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IMPACTS OF CLASSROOM'S MOBILE LEARNING: CAN SMARTPHONE SUPPORT STUDENTS' COLLABORATION?

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Abstract: The trend of facilitating technological devices for students in the classroom still becomes controversial among teachers, whether these devices can be effectively applied or conversely. This study aims at revealing students' collaboration effectiveness using smartphones. 528 teachers of primary and secondary schools in Sleman District, Indonesia involved as the respondents. Data collection used self-rated questionnaire indicating teachers' perceptions and was analyzed by descriptive and factor analysis tests. The results confirmed that learning and discussion with peer, comfortableness with learning activity, dynamic learning atmosphere, mutual appreciation when giving feedback, mutual respect with peer, and collective usage encourages a good habit of learning descriptively engaged students' collaboration effectiveness, whereas one factor, peer's social relationships with teachers gain better showed its ineffectiveness. Further, the principal component sequentially adjudged the position of seven perceived factors with the Eigenvalue and the factorial analyses affirmed two rooted components with a total factor of 72.97%, where component 1 gained 67.16% and component 2 gained 5.81%. Using smartphones coherently need an exploration and an engagement through the social mechanism to support students' learning activities.
Keywords: *collaboration; learning effectiveness; smartphones facilitation.*

INTRODUCTION

Recently, efforts of facilitating mobile digital devices as one of the technological-based learning in schools become the considerable concern among media, schools (Griffiths & Williams, 2018), policy-makers, NGO's, educator specialists, and teachers to obtain students' well-being achievements. Documented empirically from the early sixties, the new technological developments have inspired and supported the innovative learning cycles. The early generations of mobile phones, so-called by smartphones, facilitate great multimedia and high technology contents to heighten students' pleasure and encouragement (Gheytasia, Azizifara & Gowhary, 2015). The vogue of smartphones has hugely been worldwide for a few years. This actual establishment indicates smartphones usage and high average expectations among students (Kétyi, 2013), as the daily use of smartphones had better contain the benefits, such as ubiquity, portability, interactivity, and teachers' feedback and comments (Kacetl & Klímová, 2019). Teachers have an important role to engage in students' mobile learning (Pedro, Barbosa & Santos, 2018) and to follow the existence of smartphones is enormously popular among students (Salzer, 2018). However, as one of the communication strategies; the information tools, dispersion, and advancement will widely implicate positive and negative impacts (Zinaida & Havivi, 2019). Mobile technology aims to support any innovative learning strategies on pedagogical

effectiveness (Lee, Min, Oh & Shim, 2018). Teachers become more amenable to campaign the mobile learning initiatives in their classrooms (Farley, Murphy, Johnson, Carter, Lane, Midgley, Hafeez-Baig, Dekeyser & Koronios, 2015), as smartphones attempt to connect students with the contents of social media, recording practical presentations and teachers' talks, and producing videos for scientific purposes (Barnwell, 2016). Therefore, mobile technology can be applied in the classroom chiefly and energize the splendid-not-so-splendid impacts of smartphones usage (Pedro, Barbosa & Santos, 2018).

Conversely, the learning advantages with smartphones will be conditionally well-documented, although some teachers still disincline to facilitate their classes with the technological-based learning (Alrasheedi & Capretz, 2015). Teachers need to think harder modify their mobile-based learning classes, although they are not experts in dealing with smartphones that mostly become a distraction (Barnwell, 2016) as citing time pressures as if restricting their mobile learning adoption (Crompton, 2013) mainly. Heading teachers to the technology-adapted teaching in the classroom refers to the pedagogical practices that can be circumscribed by its functions and lead difficulties for them to modify their persevering faiths and behaviors (Sung, Chang & Liu, 2016). Regarding these discrepancies, Gheytasia, Azizifara and Gowhary (2015) took tertiary students' perceptions of using smartphones, whose the responses are unsatisfactory. Most students express negative impacts overbalancing the positive impacts of using smartphones. They also support prohibiting the use of smartphones in classroom. Although some students agree there must be a limitation to access smartphones collectively. Griffiths and Williams (2018) testify evidence that smartphones usage in schools has created students' well-being in both limited and mixed achievements. Smartphones widely distract students' learning, particularly at the tertiary level. Pointedly, smartphones usage can embarrass students' social interaction. However, smartphones will be encompassed gradually within the existence of school regulations.

Previous studies addressed students' engagement in the classroom collaboration in which the use of smartphones supported their class activities. Aljaloud, Gromik, Kwan, and Billingsley (2019) proved that smartphones facilitation promoted the progressive teacher-student and student-student relationships to gain and evaluate the knowledge, although this promotion did not guarantee students' learning improvement. The collaboration was apparent in students' knowledge gaps, barriers, sharing, mutual communication among peers to raise interactive learning qualities (Bere & Rambe, 2019). Smartphones operation greatly dealt with students' collaborative classroom activities which involved social interactions between group members whereas working with regular tasks (Chang, Chatterjea, Goh, Theng, Lim, Sun, Razikin, Kim & Nguyen, 2012). Its effectiveness conveyed students' creativity matters, increased collaboration factors, provided difficulty decrease in learning, strengthened the learning organization, and oriented to problem-solving (Sumekto, 2017a). Smartphones openly developed knowledge, shared facts, emotions, and expanded peer's social relationships towards panel discussion, mating and noting peer's ideas, and other online sources (Gatti, Brivio & Galimberti, 2017). Nevertheless, teachers should knowledgeably understand some patterns of technological devices that engaged students' mobile learning (Jin, Kim & Baumgartner, 2019). However, groups' working and inter-connectedness towards shared objectives of positive interdependence characteristics became pieces of evidence regarding inputs and outputs through the portraits of togetherness among learners. Students would be ready for peer's effective communication processes and collective workings hand-in-hand (McKinney & Cook, 2018). Other studies constructed students' collaboration might apply for classroom-based technological devices. They believed smartphones purposefully guided students' communication and collaboration to predict the effectiveness of the endogenous aspects towards their creativity, elaborate problem-solving, and meta-cognition (Lai & Gwang, 2014), and affordability (Kukulska-Hulme & Viberg, 2018). They found that collaboration complied with flexible usage, sustainability, well-timed feedback, socialization, self-reflection, total involvement, inspirational source, and peer-coaching. Pointedly, smartphones-based application promoted students' motivation and satisfaction in learning activities, although its application would not guarantee students' clinical skills and knowledge (Lee, Min, Oh & Shim, 2018).

This study pursues research questions in terms of classroom's mobile learning and students' collaboration effectiveness, as follows: (1) Does smartphone facilitation in the classroom engage students' collaboration? (2) Can students' collaboration become effective learning when using smartphones? As contextualized in the background, this study aims at engaging students' collaboration effectiveness when smartphones are facilitated in the classroom during their learning activities.

METHOD

This study undertook 528 teachers who still actively served themselves at public and private schools in Sleman District, Indonesia to be the respondents. The reason for choosing the respondents was empirically undertaken as if they were the role models for the classroom-based instruction issues. They were active teachers in 2019/2020 academic enrollment at their schools. As recorded into the database, 57% (*n* = 301) primary teachers and 43% (*n* = 227) secondary teachers respectively participated in fulfilling the questionnaire. Respondents' age profile set from 20 to 65 years old, which meant that Mean age was 42.5 and standard deviation was 31.819 when the questionnaire is completed using the Google form. Of 528 respondents participated in this study, .4% (*n* = 2) teachers had educational background in Arabic, 5.8% (*n* = 31) in Indonesian, 6% (*n* = 32) in English, 2.6% (*n* = 14) in Javanese, 2.3% (*n* = 12) in Counseling, 45% (*n* = 238) in Class Teacher, .4% (*n* = 2) in History, 1.9% (*n* = 10) in Information & Communication Technology, 2.5% (*n* = 13) in Arts, 5.1% (*n* = 27) in Science, 3.8% (*n* = 20) in Social Science, 1.3% (*n* = 7) in Life Skills, 7% (*n* = 37) in Mathematics, 5.1% (*n* = 27) in Islamic Religion, .4% (*n* = 2) in Christian Religion, .1% (*n* = 1) in Hindu Religion, 6.3% (*n* = 33) in Physics, Sports, and Health Education, and 4% (*n* = 20) in Civics Education.

Data were collected from the self-rated questionnaire that indicated teachers' perception of facilitating smartphones in the classroom with a 4-Likert scale. Data were collected through the self-rated questionnaire of teachers' perception upon students' collaboration effectiveness determining seven perceived factors. These factors were to align Cronbach's alpha reliability coefficient test (Cronbach & Shavelson, 2004). The factors had the internal consistency results upon teachers' perception with Cronbach's alpha, as follows: .928 for students' learning and discussion with peer, .926 for students' comfortableness with their learning activity, .926 for students' dynamic learning condition, .927 for mutual appreciation among students when giving them feedback, 9.25 for students' mutual respect with peer, .931 for using collective smartphones encourages a good habit of learning and .935 for peer's social relationships with teachers gain better. Meanwhile, the scale mean ranged from 15.23 to 15.60. Overall, the value of alpha gained .938. Data analysis used descriptive and factor analysis tests (Ary, Jacobs & Sorensen, 2010), which confirmed the results about principal components analysis of seven perceived factors with the Eigenvalue (Pallant, 2011) to gain the effectiveness of facilitating smartphones as one of the technological-based devices in the classroom learning.

RESULTS AND DISCUSSION

First, the effectiveness of learning and discussion with peer referred to the descriptive and frequencies statistics results (Table 1 and Figure 1). The results were recorded teachers' perceptions in the following: 78 (14.8%) of students' learning and discussion with peer were not very effective, 174 (33%) was not effective, 217 (41.1%) was effective, and 59 (11.2%) was very effective if the smartphones were facilitated in the classroom for assisting students' learning activities. The highest score of the effectiveness of learning and discussion with a peer gained 3.00 (M = 2.49; SD = .878; *n* = 528). The overall effectiveness of learning and discussion with the peer was **effective**, with 41.1% and put this category in the fifth rank based on teachers' perception. Meanwhile, the score distribution was shown in Figure.

Table 1. *Learning and discussion with peer*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	78	14.8	14.8	14.8
	2.00	174	33.0	33.0	47.7
	3.00	217	41.1	41.1	88.8
	4.00	59	11.2	11.2	100.0
	Total	528	100.0	100.0	

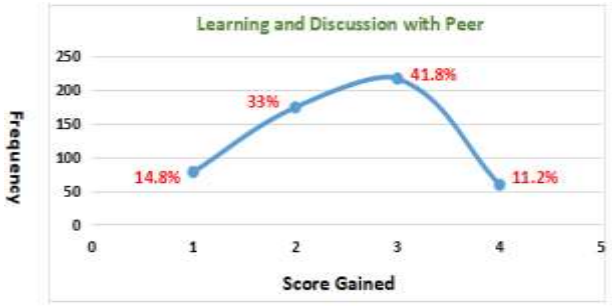

Figure 1. *Scatter with smooth lines & markers of learning and discussion with peer*

Teachers showed their perception of accommodating students' learning with smartphones in the classroom. Undertaken from the results, teachers perceived the effectiveness of students' learning and discussion with peers was very effective as if the smartphones were facilitated for assisting students' learning activities. These facts are consistent with Bere and Rambe's (2019) persistence in which the benefits of allowing the use of smartphones shall be accordingly relevant with the contextual functions of supporting disruptive behaviors. Showing participation time and learning strategies can create a substantial role in engaging students' mutual communication, solving complex problems, and supporting creativity that deal with students' collaborative learning and higher-order-thinking skills efforts (Lai & Hwang, 2014). Students' initial collaboration emphasizes and entrusts a number of learning and discussion with peers' creativity, communicative competence, critical thinking, problem-solving, and autonomy and confidence. These constructive interactions lead to Chang, Chatterjea, Goh, Theng, Lim, Sun, Razikin, Kim and Nguyen's (2012) findings relating to the benefits of smartphone for students' collaboration as if these are appropriately best applied to facilitate the learning activities. Moreover, Sue and Chrissi (2015) believed in students' communication that is naturally conveyed by a two-way process with sharing ideas, thoughts, and experiences in turns that will construct meaningful learning and engage in multi-directional voices and perspectives.

Second, the effectiveness of students' comfortableness with their learning activity was established through the statistical descriptive and frequency analyses (Table 2 and Figure 2). Teachers perceived that students' comfortableness with their learning activity proved in the following: 46 (8.7%) was not very effective, 122 (23.1%) was not effective, 259 (49.1%) was effective and 101 (19.1%) was very effective when teachers facilitated their students to learn with smartphones in the classroom. Students' comfortableness results also confirmed the highest score was 3.00 (M = 2.79; SD = .852; *n* = 528). The overall effectiveness of students' comfortableness with their learning activity was **effective**, with 49.1% and placed in the first rank based on teachers' perception. Meanwhile, the score distribution was shown in Figure 2.

Table 2. *Students' comfortableness with their learning activity*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	46	8.7	8.7	8.7
	2.00	122	23.1	23.1	31.8
	3.00	259	49.1	49.1	80.9
	4.00	101	19.1	19.1	100.0
	Total	528	100.0	100.0	

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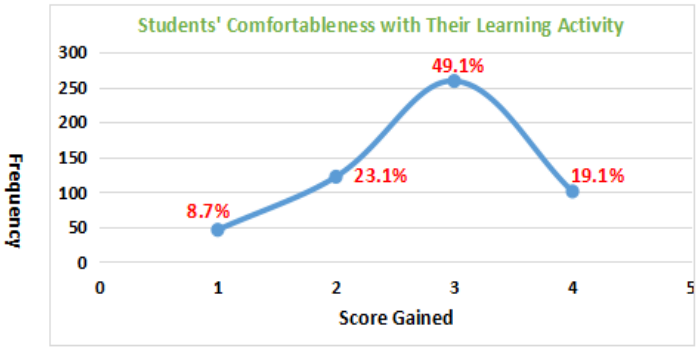

Figure 2. *Scatter with smooth lines & markers of students' comfortableness with their learning activity*

Students' comfortableness with learning activity relates to class circumstances whilst the teacher conditionally allows students to use smartphones. The sophisticated use of the technological device may maintain a daily learning habit, in which smartphones challenge the individual efforts and social supports (Jin, Kim & Baumgartner, 2019). This situation possibly becomes more comfortable since the frequency of using smartphones can be controlled by most students (Kétyi, 2013) in learning activities. Students' collaboration is conceptually formatted as the learning habit towards groups' respectfulness and collegiality. The collaboration may conditionally share students' existing experiences in authentic and fair ways to increase the learning processes and meaningful outputs (Sumekto, 2017b). Of the determinants, Sung, Chang, and Liu (2016) trust the suitable applications and software are well-installed in smartphones. The impact will be more effective than getting along with the lessons and self-directed study.

Third, the effectiveness of students' dynamic learning atmosphere was found through the descriptive and frequencies analyses (Table 3 and Figure 3).The results showed that 54 (10.2%) students' dynamic learning atmosphere was not very effective, 144 (27.3%) was not effective, 249 (47.2%) was effective, and81 (15.3%) was very effective if teachers took a decision to allow their students used smartphones in the classroom during classes for learning assistance. The highest score of its effectiveness was 3.00 (M = 2.68; SD = .855; *n* = 528). The overall analyses could be confidently withdrawn that the effectiveness of students' dynamic learning atmosphere was **effective**, with 47.2% and gained the second rank based on teachers' perception. Meanwhile, the score distribution was confirmed in Figure 3.

Table 3. *Students' dynamic learning atmosphere*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	54	10.2	10.2	10.2
	2.00	144	27.3	27.3	37.5
	3.00	249	47.2	47.2	84.7
	4.00	81	15.3	15.3	100.0
	Total	528	100.0	100.0	

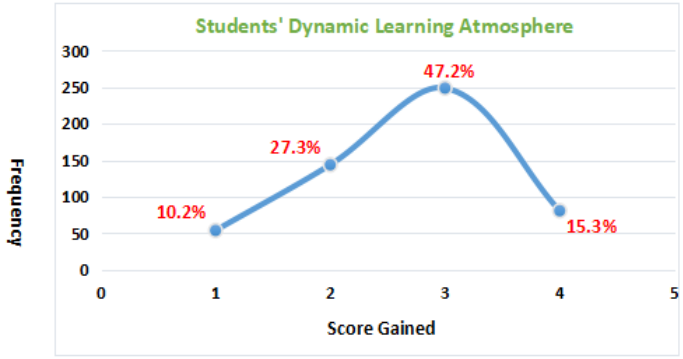

Figure 3. *Scatter with smooth lines & markers of students' dynamic learning atmosphere*

Students' dynamic learning atmosphere comply with the use of smartphones. This takes up with students' deep collaboration and engagement. Dynamically, smartphones are still debatable among students conveying with low and high groups' abilities. Some are possible to perform better than other peers in any learning circumstance (Tay, 2016). So, facilitating and integrating smartphones in the classroom are the challenging matter. A teacher needs to integrate the use of smartphones becomes attractive and inspiring class (Anshari, Almunawar, Shahrill, Wicaksono & Huda, 2017). In this respect, Clayton and Murphy (2016) provide that smartphones can replace functions of papers, pencils, and textbooks to enhance students' knowledge and learning experience as well as rapidly become an amused and alternative learning source. Meanwhile, Admiraal, Kester, Jansen, Jonge, Louws, Post and Lockhorst (2018) emphasize the personalizing learning with smartphones may develop teachers' convergent and divergent teaching approaches and create students-control advocacy through the surface things of striding, practicing, concluding with a certain limitation directed by the teacher.

Fourth, the effectiveness of mutual appreciation among students when giving the feedback was summarized through the descriptive and frequencies statistics (Table 4 and Figure 4). The analyses indicated that 54 (10.2%) students' mutual appreciation when giving the feedback was not very effective, 144 (27.3%) was not effective, 249 (47.2%) was effective, and 81 (15.3%) was very effective if students were given opportunities to work with their smartphones in the classroom to assist their learning activities. The highest score of the effectiveness of mutual appreciation among students when giving the feedback was 3.00 (M = 2.68; SD = .855; *n* = 528). This factor attained **an effective** category with 41.1% and raised the sixth rank based on teachers' perception. Meanwhile, the score distribution was set up in Figure 4.

Table 4. *Mutual appreciation among students when giving feedback*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	49	9.3	9.3	9.3
	2.00	198	37.5	37.5	46.8
	3.00	217	41.1	41.1	87.9
	4.00	64	12.1	12.1	100.0
	Total	528	100.0	100.0	

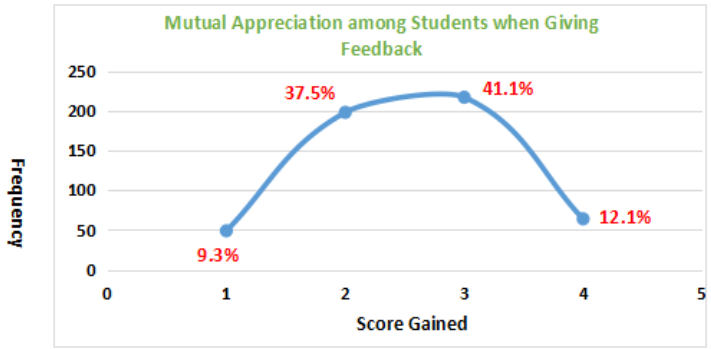

Figure 4. *Scatter with smooth lines & markers of mutual appreciation among students when giving feedback*

This factor corresponds with mutual appreciation when giving feedback. It addresses social constructivist perspectives in measuring students' interpersonal learning impacts conveying peer feedback, oral communication performance, and communication. So, smartphones are allowable to facilitate students' engagement in group discussion assignments and carrying out peer feedback (Fang, Cassim, Hsu & Chen, 2018). The collaboration strategy allows for developing the adaptive expertise and deepening an understanding among students when using one-to-one smartphone enhances the scope of discussion and solves problems (Masukawa & Endo, 2013). Students reflect their practical ways with the device and identify opportunities for the collaborative learning as well as express themselves creatively. This

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relevant experience is playful-making on one to another (Sue & Chrissi, 2015). Students share their constructive criticism and are ready to receive any feedback, whilst hard works and mutual respects are prioritized (Furrer, Skinner & Pitzer, 2014). Smartphones appropriately supports collaborative learning engagement more active, creates the growth of learning, and provides the significant inputs to encourage students (Hashemi & Ghasemi, 2011).

Fifth, the descriptive and frequencies statistics analyses of students' mutual respect with peer (Table 5 and Figure 5) were not very effective. This was proved by 62 (11.7%) teachers who perceived this factor and 197 (37.3%) teachers answered that students' mutual respect with peer was not effective when smartphones are allowed to use during the classes. On the other hand, 220 (41.7%) teachers' perceived that the effectiveness of students' mutual respect with peer was effective and 49 (9.3%) was very effective when smartphones are facilitated in students' learning activities. The analyses also recorded that the highest score of the effectiveness of students' mutual respect with a peer was 3.00 (M = 2.48; SD = .819; *n* = 528). However, the effectiveness entirely gained an **effective** category with 41.7% and took up the fourth rank based on teachers' perception. Meanwhile, the score distribution was indicated in Figure 5.

Table 5. *Students' mutual respect with peer*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	62	11.7	11.7	11.7
	2.00	197	37.3	37.3	49.1
	3.00	220	41.7	41.7	90.7
	4.00	49	9.3	9.3	100.0
	Total	528	100.0	100.0	

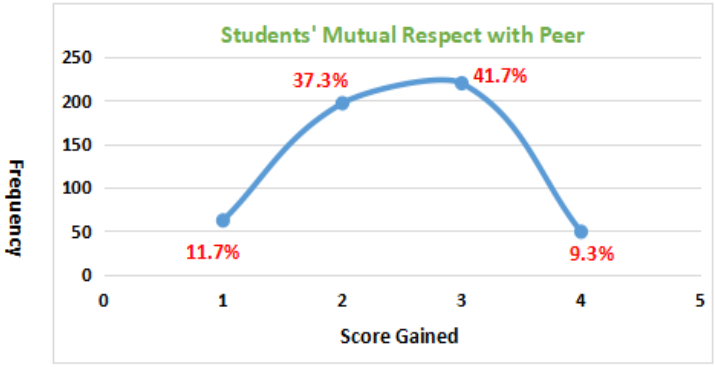

Figure 5. *Scatter with smooth lines & markers of students' mutual respect with peer*

This factor deals with mutual respect with peers. In the case of enhancing mutual respect with peers, students may control an oral production and accept the corrective feedback heightening the communication skills (Fang, Cassim, Hsu & Chen, 2018). Smartphones can be an advantageous device for a pair-study approach, collaborating corrective feedback for the subject matters, verifying students about contents misinterpretation, and supporting teachers to modify and adjust the subject matters (Salzer, 2018). For example, a teacher can set up an online mind-map that is simultaneously editable to students work collaboratively with peers. In this case, a Geography subject can be exemplified on how students can watch the mute iMovie animation about the tectonic plate movements, then they work in groups to tape a voice-over to facilitate the iMovie (Tay, 2016). Herein, students' collaborative learning may gradually indicate the progresses involving enjoyment, social media usage, and learning satisfaction and successes (Al-Rahmi & Zeki, 2017).

Sixth, the effectiveness of smartphones' collective usage that encourages a good habit of learning (Table 6 and Figure 6) shown the result in the following: 51 (9.7) smartphones' collective usage that encourages a good habit of learning was not very effective and 171 (32.4%) was not effective. But, 242 (45.8%) teachers' perceived that the effectiveness of smartphones'

collective usage that encourages a good habit of learning was effective and 64 (12.1%) was very effective, in condition as if teachers allowed students' to use smartphones to support their learning activity in the classroom. The highest score of the effectiveness of the smart phones' collective usage that encourages a good habit of learning was 3.00 (M = 2.60; SD = .822; *n* = 528). The effectiveness of students' mutual respect with peers was **effective**, with 45.8% and gained the third rank based on teachers' perception. Meanwhile, the score distribution was shown in Figure 6.

Table 6. *Smartphones' collective usage that encourages a good habit of learning*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	51	9.7	9.7	9.7
	2.00	171	32.4	32.4	42.0
	3.00	242	45.8	45.8	87.9
	4.00	64	12.1	12.1	100.0
	Total	528	100.0	100.0	

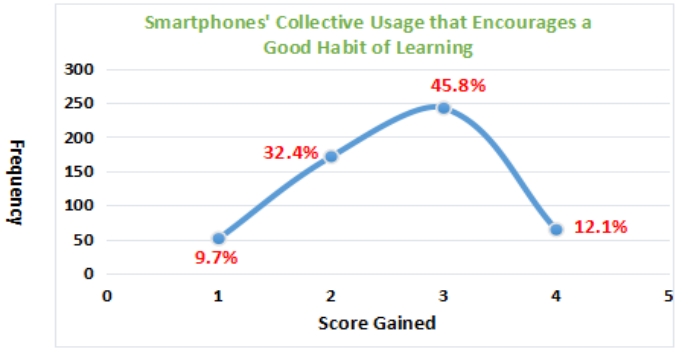

Figure 6. *Scatter with smooth lines & markers of smartphones' collective usage that encourages a good habit of learning*

Smartphones' collective usage encourages a good habit of learning conditionally. It adopts mobile-based learning become prospective students' learning opportunity. Kacetl and Klímová (2019) believed that the benefits flow students' cognitive enlightenment, encouragement to learn both formal and informal settings, autonomy, and confidence, promotion of personalized learning, assistance for slow learners to fulfill their learning objectives. The use of smartphones encompasses a change in students' learning since the interactive mobile device contains the media-rich features. Hence, technical and pedagogical elements facilitate teachers and students' understanding to adapt the high technology device (Montrieux, Vanderlinde, Schellens & De Marez, 2015) as part of the effective e-learning innovation (Burns & Kurtoğlu-Hooton, 2016). Students' self-exploration and ideas sharing build an autonomy-supportive context collaboratively (Beiswenger & Grolnick, 2010) and an appropriate occupation of instruction strategies regarding the interactive online learning (Lin, Chen & Liu, 2017) with the relevant applications (School Technology Branch of Alberta Education, 2012).

Seventh, the effectiveness of peers' social relationships with teachers that gained better dealt with the descriptive and frequencies statistics as shown in Table 7 and Figure 7. The results confirmed in the following: 79 (15.0%) teachers perceived the effectiveness of peer's social relationships with teachers that gained better was not very effective and 205 (38.8%) was not effective. Meanwhile, 186 (35.2%) teachers' perceived the effectiveness of peer's social relationships with teachers that gained better was effective and 58 (11.0%) was very effective. The highest score of the effectiveness of peer's social relationships with teachers was 2.00 (M = 2.42; SD = .874; *n* = 528). Therefore, the overall effectiveness was **not effective**, with 38.8% and proved in seventh rank based on teachers' perception. Meanwhile, the score distribution was shown in Figure 7.

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Table 7. *Peer's social relationships with teachers that gain better*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	79	15.0	15.0	15.0
	2.00	205	38.8	38.8	53.8
	3.00	186	35.2	35.2	89.0
	4.00	58	11.0	11.0	100.0
	Total	528	100.0	100.0	

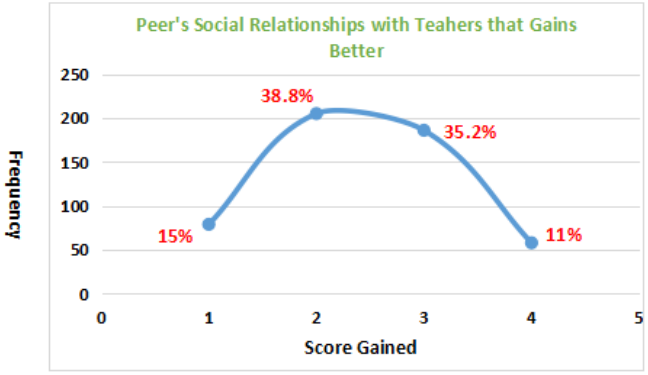

Figure 7. *Scatter with smooth lines & markers of peer's social relationships with teachers that gain better*

Peers' social relationships with teachers gain better when the sophisticated use of the technological device is needed to maintain a daily learning habit either individual efforts or social supports (Jin, Kim & Baumgartner, 2019). In creating peers' social relationships, a teacher motivated to adopt the factual mobile-integrated education program and to gradually modify the program into students' personalized program (Sung, Chang & Liu, 2016). Meanwhile, students can customize the technology contents complying with a more efficient learning (Gheytasia, Azizifara & Gowhary, 2015). Peers' social relationships can flexibly be accommodated using accessible smartphones (Anshari, Almunawar, Shahrill, Wicaksono & Huda, 2017) with the right situation for successful learning and teaching, and positive attitudes, where students stay with inclusiveness, appreciation, and enjoyment, and secure (APS Group Scotland, 2013). Relationships create the objectives of building a loveable learning atmosphere (Furrer, Skinner, & Pitzer, 2014) since the relationships and interactions are the point of leading an understanding commitment (Pianta, Hamre & Allen, 2018).

Alternatively, smartphones will not only bother teachers and peer, but also annoy those who are willing to pay attention (Ictech, 2018). In this case, Baker, Lusk and Neuhauser (2012) confirm that nearly half of their respondents trust smartphones usage become harmful to the learning processes. Text messaging from smartphones detracts students who are willing learn, blemishing the class session for those who are bothered (Tindell & Bohlander, 2012). Further, Jesse (2015) believed that the downside of increased number of using smartphones causes anxiety among students since they tend to have their smartphones with them. A nuisance or inconvenience to other classmates and teachers as this situation shows a lack of participation and teacher-students relationships when sharing personal and academic issues (Sánchez, González & Martínez, 2013). Based on the empirical result, the number of 38.8% shows that peer's social relationships with teachers that gains better is **not effective**. Furthermore, the analysis corresponded with seven perceived factors influencing in students' collaboration effectiveness. The significant correlations were r = .743, n = 528, p<.000. The highest level of effectiveness of students' comfortableness with learning activity associated with the lowest level of peers' social relationships with teachers. However, the effectiveness of these factors was accordingly positive and significant with p<.01 level for 2-tailed prediction. Table 8 showed the Pearson correlations coefficients in the following orders: .743, .698, .728, .729, .633 and .595.

Table 8. *Pearson correlations coefficients among students' collaboration effectiveness*

	Factor		1	2	3	4	5	6	7
Pearson product-moment	1. Learning and discussion with peer	Pearson Correlation	1	.743**	.698**	.728*	.729**	.633**	.595**
		Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
		N	528	528	528	528	528	528	528
	2. Comfortableness with the learning activity	Pearson Correlation	.743**	1	.792**	.705**	.709**	.667**	.603**
		Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
		N	528	528	528	528	528	528	528
	3. Dynamic learning atmosphere	Pearson Correlation	.698**	.792**	1	.709**	.706**	.665**	.627**
		Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
		N	528	528	528	528	528	528	528
	4. Mutual appreciation among students when giving feedback	Pearson Correlation	.728**	.705**	.709**	1	.785**	.649**	.602**
		Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
		N	528	528	528	528	528	528	528
	5. Students' mutual respect with peer	Pearson Correlation	.729**	.709**	.706**	.785**	1	.691**	.664**
		Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
		N	528	528	528	528	528	528	528
	6. Collective usage encourages a good habit of learning	Pearson Correlation	.633**	.667*	.665**	.649**	.691**	1	.676**
		Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
		N	528	528	528	528	528	528	528
	7. Peer's social relationships with teachers	Pearson Correlation	.595**	.603**	.627**	.602**	.664**	.676**	1
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
		N	528	528	528	528	528	528	528

**Correlation is significant at the .01 level (2-tailed)

By aligning the coefficients outputs, the independent-samples t-test was next determined to generate primary and secondary teachers' perception upon students' collaboration effectiveness that compared a significance difference. There were no primary teachers' significant difference (M = 2.06, SD = .789) and secondary teachers (M = 2.25, SD = .561; *t* (-.757) = 27, *p* = .456 using two-tailed). The weightiness of the mean difference was -.193%; *CI*: -.718 to .331. Seven perceived factors referred to the principal components analysis (PCA) outputs. Before indicating the PCA, factor analysis suitability was examined through the correlational matrix that exhibited the existence of obtainable coefficients of .107 above. Therefore, the Kaiser Meyer-Olkin gained .612, reaching the entrusted value of .6 or above, whilst Bartlett's Sphericity test was significant (*p* = .000). Therefore, factor analysis was appropriate (Pallant, 2011). This examination contended with the significance of the statistics and performed the factorability of the correlational matrix.

The PCA's outputs inferred the existence of seven factors with the Eigenvalue transcending 1, indicating 73%, 7.2%, 5.4%, 4.5%, 4%, 2.9%, and 2.7% of the factors correspondingly (Table 10). The scree plot examination defined a bounded part afterward granting seven factors. After that, the scree plot was determinable to decline two axes for an analysis beyond (Figure 8) and endorsed by the comparable analysis outputs. Moreover, the scree plot demonstrated two axes with the Eigenvalue that exceeded the corresponding criterion values for bringing about the accessible size of matrix data [7 factors x 528 primary and secondary teachers] at random.

Table. 10. *Total variance explained upon students' collaboration effectiveness*

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Square Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.114	73.052	73.052	4.702	67.164	67.164	4.746
2	.507	7.240	80.292	.407	5.813	72.977	4.042
3	.375	5.352	85.643	N/A	N/A	N/A	N/A
4	.317	4.524	90.167	N/A	N/A	N/A	N/A
5	.285	4.069	94.237	N/A	N/A	N/A	N/A
6	.209	2.981	97.217	N/A	N/A	N/A	N/A
7	.195	2.783	100.000	N/A	N/A	N/A	N/A

Extraction Method: Principal Component Analysis.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

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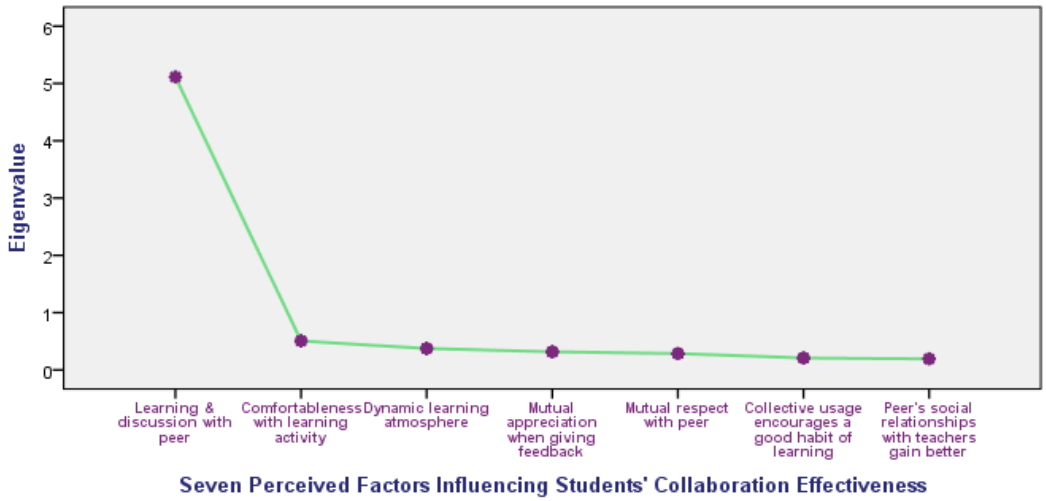

Figure 8. *Scree plot of seven perceived factors influencing students' collaboration effectiveness*

The factorial analysis continuity extracted two substantial components with a value of 72.97%. This value was derived from component 1 that contributed 67.16%, whilst component 2 resulted in 5.81%. In determining seven perceived factors, the rotated oblimin consecutively reflected the results (Table 11). This rotation confirmed the presence of a simple structure conveying component 1 and component 2. The components indicated the number of squared loadings with the factors partially emphasizing on component 1. The exposition of both components was reasonable with the experimental outputs of students' collaboration effectiveness. Herein, component 1 resulted a positive effectiveness, whereas component 2 complied with a negative effectiveness (r = -.718) that separately scaled these factors.

Table 11. *Pattern & structure matrix for PCA with the oblimin rotation of two-component of collaboration effectiveness*

Obtainable Rotation Factor	Pattern coefficients		Structure coefficients		Communalities
	Component 1	Component 2	Component 1	Component 2	
5. Mutual respect with peer	**.947**	N/A	**.892**	-.718	.784
4. Mutual appreciation when giving feedback	**.855**	N/A	**.863**	-.717	.753
7. Peer's social relationships with teachers gain better	**.796**	N/A	**.758**	-.613	.627
6. Collective usage encourages a good habit of learning	**.739**	N/A	**.793**	-.678	.690
1. Learning & discussion with peer	**.611**	N/A	**.820**	-.758	.737
3. Dynamic learning atmosphere	**.463**	-.426	**.816**	-.810	.758
2. Comfortableness with the learning activity	N/A	-.948	**.815**	-.973	.765

Note: major loadings for each item were in boldface

CONCLUSION

The effectiveness of students' interrelationships between the smartphones facilitation and the collaboration constitutes the potential strategy of learning performance by increasing students' participations. Smartphones facilitation support the effectiveness of students' collaboration in the classroom within teachers' supervision. This condition relies on recognizing substantial collaborative learning qualities and integrating the purpose of smartphones facilitation insights. Upon teachers' guided use of the smartphone, students' collaboration effectiveness will continually provide their learning responsibility and maturation. Nevertheless, students' collaboration effectiveness somehow needs an exploration and an engagement through the social constructivism conveying their learning activities. Conversely, teachers' open-minded instructions may be still far-reaching options, carrying most teachers on retaining the conventional didactic approaches, and poorly lacking day-to-day implementable supports from the authorities. This study is also aware of students' socio-cultural increase for the mobile-based learning implementation.

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