



Indonesian Mathematics Teachers' and Educators' Perspectives on Social Media Platforms: The Case of Educational Facebook Groups

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Abstract Facebook groups (FGs) have been widely used by teachers/educators. However, the type of educational FGs they value most, and the reasons for their choices, are less clear. This paper examines the perspectives of 440 participants (86% mathematics teachers and 14% mathematics teacher educators) on their educational FGs. It identifies the types of FGs they value most, the reasons for their choices, and aspects they dislike. Data collected through an online survey suggests that FGs are used for professional engagement across Indonesia. Support for FGs included the perceived benefits of sharing information/resources about mathematics (as well as education in general), networking and communication with others, opportunities for teacher professional development sessions and announcements about/access to up-to-date information. However, limitations with the platform included occasional irrelevant posts/comments, unexpected member behaviour and the lack of responsiveness from FGs administrators. Commonly, most participants saw value in discipline-specific (i.e. mathematics) engagement, leading to professional learning/support. This study stimulated further discussion on ways to maximise benefits whilst simultaneously overcoming the identified challenges of these participant-driven online communities.

Keywords Facebook group · Mathematics teachers and educators · Professional development · Value of Facebook groups · Social networking sites

Introduction

Facebook group (FG) is a Facebook application (as distinct from Facebook walls and Facebook pages) that enables users with similar interests to interact without necessarily being Facebook friends (Boyd and Ellison 2007; Lin et al. 2016). The platform allows anybody to create a community to converse around a theme, topic, or idea; thus, it is not surprising if one person belongs to multiple FGs.

FGs have become attractive to teachers wanting to collaborate and generate ideas for classroom instruction, update and support one another, and seek professional advice (Bissessar 2014; Kelly and Antonio 2016; Rensfeldt et al. 2018). In fact, participation in FGs could form a beneficial community of practice for teachers. Therefore, FGs are considered an important tool to complement traditional teacher professional development (Lantz-Andersson et al. 2017; Mercieca and Kelly 2018). However, recent studies raised the concern of the FG nature which enables the users to easily post unrelated or irrelevant content (e.g. advertisements) that could distract the professional conversations among teachers (Rensfeldt et al. 2018). Given the phenomenon that FGs are now a prevalent aspect of teachers' lives (e.g. almost 50% of 440 respondents in this study participated in more than 10 FGs), it is important to realise the contradictory nature of such digital technologies when this platform is considered to be a tool to support ongoing teacher professional development.

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Previous studies have pointed out that the majority of studies on FGs for teacher professional development were conducted in the context of developed countries (e.g. Lantz-Andersson et al. 2017; Ranieri et al. 2012; Rutherford 2010), where resources for teacher professional development such as teaching resources/ideas are often more accessible than in developing countries. It is also noteworthy that most of the studies only presented benefits of FGs without examining the challenges (Bett and Makewa 2018; Bissessar 2014; Chung and Chen 2018; Cinkara and Arslan 2017; Kent 2018; Lantz-Andersson et al. 2017; Mercieca and Kelly 2018; Ranieri et al. 2012; Rutherford 2010). Furthermore, those studies have been limited in their investigations to a small number of FGs with little indication of whether the teachers valued one group above others. In terms of subject matter specificity, the existing studies focused on one disciplinary content area, i.e. in the area of English as Foreign Language (EFL) (Bett and Makewa 2018; Chung and Chen 2018; Cinkara and Arslan 2017; Kent 2018). Thus, more empirical evidence is needed to address current gaps in the use of FGs for teacher professional development.

The present study was conducted in a developing country, Indonesia, with prevailing issues concerning a significant gap between professional development demands and available support. The challenges for mathematics teachers have been excessive for at least three main reasons: (1) Indonesian students consistently perform poorly in two International high-stake mathematics tests, TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment) (Jalal et al. 2009; Patahuddin et al. 2019), (2) the World Bank video study indicated limitations of classroom mathematics teaching across Indonesia (Human Development Department East Asia and Pacific Region 2010), and (3) a lack of mathematics content and pedagogical knowledge of mathematics teachers (Ng 2011). This study was also situated where Facebook has been widely used by teachers in Indonesia. It is worth noting that Indonesia is one of the top users of mobile phones in the world and the number of Facebook users has reached over 130 million in 2018 (Kemp 2018; Patahuddin and Logan 2019).

The purpose of the study was to investigate mathematics teachers' and educators' perspectives on their most valued educational FGs (i.e. 573 distinctive groups), including reasons for their choices and pitfalls they experience. The choice to investigate respondents' most valued FGs assumed that they tend to visit these groups when accessing Facebook. Findings from this study help to advance our understanding of ways to optimise social media as a complementary or alternative tool for teacher professional development. Specifically, this study was guided by the following research questions:

- (1) What educational FGs do Indonesian mathematics teachers/educators value most?
- (2) What are the opportunities and pitfalls of these educational FGs from an Indonesian perspective?

The Use of Facebook Groups by Teachers

This review of Facebook-related literature focuses on research related to educational FGs used for teacher professional development; it excludes literature on the use of FGs as a tool for instruction. To date, to the best of our knowledge, there are eleven peer-reviewed published papers which studied the use of FGs for teacher professional development. This section seeks to understand the types of educational FGs under those investigations, the opportunities and challenges in using FGs as a tool to support professional development, whilst identifying teachers' engagement within FGs (e.g. sharing and networking).

Types of Educational Facebook Groups

The review suggests that the types of FGs used by teachers for professional development were associated with Facebook settings (open/public, closed/private) and the membership size (small or large). Four studies investigated open/public FGs (Cinkara and Arslan 2017; Kelly and Antonio 2016; Kent 2018; Ranieri et al. 2012), four explored closed/private FGs (Bett and Makewa 2018; Lantz-Andersson et al. 2017; Mercieca and Kelly 2018; Ranieri et al. 2012), and three others did not mention the Facebook setting. In terms of size, almost all researchers considered their investigated FGs as large despite of a wide range of membership numbers (i.e. over 1,000 to 30,000). The claim is likely related to the proportion of teacher community in the research context.

The types of FGs were also identified based on the content conversed among members (i.e. generic, thematic, or disciplinary subject matter). In generic FGs teachers discussed any aspect of their professional and personal development (e.g. Bissessar 2014) while in thematic FGs, the conversation was more specific such as discussing the flip classroom approach (Lantz-Andersson et al. 2017). The disciplinary-based FGs were characterised by one disciplinary subject matter and up to now only included the area of English as a Foreign Language (Bett and Makewa 2018; Chung and Chen 2018; Cinkara and Arslan 2017; Kent 2018). This FG type seemed to influence teachers' engagement. For instance, teachers' participation in the generic FGs mainly serves as a mode of bridging social capital, whereas thematic groups serve as a mode of

maintaining social relationships and providing emotional support (Ranieri et al. 2012). Another pattern noticed from this review is that the thematic groups were all set up as closed group, the disciplinary-based groups were closed or open and the generic groups tend to be open.

Opportunities and Pitfalls of Educational Facebook Groups

Overall, all the studies above, despite their differences (in terms of setting, membership size, or content), suggest the opportunities provided by FGs as a complementary professional learning tool/site. However, the majority of these studies identified the benefits without acknowledging any challenges of using FGs for teacher professional development as summarised below.

The first published paper (Rutherford's study 2010) examined the potential of one Canadian FG for informal professional development. The content analysis on discussion posts suggests that FGs became a site for educational conversations such as enabling more knowledgeable teachers to prompt and support others in enhancing their professional knowledge, a critical aspect of social constructivist theories (Vygotsky and Luria 1981). In addition, through interviewing four of the six FG administrators and 22 members of a teacher FG in Trinidad and Tobago, Bissessar (2014) found that the FG supported teacher professional development by discussing teaching methodologies and instructional technology whilst also providing personal development for teachers, for instance, through social support and collaboration.

A more recent study also demonstrated teachers' mutual engagement through FG interactions based on the analysis of most active discussion posts in an FG over three years (Lantz-Andersson et al. 2017). They found three major threads regarding the sharing interactions among teachers: (1) requesting and giving tips; (2) asking for and providing concrete instructional examples; and (3) questioning and justifying the flip classroom approach. Furthermore, FGs become an additional support system that address the professional needs of novice teachers in Australasia (Mercieca and Kelly 2018) and English teachers in Kenya, Taiwan and Korea (Bett and Makewa 2018; Chung and Chen 2018; Kent 2018).

Other research however suggests that there are limitations and concerns associated with the use of FGs. For instance, a large and open FG was limited to provide adequate trust and collegiality. Consequently, the group was not a place for teachers to reflect and receive feedback on their practice (Kelly and Antonio 2016). In addition, the most recent study highlights the disadvantages of FGs due to Facebook's 'news feed' containing third-party advertisements (Rensfeldt et al. 2018). This is in line with the

issues in social media use raised by other researchers, relating to privacy, safety and inappropriate content (Kwan and Skoric 2013).

The above studies were approached from different research methods (including content analysis, interviews, online questionnaires, and mixed method), indicating various attempts to understand this area. The studies show different types of FGs with various advantages and challenges. The current study also applied online questionnaires, yet with a close examination of participants in one disciplinary area (i.e. mathematics) in the context of developing countries.

The Study

Participants

This study consists of 440 participants (239 male and 201 female), 86% being mathematics teachers (14.5% elementary teachers,¹ 37% middle school teachers, and 34% high school teachers), whilst the remaining were mathematics university educators. The participants lived in cities (51.8%), rural areas (44.5%), and remote areas (3.6%). Their ages were categorised as less than 30 years (25%), 30–49 years (64.3%), and more than 50 years (10.7%). The majority of participants (81.4%) had more than 4 years of teaching experience, whereas 11.1% of them had less than 3 years and others (7.5%) had 3 to 4 years of experience.

All participants were familiar with the Facebook environment, 96.4% having used Facebook for more than 3 years and nearly 50% for more than 6 years. Over half of the participants indicated using Facebook between 1/2 to 3 hours per day. Given that Indonesia has been recognised as one of the world's top users of mobile phones (Kemp 2018), it is unsurprising that 48% of the participants accessed Facebook through mobile phones and 30.2% through laptops. Notably, approximately 80% of them participated in more than 6 FGs, with nearly 20% participating in more than 20 FGs and an average number of Facebook friends being in excess of 1000. Hence, this broad network is indicative of the possibility of connecting with a large number of people.

Data Collection and Data Sources

The majority of participants were approached through FGs, the first author's Facebook Wall and inbox, personal e-mail communications, and Indonesian teachers' mailing lists, with a few being approached through WhatsApp. They

¹ Classroom teachers in elementary schools who considered themselves as mathematics teacher.

were sent a link to a survey hosted on Qualtrics, an online survey tool, and were offered a chance to win one of seven prizes as an incentive (i.e. 2 mobile phones worth around US\$100 each and 5 phone credits worth US\$7). The survey was open for 6 weeks during July–August 2015 and an ethical approval for this study was obtained from University of Canberra Human Research Ethics Committee.

To address the research questions, data sources only focused on one part of the survey, which asked for responses to the following open questions: (1) Name a maximum of three FGs related to education that you value the most; (2) Describe your reasons for valuing these groups the most; and (3) Describe any aspects you dislike about these groups.

Data Analysis

The responses to the three questions above resulted in a list of FGs, with a large amount of written text related to the second and third research questions. Therefore, data analysis was conducted in an iterative manner following the process described by Braun and Clarke (2006): becoming familiar with the data; generating initial codes; searching for themes; reviewing themes; defining and naming themes; and producing the report. This analysis is a grounded theory approach (Glasser and Strauss 1967) which allowed us to identify the types of most valued FGs, reasons of their most valued group, and the disliked aspects.

Familiarity with the data happened through organising these data (downloaded from Qualtrics) into Microsoft Excel and prolonged engagement of the two researchers in various educational FGs in Indonesia. Initial codes were generated through reading and re-reading data (in Indonesian language) while considering the eleven educational FGs-related literature presented in the previous section. A repeated review of the initial codes resulted in categorisation of codes into themes as suggested by Miles and Huberman (1994). Next, we generated a descriptive table to capture the patterns regarding the types of most valued FGs, the reasons for their choices, and the disliked aspects.

This analysis was conducted by two researchers collaboratively, often utilising the screen-share of Skype (<https://www.skype.com/en/>) as the two researchers were located in two countries. If there was disagreement on the coding, a third researcher was involved in the discussions. The consistency of our coding and our thematic categorisation were ensured through revisiting our analysis after a break of about three months (Mackey and Gass 2005). The final codes and themes produced is explained below.

Coding FG Types

The initial analysis of the most valued FG yielded 1107 FGs. Our familiarity of Indonesian educational FGs and the ability to confirm groups through the search function helped to conclude that this study consisted of 573 distinctive groups out of the 1107 FGs. Based on the names and profiles of most groups, we characterised the groups into 30 codes, simplifying it into six major themes as presented in Table 1 below. In addition, the five most popular FGs identified by the participants were also examined to gain further insights into the nature and purpose of the groups.

Coding Teachers' Reasons

We found 486 different reasons from 440 participants about deciding their most valued FGs. These reasons were analysed and resulted in 23 different codes, such as mathematics educational resources, mathematics content and tasks, and mathematics instruction. Later, these codes were categorised into themes such as “sharing mathematics resources/information”. In total, we developed six main themes after several iterative processes, as presented in Table 2.

Coding Teachers' Dislikes

There were 512 aspects that the respondents disliked from their educational most valued FGs, and these resulted in 15 codes. These codes were then categorised into three themes, as summarised in Table 3.

Results

Identification of Most Valued Facebook Groups

Participants were asked to identify a minimum of one and a maximum of three most valued educational FGs (Table 4).

Table 4 indicates that the mathematics teachers/educators directed their attention to discipline-specific FGs for professional learning/support. The analysis of three most valued educational FG reveals that the top FG type was related to mathematics (M-FG). TI-FG ranked second, and TT-FG was the least popular.

Further analysis of the five most popular FGs found that four of the groups were included within the Math-FG category and one was in the Teacher/Institutional FG [TI-FG]. Of the four Math-FG, three groups were public with the number of members ranging between 11,000 and 65,000. This means the contents are visible to a broader community and could attract more mathematics teachers/

Table 1 Themes and description of most valued FG

Themes of most valued FG	Description
1. Mathematics FG [M-FG]	Including any FG with the word “Matematika” such as Matematika gembira, ELPSA Matematika, and OSN Matematika
2. Non-Math FG [NM-FG]	Including any FG that was dedicated to more specialised subjects but not in mathematics. For example, classroom research, religion, and curriculum
3. Teacher/institutional FG [TI-FG]	Including any FG that represent teacher association such as IGI (Ikatan Guru Indonesia), IGI from various provinces and Forum Guru. Also, this included educational institutions such as training institutes, schools, and universities
4. General FG [G-FG]	Including any FG that covers general matters such as scholarship, competition, and alumni groups
5. Teacher Training [TT-FG]	Including any FG dedicated to training, such as “diklat online” or e-training, and MGMP (teacher working groups)
6. Others	Any group that cannot be confirmed through a Facebook search and that are unfamiliar to the authors

Table 2 Themes of reasons for most valued FGs

Themes	Codes of reasons	Examples
1. Sharing educational resources/information [SER]	Educational information/resources; Sharing instructional experiences/problems/ideas; Teacher/school administration; General information; Sharing curriculum, lesson plan, syllabus; Teacher information	<ul style="list-style-type: none"> • “is very helpful in finding appropriate educational information” [T211] • “allows [us] to share ideas with other educators in Indonesia to support student learning” [T428]
2. Sharing mathematics resources/information Announcements [SMR]	Mathematics educational resources; Mathematics content and tasks; Mathematics instruction	<ul style="list-style-type: none"> • I can ask Math Olympiad questions. I also learned a lot of strategies in solving complex mathematical problems” [T3] • “opportunities to access non-routine mathematics problems” [T323]
3. Announcements [Anc]	Obtaining up-to-date information (quick, easy, useful and trusted); Educational event; Project, Program, or institutional event; Scholarship information; Policy update	<ul style="list-style-type: none"> • “There are lots of information about teacher training and announcements about mathematics competitions” [T254] • “I can find up-to-date information about school programs and government programs in relation to elementary school” [T406]
4. Networking/communication [N-C]	Communication; Community of teachers, students, or friends	<ul style="list-style-type: none"> • “I can communicate with other teachers” [T49] • “I can connect with my university friends who are now teachers” [T47]
5. Professional development [PD]	Professional development; Self-development; Educational discussion; Access PD resources; Teaching skills development;	<ul style="list-style-type: none"> • “Some teachers share their experiences and their problems in e-training and other teachers respond” [T5] • “interact with other mathematics teachers and learn different perspectives about teaching by reading other teachers’ posts in the group” [T76]
6. Administration [Adm]	Group administration; Role as an admin group	<ul style="list-style-type: none"> • “the group admin is quite active ... in discussing anything such as teachers’ challenges” [T74]

educators. The three groups were characterised by their main activities, being discussing or sharing ideas about mathematics pedagogy and solving complex mathematics problems for Olympiads. Another Math-FG was closed, which was created as a communication channel to support an education project for mathematics educators in a disadvantaged community in Indonesia. Notwithstanding the small number of members (less than 250), it rates as the most valued FG, highlighting its usefulness to participants. In addition, the top TI-FG was public, with more than

75,000 members. This was a generic group that was dedicated to any teacher without specifying the school level, discipline areas, or regions.

Reasons for Choice as First Most Valued Educational Facebook Groups

Subsequent analysis provided insights into the participants’ reasons for choosing their first most valued educational FGs, indicating the opportunities of educational FGs. For

Table 3 Themes of dislike aspects from most valued FGs

Themes of	Codes of disliking aspects	Examples
1. Inappropriate content [In-C]	Spamming (promotion, pornography, virus); Unrelated post; private complaint; less satisfactory posts; inappropriate comments; less trusted information/resources; repetitive post/too many things discussed	<ul style="list-style-type: none"> • “Many (product) promotions that are not related to the group” [T40] • “some posts are not related to the aims of the group. For example, [there was] an education group but the posts were about politics” [T4] • “people sometimes post pornography content” [T75]
2. Unexpected/inappropriate membership [In-M]	Conflict trigger posts/comments; personal limitation of group members; inappropriate group members; the number of group members	<ul style="list-style-type: none"> • “the members tend to complain about their individual problems such as their low salary, their expectations to be certified, and many other complaints that undermine teacher profession” [T25] • “There are members who tend to post content that contains SARA [the term used to ethnic, religion, and race] and blame other educators” [T239]
3. Group administration [In-Adm]	Less active/less update; slow responses; group rules	<ul style="list-style-type: none"> • “when I uploaded a problem in this group, sometimes I got the answers from the administrator after quite long time even sometimes there were no response” [T3] • “Discussion is sometimes misleading due to the number of members who should not be a part of the FG. So, the admin group didn’t filter the group member appropriately” [T164]

Table 4 Descriptive data about types of the respondents’ most valued FGs

Facebook group types	FG 1		FG 2		FG 3	
	Frequency	%	Frequency	%	Frequency	%
Math-FG [M-FG]	145	33	107	29.3	87	28.8
Teacher/Institution FG [TI-FG]	143	32.5	85	23.3	77	25.5
General FG [G-FG]	63	14.3	74	20.3	63	20.9
Non-Math FG [NM-FG]	46	10.5	58	15.9	43	14.2
Teacher Training [TT-FG]	29	6.6	36	9.9	27	8.9
Others	14	3.2	5	1.4	5	1.7
Total	440	100	365 ^a	100	302 ^b	100

FG1, FG2, and FG 3 each represents the first, second, third most valued educational Facebook Group

^a75 respondents did not write a second FG

^b138 respondents did not write a third FG

Table 5 Reason for choosing a Facebook group as first most valued ($n = 271$)

Themes	Number of participants	%
Sharing educational resources/information [SER]	86	31.73
Sharing mathematics resources/information [SMR]	65	23.99
Announcements [Anc]	55	20.30
Networking/communication [N-C]	28	10.33
Professional development/professional learning [PD]	28	10.33
Administration [Adm]	9	3.32
Total	271	100

this purpose, we excluded participants who only wrote the FG name without any reason, resulting in 271 respondents. This analysis is summarised in Table 5.

The most valued FG was a site for sharing educational resources/information (approximately 32%) or for sharing mathematical resources (approximately 24%). Many

Table 6 A cross-tab analysis of FG types and reason for first most value ($n = 271$)

Types of most valued FG	Themes of reasons						Total
	SER	SMR	Anc	N-C	PD	Adm	
M-FG	14	52	17	5	9	0	97
NM-FG	12	3	1	3	3	0	22
TI-FG	39	4	18	8	10	1	80
G-FG	14	3	11	9	3	0	40
TT-FG	5	2	7	1	3	2	20
Others	2	1	1	2	0	6	12
Total	86	65	55	28	28	9	271

teachers considered FGs as the best place to access the most up-to-date information or announcements, particularly regarding education, policy, and scholarship information. Accounting for about 10% of the reasons, the next identified theme was networking and maintaining communication with old friends and other teachers, similar to the reason of enhancing professional development. Despite having a small group of participants referring to group administration as their reason for most valuing a group, it is worth noting that there were suggestions of still needing to facilitate FGs.

To better understand the practices across the most valued FG, we present the cross-tab analysis below. Table 6 reveals that 45% ($n = 39$) of sharing educational resources was clustered within TI-FG, groups that mostly represent teacher association or educational institutions. By contrast when teachers want to share mathematical resources, they are more likely to do so in M-FG, with 80% ($n = 52$) of all attributed sharing undertaken in M-FG. The participants are also more likely to value M-FG and T-FG as a site for professional development (e.g. e-training). Examples of each reason can be seen in Table 2.

Disliked Aspects Found from Participants' Most Valued Facebook Groups

Among the 440 participants, approximately 13% stated that there were no aspects they disliked as indicated by the following statements: "So far, I haven't found anything that I disliked" (T1); "None, because the groups that I value the most were beneficial for me (T155); and "I don't have any that I disliked because majority of the FG members are university students, teachers, and mathematics experts" (T172). However, nearly 90% of the participants listed some aspects they disliked from their most valued groups, as summarised in Table 7.

As Table 7 suggests, most (approximately 80%) of the reasons for the respondents' dislikes concerned the content of the FGs. The nature of FG membership and group

administration accounted for approximately 10% each of the responses. Despite the many benefits experienced by teachers/educators, this study also notes that FGs could also cause distraction due to the disliked aspects.

Cross-tab analysis (Table 8) shows that there is strong consistency in this data, which indicates that almost all pitfalls or negative association with FGs involve inappropriate content being uploaded. To this point, the capacity for groups to be able to filter out unwanted material is required to avoid negative impacts on users' experiences.

Discussion

This study set out to examine mathematics teachers' and educators' most valued FGs, the reasons for their choices, and to identify the pitfalls they experience from participating in these FGs. Our analysis of teachers' responses to the survey questions reveals three points of discussion.

First, this study suggests that FGs could be utilised as a medium to enhance disciplinary and pedagogical knowledge of teachers and educators, which could address the ongoing and worldwide issue of teachers' lack of content and pedagogical knowledge for teaching. This is evident by the fact that participants look for discipline-specific FGs to enhance professional learning. The most valued FGs were associated with mathematics education and the top reason for engagement within their most valued FGs was about learning mathematical content and instructions. The present study extends the literature on a specific disciplinary subject matter as it is the first to address the use of FGs for mathematics teacher professional development. Existing works have predominantly focused on FGs for EFL teachers (Bett and Makewa 2018; Chung and Chen 2018; Cinkara and Arslan 2017; Kent 2018). We argue that this finding is novel given the fact that online communication within mathematics was considered challenging due to difficulty in explaining mathematical concept visually, with graphics, or in symbolic terms via online (Frid 2002).

Table 7 Mathematics teachers'/educators' dislikes ($n = 384$)

Themes	Number of participants	%
Inappropriate content [In-C]	311	80.99
Unexpected/Inappropriate membership [In-M]	38	9.90
Group admin [In-Adm]	35	9.11
Total	384	100

Table 8 A cross-tab analysis of FG types and disliked aspects from most valued FG ($n = 384$)

Types of most valued FG	Themes of dislikes			Total
	In-C	In-M	In-Adm	
M-FG	110	9	14	133
NM-FG	35	2	2	39
TI-FG	99	15	14	128
G-FG	36	10	5	51
TT-FG	22	1	0	23
Others	9	1	0	10
Total	311	38	35	384

The latest features of FGs such as the ability to post photos, videos, files seem to alleviate these types of challenges. This suggests that the findings from this study may also be applicable to other disciplinary areas.

Second, this study also confirms previous studies on FGs which shows the opportunities to use FGs as a complementary site for professional learning in general (e.g. Bett and Makewa 2018; Kelly and Antonio 2016; Lantz-Andersson et al. 2017). While the previous studies similarly indicate the usefulness of FGs, the present investigation had a much broader scope, examining 573 distinctive FGs that are valued by 440 mathematics teachers/educators. In addition, most studies did not explore the challenges of using FGs for teacher professional development and therefore the identification of challenges experienced by teachers, even from their most valued FGs, should shed light on this dimension. The current study provides robust empirical evidence about the challenges of a fully voluntary educational space/tool despite the many identified benefits. This can stimulate further discussion since the values and sustainability of FGs largely depends on members' participation and their willingness to contribute ideas and experiences to other group members.

Third, this study suggests that if FGs are to be developed as a productive space for teacher professional development, teachers' responses from this study on the opportunities and challenges of using educational FGs must be considered. For example, teachers tend to engage in FGs due to

the usefulness of the educational sharing from members; therefore, the attempt to invite educational experts must be exercised. In contrast, teachers disliked the aspect of irrelevant content (e.g. spam, pornography, unreliable information), which needs to be filtered by knowledgeable administrators. Meanwhile, from the administrators' perspective, a study by Çevik et al. (2014) suggests that administering FGs poses challenges concerning how to enhance members' engagement. This indicates the need for further studies on how to support teachers in this informal environment to focus on its domain, maintain relationships, and develop its practice (Wenger et al. 2002).

Concluding Comments

Overall, this new line of investigation demonstrates that educational FGs provide both opportunities and challenges for mathematics teachers/educators as evident by the six identified major reasons for their engagement in their most valued FGs and the three main aspects they disliked about those groups. As a result, this investigation expanded the existing studies relating to social network use in supporting teacher professional development which were mostly conducted in developed countries with a limited number of FGs.

This study highlights the affordances of FGs in providing opportunities for their members to connect not only

with friends, but also other like-minded professionals across the archipelago of Indonesia, in sharing expertise, practices, and ways of thinking. Moreover, due to the lack of formal professional learning opportunities for most Indonesian teachers/educators and given the low quality of mathematics education in Indonesia (Allen et al. 2018; Human Development Department East Asia and Pacific Region 2010), policymakers could use FGs to deliver professional development programs. This online platform could complement teachers' professional development, especially for those who, due to remoteness, are less able to attend face-to-face professional development programs provided by the government. In other words, this study implies that Facebook cannot be regarded as an interruption to be avoided, but rather, if used mindfully, a powerful tool with the potential to enhance group members' professional development.

The present study is subject to two major limitations. First, although all participants self-reported that they were school teachers or university educators, we were unable to verify their teaching registration. Second, this study did not examine the impacts of FG participation on teachers' professional growth and their classroom practices. Nevertheless, the findings may serve to alert fellow practitioners of some issues involved in using Facebook as a tool for informal professional learning. Future research requires rigorous empirical studies that investigate ways of optimising FGs and other social media platforms as additional sites for teacher professional development. In addition, as Ferdig (2007) argued, social software such as FGs provides opportunities that are both bad and good for their users. FGs do have challenges depending on how they are used, their content, and their members' contribution. Therefore, further research is also important to understand to what extent the disliked aspects and challenges experienced by teachers or educators impact the positive sides of their engagement within their educational FGs.

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