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Effects of smartphone utilization on junior high school students' mathematics performance

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Abstract

Smartphones are widely used among high school students nowadays. With their constant use of this technology, they have become more dependent on it. This study assessed the extent of smartphone utilisation and the academic performance of the 195 junior high school students at a public national high school. Respondents were identified using stratified random sampling and were asked to answer a survey questionnaire assessing their smartphone utilisation during their math classes while their performance in the subject was determined using their First Quarter grades. The data gathered were treated using descriptive and inferential statistics. The results revealed that the respondents had very satisfactory performance and they often use their smartphones during their math classes. Smartphone utilisation has a negative negligible correlation with the student's academic performance in Mathematics. Furthermore, Smartphone utilisation has no significant relationship between the respondents' math performance. Hence, teachers are encouraged to monitor students' use of gadgets during their math classes.

Keywords: academic performance, Mathematics, junior high school students, smartphone utilisation

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1. Introduction

Technological development has advanced over the years and it has changed the way people live, communicate, travel, and learn (Mora Rodriguez, 2013). This advancement of modern technology has produced different technological devices, which gives humans great help in dealing with every day challenges (Wardynski, 2019). One of these technologies, which have brought about a significant change in the lives of the people is the smartphone. Smartphones are the latest models of mobile phones which are already accessible even to students (Darko-Adjei, 2019; Silver, 2019). With smartphones, students can check their emails, download applications for reading and editing office programmes, take pictures and videos, record sounds for reporting and browse the internet (Clayton & Murphy, 2016). Social communication media such as Facebook, Twitter, Instagram, Viber, WhatsApp, Global Positioning System function and games are especially popular on smartphones.

In high schools, the most commonly used devices for educational purposes are tablets (iOS/Android), smartphones (iOS/Android), and laptops (Windows/Macintosh). These devices are used inside the classroom to enhance the students' performance and to improve their learning experiences (Gore, 2010;Lieberman, 2019). With the use of these devices, students are more interested and eager to learn every day's lesson. They tend to be more interactive in the different classroom discussions (Dietz & Heinrich, 2014). Moreover, a smartphone is considered a vital invention of human beings because of its contribution to the development of the quality of human life (Ravichandran, 2009).

The use of smartphones has become vital to the students' learning experiences (Darko-Adjei, 2019; Sung, Chang & Liu, 2016). Students are more accustomed in using collective technologies and they are fully grown in the era of mobile phone technologies (Blondel et al., 2015). In schools, almost all students have acquired smartphones due to its low cost compared to other devices. Students have become well versed and more oriented towards the different features and applications that each smartphone is able to offer (Noorhidawati et al., 2015).

This technological advancement caused the education sector to adopt the change and made use of this technology inside the classroom (OECD, 2016). Hence, technology is significant in transforming the classroom setting from a traditional set up to a student-centred classroom, which is quite relevant these days (Mora Rodriguez, 2013). The transition to a student-centred classroom has been shown to lead to an increase in students' school performance (Cavanaugh et al., 2011). It lessens the adoption of the traditional activities and learning processes in teaching that are widely used in schools. Thus, embracing technology advancement in the four walls of the classroom is very evident (Valk et al., 2010).

Currently, the education system is making a move towards the use of technology in the classroom ranging from elementary to the collegiate level of education. With this, educators need to realise that today's students are far different from students' years ago. With today's generation, it is better to integrate the use of technology like smartphones into the teaching – learning process. It is interesting to make use of this gadget to be one of the instructional materials that teachers can use since this has been used by the students already. Transforming this gadget into an instructional material will be easy for the teachers to introduce because students already have an interest in using the gadget (Apuke & Iyendo, 2018**)**.

On the contrary, this advancement in technology also has a negative effect on the students. The increase in technology use inside the classroom can cause a decrease in the academic performance of the students. This is due to the lack of concentration during discussions where students tend to spend

more time handling their mobile phones (Dietz & Heinrich, 2014). Students may lose their focus and interest in the discussion, especially if they get messages or calls in between classes. They could see their mobile phones as more interesting than the events occurring inside the classrooms due to the different applications that are present in mobile phones which students tend to explore more (Sana et al., 2013).

With all the advantages and disadvantages that smartphone utilisation inside the classroom has brought to the students (Rodriguez, 2015; Ifeanyi & Chukwuere, 2018; Mohammadi, Sarvestani, & Nouroozi, 2020), it is imperative to look into its effects on the performance of the students particularly in Mathematics. The capability of these gadgets to calculate math problems needs to be assessed as students are already using these applications when they learn Mathematics (Ng et al., 2017). Some teachers allow students to use their smartphones during their math class as an alternative for calculators. It has been practiced by some schools recently; however, there were few assessments on its effects to the students' academic performance in the subject (Sung, Chang, & Liu, 2016).

1.1 Conceptual framework

The study explored the different literature studies that can provide a foundation in the development of the concepts that this study is trying to investigate.

With modern technology, a more sophisticated mobile phone emerged which is called the smartphones. It is used to help students in gaining information from the internet, transmogrify it, shift it, and collaborate with students (Ferry, 2009). All of these skills enable learners to associate to their everyday lives (Horizon Report, 2009). Students are more likely to engage in rich technology interactions when they are outside the classroom (Haythornwaite & Andrews, 2007) in order to supplement what has already been taught in class.

Changes in instructional practices resulted in changes in student engagement and student achievement. It is believed that technology can be used to engage today's students and that the transition to a student-centred classroom has been shown to lead to an increase in student performances (Dawson et al., 2008). It is important to integrate cell phone technology in the teaching and learning process because it is already necessary in most under-resourced rural communities (Makoe, 2013).

In the last generations, notebooks and pencils are commonly used in the classrooms in learning, but as of now, students use their mobile phones inside the classrooms (Economist Intelligence Unit, 2008). The establishment of the connections of the students, educators, and technology are important for 21st-century learners who experience change in the pedagogical model from teacher-centred instruction to student-centred instruction based on collaborative learning. Prensky (2009) claims that students have changed radically because the students of today are no longer the people that the educational system was designed to teach. They crave interactivity. With the use of smartphones, it can support a more active, learner-centred and differentiated learning environment that contributes to increased student motivation (Markett et al., 2006).

1.2 Related research

The technological devices such as smartphones may have a positive effect on investigating skills, strategic thinking and creativity potentials of the students (Muduli, 2014). They are better sources for learning for the youth. The classroom learning and engagement of the students can be impacted positively by the use of these digital devices, such as smartphones (Samson,2010). Its effective usage

may also have a positive impact on the cognitive thinking and could also make the students master multitasking (Ophir et al.,2009).

A study conducted by Norries et al. (2011) showed that learners scholastic performance increases when learners are allowed to use their mobile devices during classroom discussions. It may also improve the efficiency of students' study activities by allowing them to continuously search for information and by facilitating teamwork (Chen & Yan, 2016; Ha & Hwang, 2014). Moreover, it permits student's active engagement with the use of the functions of smartphones that aids in exploring the various levels of interactivity and learner centeredness (Ozdamli & Cavus, 2011). Students learn through actively formulating new ideas from previous knowledge and experiences, rather than waiting for the information delivered to them by the teacher (Warnich & Gordon, 2015). Since students are actively involved in the learning process, they become responsible of their own learning(Valk et al., 2010).

Although the use of smartphones had positive impacts on education it still had a negative effect. Although the digital activities make the students strong in technical skills made them weak in real-life practical skills. Since learners spent more time on their mobile phones, they opt to engage in outdoor activities and minimally interact with their family and friends. Learners should try to lessen using smartphones and use it for education purposes (Walsh, 2012). Students tend to be more acquainted with their smartphones because they do not want to miss anything that is happening online – nowadays often referred to as fear of missing out but to be in constant interaction with what is happening around may result in the lack of focus on their school-related-tasks(Chen & Yan, 2016; Elhai & Hall, 2016; Firat & Tadajewski, 2010). The constant diversion of students between school tasks and social activities on the smartphones could result in cognitive overload and inefficiency (Chen & Yan, 2016; Junco, 2012; Oulasvirta et al., 2012).

Another study conducted in Kent State University, USA, showed that students using cell phones more frequently have lower academic performance as compared to those in whom its use is less. The extended time of using mobile phones had quite an effect on students' study habits (Kent State University, 2013). When mobile phones addiction level increases, the students' sleep quality deteriorates. Since students use their gadgets more often, they lack sleep or had a reduced time of study which directly affects their school performance. Learners are more attached to their mobile phones which might cause distractions in the learning environment (Geser, 2006; Junco, 2012; Timm, 2008).

It is known that students using mobile phones during class are experiencing negative side effects on their academic performance (Junco, 2012). The study of Gingerich and Lineweaver (2014) showed that the use of smartphones demonstrates a significant negative effect on the academic performance. Whether students realise it or not, their classroom mobile phone usage is also leading to negative side effects on their studies in proximity (Wood et al., 2012). Students may believe that using mobile phones during class is a personal choice and will only affect themselves (Pulliam, 2017). Educators can be agents in helping learners use their mobile phones properly inside the classroom.

Thus, the evolution of technology gradually affects the school performance as well as students' achievement. With the use of mobile phones, learners can learn comfortably, can quickly come up with answers and can access the different mobile educational applications anytime. Educators have to embrace the use of technology inside the classroom to adapt to the change in the community. With these arguments, this study is necessitated to provide a concrete view of the effects of smartphone utilisation to the students' performance in Mathematics.

1.3 Purpose of the study

This research aims to assess the effects of smartphone utilisation on the academic performance of the junior high school students in Mathematics. Specifically, it sought answers the following problems:

1. What is the level of academic performance of the students in Mathematics?
2. What is the extent of students' smartphone utilisation?
3. Is there a significant relationship between the extent of smartphone utilisation and the academic performance of the students?

2. Methods and Materials

This section presents the research method, participants, data collection tools, data collection process, and data analysis.

2.1 Research method

This study used the descriptive correlational research design to investigate the relationships between smartphone utilisation and the students' academic performance in Mathematics. A correlational-research determines the relationship between two variables without the intent of manipulating them (Bhandari, 2021). The extent of student's smartphone utilisation and academic performance were assessed using specific tools in order to describe these variables accurately before hypothesis testing was conducted to test their relationship.

2.2 Participants

This research was conducted at a public national high school in Consolacion, Cebu, Philippines. Students from the junior high school who voluntarily participated took part in providing the salient information needed in this study. Table 1 presents the distribution of the profile of the students in terms of their age, gender, and grade level.

Table 1. Profile of the students

Profile	f	%
Gender		
Male	86	44.10
Female	109	55.90
Total	**195**	**100.00**
Age (in years)		
17 – 18	7	3.59
15 – 16	57	29.23
13 – 14	88	45.13
11 – 12	43	22.05
Total	**195**	**100.00**
Grade Level		
Grade 10	41	21.03
Grade 9	38	19.49
Grade 8	54	27.69
Grade 7	62	31.80
Total	**195**	**100.00**

As reflected in Table 1, there are more female students who participated in the study. Moreover, the majority of their the age ranged from 13 to 14 years old, while grade 7 students had the highest number of participants.

2.3 Data collection tools

A structured researcher-made questionnaire was used to gather information from the students on the extent of their smartphone utilisation. It has 10 indicators which the respondents answered based on their agreement towards their utilisation of the smartphones using a 5-point Likert scale: 5 – Strongly Agree, 4 – Agree, 3 – Undecided, 2 – Disagree, and 1 – Strongly Disagree. The instrument had undergone a validity test with the aid of a statistician and the experts in the field who checked its content and face validity. A pilot testing using Cronbach's alpha was also conducted with 10 respondents in order to determine the internal consistency of the results on the indicators of the construct being measured (Tavakol & Dennick, 2011). A Cronbach's alpha value that is greater than 0.70 thresholds was observed during the pilot testing as a sufficient measure to ensure the reliability of the instrument (Taber, 2018). Thus, the achieved value of 0.868 denotes a high internal consistency on the construct being measured.

Moreover, their academic performance in Mathematics was determined using their First Quarter grades in Mathematics based on their permanent record. Lastly, the participants were identified using stratified random sampling in which their year level was used as the stratum. A stratified random sampling is a probability sampling which involves dividing a population into small groups called strata. The small groups are formed based on their common characteristics (Hayes, 2021).

2.4 Data collection process

To ensure better and accurate outcomes, the survey questionnaires were administered personally by the researchers by providing certain directions as well as in explaining to the students the purpose of the study. The researchers had further informed the students that their answers will be kept with utmost confidentiality. In determining the academic performance of the students, their First Quarter grades in Mathematics were taken from the Registrars' Office with the permission of the latter.

2.5 Data analysis

The data obtained from the students were treated using descriptive statistics such as percentage and frequency count for their profile and academic performance. The weighted mean and standard deviation were used to describe the extent of the students' smartphone utilisation. Pearson's *r* was used to test the relationship of the extent of students' smartphone utilisation and their academic performance.

3. Results

This section presents the academic performance of the respondents, the extent of their smartphone utilisation and the test on the relationship of these variables.

Table 2. Performance level of the respondents in Mathematics

Performance Level	Numerical range	f	%
Outstanding	90 – 100	44	22.6
Very Satisfactory	85 – 89	104	53.3
Satisfactory	80 – 84	16	8.2
Fairly Satisfactory	75 – 79	31	15.9
Did not meet the Expectations	Below 75	--	--
Total		**195**	**100.00**
Average		**86.6**	

Table 2 presents the First Quarter grades in Mathematics of the respondents which are categorised according to the Department of Education order no. 58 series of 2017. As reflected in the table, there were 44 (22.6%) students who performed outstandingly in their mathematics class, however, there were 104 (53.3%) students who performed very satisfactorily in their mathematics class. There were 16 (8.2%) students who performed satisfactorily in their mathematics class, on the other hand, there were 31 (15.9%) students who performed fairly satisfactory in their mathematics class.

Table 3 illustrates the extent of the students' smartphone utilisation during their Mathematics class and activities. The table contains statements describing how often the students utilise their smartphones in different math activities. With the overall weighted mean of 3.53 having a standard deviation of 0.460, these suggest that the students often use their smartphones in their mathematics class.

Table 3. Extent of smartphone utilisation of the respondents

S/N	Indicators	WM	SD	Verbal Description
1	I use smartphone when doing my Mathematics homework.	3.61	0.893	Often
2	I use my smartphone in my Mathematics class.	3.42	0.988	Often
3	I use my smartphone when taking a Mathematics test.	3.43	0.861	Often
4	I use my smartphone to better understand the material being covered in Mathematics class.	3.46	0.937	Often
5	I use almost all the features of the smartphone in my Math class.	3.46	0.813	Often
6	I perform more work in math activity using a smartphone that requires the use of a calculator.	3.68	0.927	Often
7	I have sufficient access to my smartphone in any Math activity.	3.44	0.952	Often
8	I have the necessary skills to use my smartphone in my Math class.	3.50	0.997	Often
9	I use my smartphone to communicate and collaborate with my classmates.	3.62	0.974	Often
10	I use my smartphone to understand complex and abstract concepts in Math.	3.56	0.867	Often
	Overall weighted mean	**3.53**		**Often**
	Overall standard deviation		**0.460**	

Legend:4.21 – 5.00 Always 3.41 – 4.20 Often 2.61 – 3.40 Sometimes 1.81 – 2.60 Rarely 1.00 – 1.80 Never

Table 4 shows the significant relationship between the smartphone utilisation and the academic performance of the respondents. As reflected in the table, 195 student – respondents yield a computed *r*-value of –0.041 which shows that there is a negligible negative correlation between the smartphone utilisation and the academic performance of the students in mathematics. The correlation had a *p*-value of 0.570 which is greater than the level of significance of 0.05 ($p > 0.05$) suggesting that there is no significant relationship between these variables.

Table 4. Correlation analysis between smartphone utilisation and academic performance of the respondents in mathematics

Variables	*r*-value	Strength of correlation	*p*-value	Decision	Remarks
Smartphone utilisation and academic performance	- 0.041	Negligible negative	0.570	Do not reject Ho	Not significant

*significant at $p < 0.05$(two-tailed)

4. Discussion

The research findings revealed that the mean average of the students' academic performance in mathematics is 86.6 which show that the students performed very satisfactorily in their mathematics class. This is further substantiated by the distribution which shows that 104 (53.3%) students falls under the very satisfactory level of performance in their mathematics class. Though the students' performance falls under the very satisfactory level, the students still have to improve their performance. The first quarter of the school year serves as the period of adjustment of the students when they engage in the new level of mathematics learning.

Teachers can help the students improve their performance on the succeeding quarters for the school year by giving students some relevant learning activities and assessing the areas where students have difficulties in learning so that intervention may be provided to address students' concerns towards learning their lessons (Albay & Eisma, 2021). Allowing students to utilise their smartphones during math classes or performing math-related tasks is one of the areas that teachers need to assess its effectiveness during the learning process (Sung et al., 2016). Otherwise, the achievement of its goal will not be determined.

Students often use smartphones during their math classes because teachers allow the use of these gadgets but students take advantage of this policy of the teachers. Thus, students use their smartphones during their mathematics class as an alternative to calculators and to learn new concepts in mathematics. Teachers allow such use of smartphones because some students do not have calculators. Without calculators, the students will have difficulties in solving math problems with complex computations because they have to do computations manually.

Interestingly, calculators aid the students in saving time to compute and provide convenience in solving math problems(Peteros et al., 2021). Calculator is one of the functions of smartphones which students already have access to. Using this gadget in solving problems provides more student engagement and motivation to learn their lesson. The use of mobile technology allows the students to

actively engage with its functions that allow for varying levels of interactivity and student-centredness (Ozdamli & Cavus, 2011).

The test on the relationship between the student's smartphone utilisation and their academic performance in math was not significant. This finding is supported by Bennett (2020) who found no significant weak negative correlation between the students' smartphone usage and their academic performance. However, this is contradicted by the study of Darko-Adjei (2019), which found a positive usefulness of smartphones to the learning activities of the students. Moreover, Ng et al. (2017) found a significant weak negative correlation between smartphone usage and the academic performance of the tertiary students. On the other hand, Irna (2020) found a significant relationship between smartphone usage and the learning achievement of the students.

In this study, allowing students to use smartphones does not contribute to their performance in the subject. Smartphones are used for calculations of complex mathematical computations but cannot confirm if the process of calculations are correct to the solutions required to math problems. This gadget is only helpful in making the calculations easier but not on the math concepts that the students need to acquire while learning mathematics. Moreover, the mathematical functions of smartphone are still dependent on its user. Thus, the students still need to be equipped with the right mathematical concepts in order to use the gadget effectively.

On the other hand, students might be tempted to use the other functions of the gadget while using this during math classes. This could distract the students' focus on the lessons because they will have the tendency to explore these functions such as surfing the internet, social media, games, and the like during math classes. If teachers do not monitor its usage, then this could have a negative effect on students' math performance. Hence, the increase in the usage of mobile technology inside the classroom can cause a decrease in the academic performance of the students (Dietz & Heinrich, 2014; Gingerich & Lineweaver, 2014) if it is not used for its intended purpose.

5. Conclusion and recommendations

The study focused on the effects of smartphone utilisation on the performance of the students in Mathematics. The results indicate that smartphone utilisation does not contribute to the performance of the students in the subject. Students' learning is not enhanced through the use of the gadget allowed in math classes which serves as an alternative to calculators. Although allowing students to use this gadget might be promising specific policies on the gadget utilisation can be outlined to ensure its effectiveness while learning the subject.

Without clear policies that should be inculcated to the students, smartphone utilisation would rather have a negative effect on their performance because this gadget can distract them during classes, especially when they are allowed to use the other functions of the gadget while having math classes. Moreover, teachers need to monitor the students while utilising the gadgets during math classes to prevent them from exploring things not related to what is prescribed by the teacher. Consistent use of the gadget could bring negative effects to the students' performance when the intent of its utilisation during classes is not strictly followed.

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