questionnaire. The questionnaire was put together by the first and third author and revised for accuracy and consistency. The student questionnaire included nine open-ended questions and twelve Likert-type questions. The open-ended questions invited students to share a memorable experience or an episode they had in any of the WhatsApp interactions. They were also invited to share the most obvious advantages and disadvantages of using WhatsApp for the purpose of learning high school mathematics and to reflect on specific characteristics of WhatsApp that make the mathematical content accessible to the students. The open-ended questions also requested possible explanations regarding students who left the group. The other part of the questionnaire provided a 6-point Likert-type scale for 12 statements concerning the experience of learning mathematics via WhatsApp with 1 = Strongly Disagree and 6 = Strongly Agree.

Data analysis

Students' responses were analyzed and coded for themes by the first two authors through content analysis of the responses to the open-ended questions. A Varimax rotation analysis was used of the data, the goal being to detect how the WhatsApp learning environment was perceived by the students by demonstrating the items are inter-correlated for internal consistency.

In this paper, we present an analysis of the quantitative data gleaned from the students' questionnaires.

Findings

Analysis of the twelve Likert-type scales found high internal validity of three categories that explained more than half of the variance in the students' answers (58.06%). The three categories were the following: [1] Factors in the WhatsApp environment that support students' emotional needs. This category accounted for about a quarter of the variance among the students' answers (five statements). [2] Factors in the WhatsApp environment that promote learning. This category accounted for approximately another fifth of the variance of the students (four statements). [3] Factors that hinder learning in the WhatsApp environment. This category accounted for an additional 8% of the variance in students' answers (two statements).

Table 1 presents the mean scores and standard deviations of all the statements, divided into the three categories. The results indicate that students' perceptions about learning in the WhatsApp environment was varied.

Table 1: Means and standard deviations of the categories and statements regarding the students' experience learning mathematics via WhatsApp, N = 152

Statement	Mean	SD
Category 1: Contribution of the WhatsApp environment made to students' emotional needs	3.51	1.15
I manage to follow the lesson during the WhatsApp discourse	3.46	1.65
I managed to understand the material in the WhatsApp environment at the same level as in a regular class	3.84	1.30
WhatsApp allows participation without fear of making errors	3.73	1.68
The written discourse in WhatsApp is preferable over the verbal discourse in a regular class	2.80	1.53
Learning through WhatsApp allowed me to meet my specific needs as a learner more than in a regular classroom	3.72	1.61
Category 2: Factors that promote learning in the WhatsApp environment	3.81	1.13
Learning via WhatsApp allows me to learn from others more than in a regular class	3.99	1.61
The value of a lesson via WhatsApp is different from the value of a regular lesson	4.65	1.40
Learning via WhatsApp improved my mastery of available technologies for learning mathematics	3.27	1.68
I invest more time and effort in mathematics in the WhatsApp project compared to students in a regular class	3.04	1.68
In the future, WhatsApp will become an important tool for students for learning math	4.09	1.67
Category 3: Factors that hinder learning in the WhatsApp environment	3.09	1.29
There is some mathematical content that cannot be explained via WhatsApp	3.53	1.73
I can't manage to cooperate with other students the way I do in a regular class	2.66	1.47

To facilitate analysis, the levels of agreement were reduced to three: disagree, somewhat agree, and agree. Figure 1 graphically illustrates the percentage of students that agreed, somewhat agreed, or disagreed with each of the twelve statements.

In the first category Contribution of the WhatsApp environment to learners’ emotional needs, the

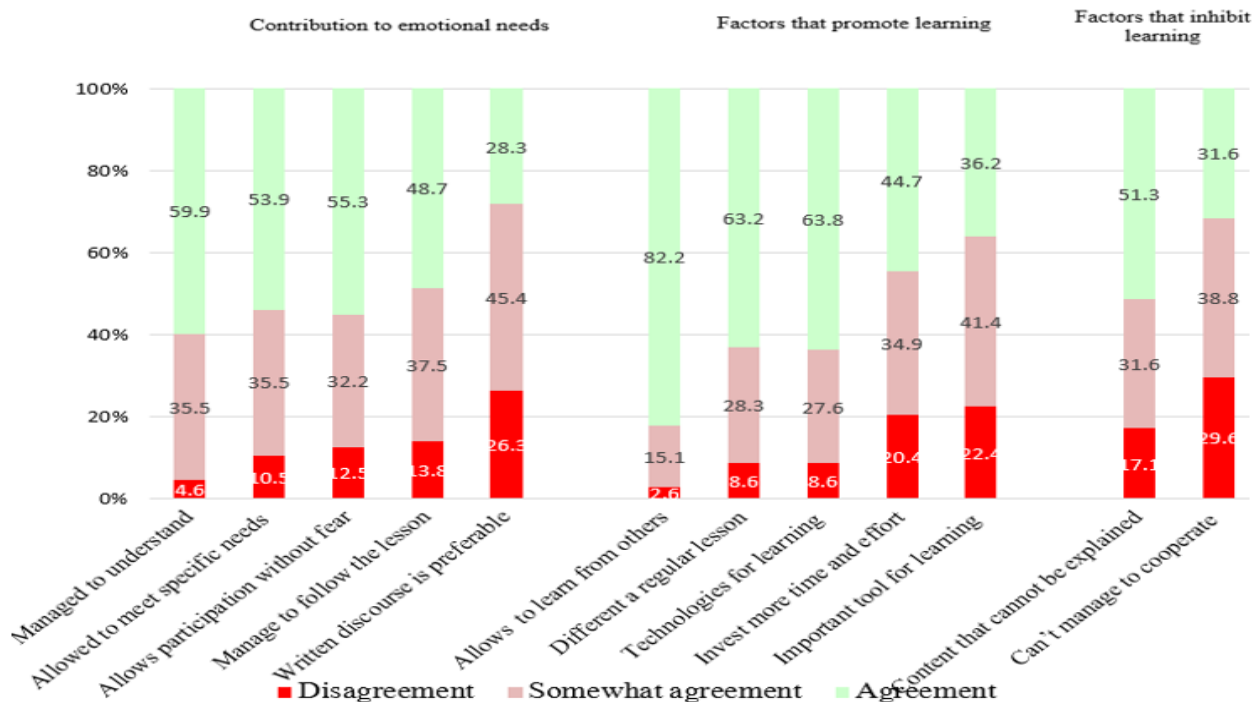


Figure 1: Proportion of students who agreed, somewhat agreed, or disagreed with the statements

highest agreement was with the statement: “I managed to understand the material in the WhatsApp environment at the same level as in a regular class.” Looking at Figure 1, we can see that 95.4% of the participating students agreed (59.9%) or somewhat agreed (35.5%) with this statement. The next highest statement in the category of emotional needs: “WhatsApp allows participation without fear of making errors,” with 55.3% and 32.2.% agreeing or somewhat agreeing with this statement, respectively. “Learning through WhatsApp allowed me to meet my specific needs as a learner more than in a regular classroom” scored third. Here, again, the great majority of students agreed or somewhat agreed with this statement (53.9% and 35.5%, respectively). However, the statement: “The written discourse in WhatsApp is preferable over the verbal discourse in a regular class” received the lowest mean score in this category, but still maintaining a high level of agreement 28.3% and 45.4%). Under the second category “Factors that promote learning in the WhatsApp environment,” there is a high degree of agreement with “The value of a lesson via WhatsApp is different from the value of a regular lesson.” Collectively, 91.5% agreed (63.2%) or somewhat agreed (28.3%) with this statement. Within this category, a high degree of agreement was also found with the statement: “In the future, WhatsApp will become an important tool for students for learning math” demonstrating that 77.6% of the students either agreed (36.2%) or somewhat agreed (41.4%) with this statement.

As well, the statement: “I invest more time and effort in mathematics in the WhatsApp project compared to students in a regular class” scored the lowest mean points (3.04%). However, overall, the great majority of the students still agree 44.7% or somewhat disagree 34.9% with the statement and the remaining 20.4% disagreeing with it. Notably, the WhatsApp environment, through students’

perspectives, allows to learn from others with 82.2% agreeing with this statement and 15.1% somewhat agreeing with this statement.

Discussion

The study examined the popular phenomenon of using WhatsApp, particularly its use to support learning through the national “Bagroup” program initiative whose objectives are to prepare students for the mathematics matriculation exams and contribute to students’ self-confidence in mathematics. This paper reports some quantitative results on how students perceived learning mathematics using WhatsApp. The findings demonstrate that, for the most part, students felt that learning through WhatsApp contributed to their emotional needs. They were able to understand the material, found their peers’ contributions helpful, felt confident to take an active part in the group without fear of making mistakes, and perceived the WhatsApp environment as one that was conducive to their learning from their peers more efficiently than in a regular classroom. Nevertheless, almost a fifth of the participants felt that this environment was not suitable for some mathematics topics. This requires further investigation as to the specific content they refer to and the pedagogical and instructional approaches to be adjusted. In addition, almost a third believed that the platform did not always allow the type of collaboration possible in a normal classroom. Here too, further investigation will shed more light on patterns of collaboration and learning mathematical content.

The findings also demonstrate that students believe that learning in the WhatsApp environment promoted their learning of mathematics (second category). with the most notable findings suggesting that this environment allows students to learn from each other and persevere more in solving mathematical problems (i.e., invest more time and effort in mathematics). We wonder whether opportunities to learn from other students (82.2% agreeing with the statement and 15.1% somewhat agreeing with the statement) may be associated with other factors such as not fearing making mistakes, or with the anonymity that the environment provides where classroom-related social roles become blurred and the threat of losing face (Lin & Yamaguchi, 2011) is mitigated.

The analysis of students’ responses to the open-ended questions may shed some more light on the differences in students’ experiences. Specifically, the relationship between students’ perception of mathematical content that is not as easily managed on WhatsApp (Category 3) and their managing to understand the mathematical concepts that were taught via WhatsApp (Category 1). As well, looking into students’ perception of not being able to cooperate with others (two thirds of the respondents agreed (31.6%) or somewhat disagreed (38.8%)) while noting their perception of WhatsApp allowing them to learn from others in the group (82.2.% agreeing and 15.1% somewhat agreeing).

The findings of this study suggest that using the WhatsApp environment in learning mathematics may provide positive experiences where learners receive opportunities to take ownership over mathematical ideas thus developing self-confidence and authorial identity in mathematics. This ties with Fellus’ (2019) broad conceptualization of learners’ mathematical identity that offers a unified framework to understanding students’ experiences in learning mathematics. Specifically, how students talk to and about themselves as learners of mathematics, what opportunities they get to take ownership over mathematical content, and the socioculturally available metanarratives about who can and who cannot do mathematics. As we further investigate learners’ experiences with the WhatsApp

environment, we will be looking more deeply into the relationship between the affordances the platform offers and one's opportunities to take ownership over mathematical ideas and to develop tolerance towards errors as ways to deepen conceptual understanding and to foster perseverance.

Acknowledgments

This study was conducted with the support of Shaanan College of Education and Oranim College of Education. We are also grateful to Sigal Atzmon, the director of the Bagroup project, for her assistance.

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