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Investigating Students' Perception towards the Use of Social Media for Computing Education in Nigeria

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ABSTRACT

This study examined the use of a social media platform – WhatsApp – by computer science students for learning computing education in the context of a Nigerian education institution. Nowadays, a large community of students in higher education institutions has embraced the WhatsApp platform for social interactions which makes it a useful tool in education. In this study, students formed three closed groups, and each group had a specific computing topic they discussed. Their discussions were in the form of posting questions, providing answers to questions, or expressing knowledge on the group topic. A questionnaire was used to collect data from the participants regarding their experiences. We conducted a descriptive analysis of the students' learning outcomes. The results show that the use of social media contributes positively to students' learning achievement, and they are motivated to acquire more knowledge about different computing topics.

Keywords: Social media, Computer science education, Computing students, WhatsApp, Social network, Nigeria

1. INTRODUCTION

Social media could be referred to as the various online communication platforms which are dedicated to interactions and collaborations and, in most cases, designed to enable people to share content efficiently and in real-time (Aldahdouh, Nokelainen, and Korhonen, 2020). According to Bermudez et al. (2016), social media has become one of the most commonly used ways of expressing feelings and ideas. Notable social media platforms include Facebook, Twitter, Instagram, WhatsApp, LinkedIn, and ResearchGate. There has been a substantial increase in the number of social media users in the last decade (Huo et al., 2019). Among these users, students of varied ages form a good portion, creating opportunities for learning activities. Aside from its benefits, researchers have concerns regarding the patronage of social media in recent years for indecent purposes. For instance, some authors have argued that unguided use of social media can lead to depression (Shensa et al., 2017) or drug abuse (Mackey, Liang, and Strathdee, 2013). Social media usage during lectures has also been associated with poor performance (Rozgonjuk, Saal, and Täht, 2018). However, the potential of social media could be harnessed in various disciplines and sectors for education, training, healthcare, and rehabilitation. For instance, a category of social media called Massively Multiplayer Online Games (MMOG), also known as Multi-User Virtual Environments (MUVE), allows users to interact with each other for gaming and healthcare education through a 3D virtual representation of themselves (avatar) (Giustini et al., 2018). Research into the use of social media in different fields is recently being explored in public health, medicine, and paramedical training (Grajales et al., 2014; Lahiry et al., 2019).

The use of social media for computing education is on the rise, especially in developed countries where students communicate with each other frequently using various social media platforms. The adoption of social media for computing education in tertiary institutions has been seen to boost individual knowledge, cooperation, coordination, and self-confidence (Lahiry et al., 2019).

Computer science students are exposed to social media for daily interactions among a network of friends. The use of smartphones, which is prevalent among students in tertiary institutions, provides the opportunity for the development of mobile learning (Oyelere et al., 2017), smart learning (Agbo and Oyelere, 2019; Agbo et al., 2019a; Agbo et al. 2019b), and other technology-enhanced learning environments. Most of the social media platforms, for example, Facebook and WhatsApp, have features that enhance collaborative learning in a closed group. These closed groups can define their objectives independently for smooth information exchange. Although studies regarding the impact of social media for education have been conducted (Tasir et al., 2011; Alhababi et al., 2015; Jamari et al., 2014; Bermudez et al., 2016; Oyelere, Paliktzoglou, and Suhonen, 2016; Richardson, 2017), investigations on students' knowledge on the possible use of social media, their attitude towards it, and their perception regarding the impact of social media for computing education are lacking. This investigation is especially important in developing countries where the use of social media platforms such as WhatsApp to reach out to contacts is growing at a faster pace (Agbo et al., 2020). In addition, while previous studies have investigated how social

media influences users' innovativeness in the context of the developed country – for instance, Finland (Aldahdouh, Nokelainen, and Korhonen, 2020) – the impact of social media usage on students' learning experience in the context of the developing countries requires more study.

This study seeks to examine the use of social media platform – WhatsApp – by computer science students for learning computing education within a Nigerian higher education institution. WhatsApp is a social media platform that has a large community of users, including students at higher education institutions. The platform supports quick and easy interaction, collaboration, and content sharing, and these make it a useful tool in education. In our study design, students of computer science at the university formed different groups, and each group has a specific computing topic they discussed and interacted with for knowledge sharing within the group. Their discussions could be in the form of posting questions, providing answers to questions, or expressing knowledge on the group topic. Similarly, we conducted an analysis of the students' opinions regarding the adoption of WhatsApp for computing studies. Finally, we investigated the students' perceptions on how the use of social media impacts their understanding of computing education. In this study, the following research questions are considered:

RQ1. How do students make use of WhatsApp, as a social media platform, for computing education in higher education institutions in Nigeria?

RQ2. What perceptions do students hold on the impact of using WhatsApp, as a social media platform, for knowledge acquisition in computing education in Nigeria?

The rest of the paper is organized as follows: section two explores the different aspects of social media, its application to education, and computing education. The section also provides a literature review on social media as an educational intervention, potential and challenges of the use of social media for teaching and learning, and factors that influence the adoption of social media for teaching and learning. Section three treats the methods, study design, and the study context. The section also discusses the instruments and participants. Section four presents the results of our study. Section five reflects on the results and discusses the study findings. Finally, section six concludes the paper with relevant recommendations and future research directions.

2. LITERATURE REVIEW

Higher education students are IT savvy, technologically inclined, and prefer learning via technology (Ismail, Hussin, and Darus, 2012). As a result, the importance of an instructional tool, such as social media platforms, in the teaching and learning process cannot be over-emphasized. Teachers must, therefore, use these qualities to their advantage to improve their teaching and learning. The new generation of students enters tertiary institutions with a strong command of competencies to communicate via information and communication technology (ICT), a situation which facilitates the introduction of social networking sites (SNSs) to support learning (Liccardi et al., 2007). The SNSs are ubiquitous in everyday life, seeping into educational environments and leaving educators with little choice but to explore how best to incorporate such tools into teaching and learning (Madge et al., 2009).

Social media participation is widespread with evidence to support learning activities. For example, Madhusudan and Raman's (2016) reported how social media sites are valuable tools for teaching and collaborative learning. Additionally, Devi, Gouthami, and Lakshmi (2019) asserted that the use of SNSs in education can be useful in blended learning while teachers can communicate instantly and directly with the students and compare notes on education techniques, curriculum, and teaching methodology. The application of SNSs in teaching and learning offers a positive impact and opens the door to new ways of learning and teaching (Devi, Gouthami, and Lakshmi, 2019). Familiarity to almost everyone, minimal cost, and minimal training are the primary reasons for social media adoption in classroom settings (Madge et al., 2009).

In higher education settings today, instructors, students, and other stakeholders collaborate on the task of knowledge construction. New web tools are emerging that are enhancing learning (Brydolf, 2007). The favorites are Facebook, Twitter, blogs, YouTube, Instagram, LinkedIn, podcasts, and others. These platforms play a significant and influential role in decision-making regarding the world – economically, politically, socially, and educationally (Devi, Gouthami, and Lakshmi, 2019). The use of electronic resources, such as text, videos, and audio materials via social media platforms, supports the learning process of students in addition to the evaluation process and can be valuable tools for collaborative learning (Moron, Seaman, and Tinti-Kane, 2011). Students who may be reluctant to speak up in class or participate in discussion blogs are provided with the opportunity to communicate through the social media platform.

2.1 Social Media in Educational Settings

Recently, research focused on the use of social media for learning and teaching in higher education institutions has gained scholars' interest. This development can be connected to the increase in the advancement of technology and the affordability of the resources needed to socialize. In the educational context of Nigeria, a study conducted in one of the universities by Oriji and Anikpo (2019) revealed that social media, such as WhatsApp, is useful in teaching and learning. Aside from WhatsApp being utilized in this study, some other popular social media sites that have been adopted in educational contexts are highlighted as follows:

2.1.1 Facebook. Rising to mainstream prominence around 2007, Facebook is a popular website that allows users to interact and collaborate within a pre-defined virtual community (Boyd and Ellison, 2007). Among other social network sites, Facebook seems to be popular among students in colleges and universities (Steinfield, Ellison, and Lampe, 2008; Lampe et al., 2011). Depending on the purpose of use, Facebook promotes social interaction. The rapid growth in the number of students has made Facebook research vital to researchers wishing to study this phenomenon and its implications on different aspects of students' learning.

The common reason for using Facebook remains social interaction and communication, while the use for academic purposes is still emerging (Hew, 2011). University teachers and students can use Facebook in relevant educational ways that promote student engagement (Lampe et al., 2011; Junco, 2012).

2.1.2 Blogs/wiki. Blogs create opportunities for students to write and display their ideas on a large scale instead of traditional writing projects (Devi, Gouthami, and Lakshmi, 2019). There have been several successful reports on pedagogical uses of blogs and wikis (Richardson, 2004; O'Donnell, 2005; Cheung et al., 2006). According to O'Donnell (2005), blogs offer a socially situated, student-centered, contemporary, technical solution. Farmer, Yue, and Brooks (2007) assert that it caters to individual self-expression and socially-driven learning. Student-centered learning is enabled in blog monologues that enhance constructivist cognition and meta-cognition (higher-order thinking). Ioannou (2011) revealed that using a wiki demonstrates higher levels of collaboration characterized by new ideas, modifications, elaborations, questioning, and agreements.

2.1.3 Podcasts. Podcasting allows placing recorded material on a website from which they can be downloaded and listened to at a later time (Scutter et al., 2010). Podcasting has been employed in the academic environment which accommodates a wide variety of learning strategies for students (Boulos, Maramba, and Wheeler, 2006). Studies show that podcasting of lectures can provide additional resources for students who are unable to attend face-to-face classes due to sickness, work, or family responsibilities. They can listen to the lecture in conjunction with presentations, also commonly made available to students (Scutter et al., 2010). McKinney and Page (2009) justified the use of the podcast when using it later to understand lecture content if one was distracted in a face-to-face class. Furthermore, Brittain et al. (2006) showed that students prefer the use of podcasts to the other formats, possibly because they could listen to the podcasts while engaging in other tasks.

2.1.4 YouTube. In the academic context, some courses have used YouTube as a platform for students to create and share videos for their courses (Johnson et al., 2010). YouTube is an excellent option for a flipped classroom in that students can watch lectures and resources before entering the classroom (Devi, Gouthami, and Lakshmi, 2019). It also provides an opportunity for student-generated media and viral advertising, as this is evident in the study of Payne et al. (2011), who showed that students expressed enjoyment in creating advertisements based upon entertainment, creativity, teamwork, and challenge.

2.1.5 Twitter. Twitter is a microblogging social networking platform that combines the opportunities of blogging and instant messaging (Raes et al., 2016). In an educational context, Twitter can be used to generate interaction in an online course or used to supplement face-to-face classroom interaction (Rinaldo, Tapp, and Laverie, 2011). Additionally, in either stream, Twitter enables the development of a social presence among students and the faculty member. Twitter can enhance active learning in higher education outside of the classroom, as Twitter enhances communication and supports informal learning practices, although its character limits constrain critical thinking and self-reflection (Kassens-Noor, 2012). Twitter offers a quick way to post class announcements and reminders, give real-time information on class field trips, and help classes track information on any topic (Devi, Gouthami, and Lakshmi, 2019)

2.1.6 Instagram. Instagram is a social network that allows users to share pictures and videos publicly or privately. This social media platform, which was launched in 2010 (Handayani, 2015), functions as Twitter but with a visual focus rather than textual. According to Kirst (2016), Instagram can become a great educational tool that makes the educational process unique, interesting, and insightful. It exists as a live stream of published photos and videos with optional filters. According to Phillips (2013), Instagram is a photo-sharing website that enables users to take, edit, and share photos. The use of the social media tool can lead to students exchanging opinions and views on different topics as well as participating in a group activity which makes it possible for the exchange of knowledge with classmates and teachers (Handayani, 2015).

2.2 Potentials and Challenges of Social Media for Teaching and Learning

There have been several studies and reports on the positive impact of social media adoption in the teaching and learning process (Brydolf, 2007; Liccardi et al., 2007; Moron, Seaman, and Tinti-Kane, 2011; Madhusudan and Raman, 2016). In contrast, the social and open environment has limitations and challenges which cannot be ignored (McLoughlin and Lee, 2007). According to Madge et al. (2009), students tend to use social media for more informal learning, such as communicating with peers about course content, but they are less interested in using these tools for more formal learning activities. Additionally, Kirschner and Karpinski (2010) analyzed another challenge of using social media in the classroom. They posit that teachers have difficulty maintaining students' attention on class activities when social media activities are initiated. This finding is in tandem with Espinosa (2015) who asserted that the distinction between entertainment and truly intellectual engagement is a challenge as visual engagement does not necessarily represent intellectual engagement. Spending hours on social media could lead to addiction, reduced motivation to participate in other activities, and perhaps cause physical health problems (Slonje et al., 2013). Social media use might increase cyber-bullying which affects the individual's psychology, and in turn, affect the learning process negatively.

In using social media in the classroom, there is pedagogical uncertainty (Armstrong and Franklin, 2013), privacy issue, and limited control over the data (Livingston and Brake, 2010). Studies (Karpinski, 2009; Roblyer et al., 2010) have shown that social networking might have negative impacts on students' learning and outcomes if they spend more time navigating the platform. The American Psychological Association (2009) asserted that too much multimedia stimulation can interfere with the deeper cognitive processing that is critical to learning. In addition, one of the challenges hindering the effective use of social media in the teaching and learning process is inadequate knowledge of usage of the online tools by the teachers and instructors. According to Fewkes and McCabe (2012), the students seem to have more understanding of these current

technologies, including social media, than the teachers.

However, social networking is still essential, regardless of the pitfalls (Picciano, 2011). Teachers, therefore, have to make an effort to overcome the challenges and take advantage of the benefits that this technological tool provides through planning (Espinosa, 2015). Appropriate plans by teachers can maximize the benefits and minimize the pitfalls to achieve a safe, productive, and interactive environment for a better learning experience (Huffman, 2013).

2.3 Social Media in Educational Settings

According to Devi, Gouthami, and Lakshmi (2019), a primary reason to adopt social media in the classroom is its familiarity by almost everyone, its ease of use, and its interactivity features. Nearly all students and instructors in higher education institutions use one or more of the social media platforms for personal activities. Several factors have been reported to have influenced the adoption of social media for teaching and learning. Bosch (2009) asserted that one of the factors that influences the use of social media in teaching is its sense of quick and easy communication among students and their teachers. In Liu's (2010) study, it was revealed that the use of social media was necessitated by social engagement, direct communication, speed of feedback (student-instructor relation), and peer relationship building. Some other factors are interaction, information sharing, and resource sharing (Mazman and Usluel, 2010); active learning (Ajjan and Hartshorne, 2008); increased communication and discussion (Bosch, 2009); and collaboration (Mazman and Usluel, 2010). Additionally, according to Rinaldo, Tapp, and Laverie (2011), social media broadened access to information related to course material. With these factors, it is strongly believed that social media can contribute positively to students' performance and overall academic experience (Junco, 2012).

From a pedagogical perspective, current research emphasizes the use of specific applications and channels, such as Facebook (Yang et al., 2011), wikis (Trocky and Buckley, 2016), and Twitter (Aydin, 2014). However, some authors point out that social media was never developed for pedagogical uses (Bruneel et al., 2013). Studies rarely reported social media as part of domain-specific pedagogies (Van Den Beemt, Thurlings, and Willems, 2020). Students reported social media as user-friendly, especially compared with Moodle (Bahner et al., 2012; Deng and Tavares, 2013). Social media was reported as interactive (Jong et al., 2014) and easy to use for communication and discussion (Manasijević et al., 2016) and for knowledge and information sharing (Lin, Hoffman, and Borengasser, 2013). McCarthy (2010) stated that an advantage obvious in studies was the combination of informal and formal learning. This points to the extent that social media enables collaboration and support (Jong et al., 2014) which, in turn, prepares students for the future and enables them to develop knowledge (Yakin and Tinmaz, 2013; Van Den Beemt, Thurlings, and Willems, 2020).

2.4 Social Media in Computing Education

In this section, we refer to social media in computing education to mean the use of social media platforms to enhance teaching and learning of computer science topics. The approach for teaching and learning of computing education can take any form, i.e., a traditional teacher-to-student approach, collaborative learning, or a self-learning approach. Although many scholars employed social media platform for different studies (Gikas and Grant, 2013), research on the use of social media for computing education remains scant (Wang and Meiselwitz, 2015). Goldweber et al. (2013) presented a framework to address the challenges confronting computer science education by motivating students through social platforms. The framework described how students gain skills they need to solve computing problems by designing their own social web community for collaborative study. Similarly, Kelly et al. (2018) designed a social platform named BlockyTalky – a new programming environment that addresses authentic participation in computing education among youths. According to the authors, this tool empowered youths to design and write interactive programs.

Recently, the study by Agbo et al. (2020) investigated the social media effect of tie strength and group communication on perceived learning outcomes among computer science students in Nigeria. The study shows that communication in group and tie strength impact students learning outcome in a computing class. In addition, Aldahdouh, Nokelainen, and Korhonen (2020) studied the influence of individual innovativeness in technology and social media usage in higher education. Their study explored social media platforms among staff members in computing education.

3. RESEARCH METHODOLOGY

This study aims at presenting students' perceptions regarding the use of WhatsApp for computing education. This study used a quantitative research method focused on university computer science students. After six weeks of interactive sessions among the students, data were collected from participants by using a questionnaire. Scales in the questionnaire were adapted from existing studies. We considered this technique of data collection because it is cheaper and easier to collect data from a large number of respondents (Tasir et al., 2011).

3.1 Study Design

In this study, we first organized a brief workshop for the students who gave their consent to participate in the study. Additionally, the approval of the university authority was obtained in order to conduct a smooth study. The workshop provided the opportunity to educate participants on the aim of the study, which is mainly to investigate their perception of how the use of social media impacts their learning outcomes. The social media tool adopted for the study was WhatsApp. The decision to make use of WhatsApp was unanimously made by the students based on its accessibility to users, its ease of use, and students' familiarity with the tool. After the workshop, three closed groups were created. Others have explored closed-groups in social media platforms for collaborative learning, sharing of knowledge, and sharing of resources (Rodliyah, 2016; Cole et al., 2017). Participants were free to join any group of their interest. Each group was expected to discuss only one specific topic. For example, three main computer science topics were selected. The topics were database management systems, data structures, and introductory programming, and these topics formed the title for each group as depicted in Figure 1. A group leader who is responsible for coordination and moderation was selected.

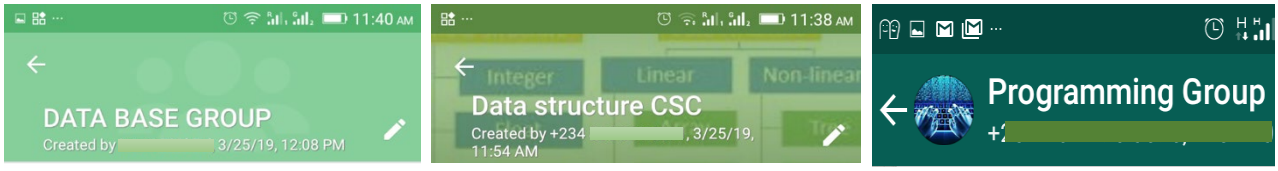

Figure 1. Screenshot of Closed Groups Created for the Study

As part of the mechanisms to monitor activities in each group, the principal investigator was added to all groups. The objective of these closed groups was to allow the members to interact for six weeks. Each member was expected to post at least a comment or question regarding the topic assigned to the group chat board.

3.2 The Survey Instrument

At the end of the six weeks, data were collected from randomly selected students via the questionnaires. The participants for this study were undergraduate computer science students in a public university located in the north-central region in Nigeria. Participating in this study was voluntary; hence, no incentives of any form were given to the students. A total of 113 students participated in the study. These students were divided into three closed groups (n = 38, n = 38, and n = 37, respectively), and each person can only belong to one group. The questionnaire consisted of a list of questions with constructs that were adopted from previous related studies (Lowry et al., 2006; Gilbert and Karahalios, 2009; Hughes et al., 2012; Bal and Bicen, 2017; Saini and Abraham, 2019; Qi, 2019). The constructs adopted for this study include Communication in Group (CIG), Perceived Learning Outcome (PLO), Social Media Usage (SMU), and Tie Strength (TS).

Based on the objectives of this study, the analysis of the data seeks to establish the influence of CIG, SMU on PLO, SMU on TS, and TS on CIG. The questionnaire consisted of five sections, including the demography of the respondents. The questions were designed to be five-point Likert scale (i.e., from 1-Strongly disagree to 5-Strongly agree).

3.3 Data Validation

Although the instruments utilized for data collection were standards adopted from previous studies, several processes were carried out to analyze the constructs. First, the instruments were given to researchers who are experts in the field of this study to provide their comments. After that, a pilot test was conducted among computer science students in Nigeria.

The data was statistically validated for reliability using Cronbach's alpha (α). Cronbach's alpha, proposed by Cronbach (1951), is an acceptable means of measuring reliability objectively. Also, it is used to validate questionnaire items to ascertain their accuracy and evaluation (Tavakol and Dennick, 2011). The scale reliability is statistically validated using Cronbach's alpha, and the estimated coefficient in this study conforms to the acceptable conventional standard. This study employed Cronbach's alpha as an index of reliability to ensure that the adapted instruments measure what they intend to measure consistently. This reliability test for internal consistency is a pre-test to ensure study validity.

4. RESULTS

This section presents the analysis of the data gathered through questionnaires from participants (n = 113). To ascertain the strength of the test items used for this study, we computed for the reliability of the test items. With this intention, a Cronbach (α) alpha was computed, and the results are presented in Table 1. The table contains the reliability test for the individual constructs and the weighted test measure of all the constructs. As indicated in the table, the values for all the constructs exceeded the acceptable threshold of 0.70 (Cortina, 1993), indicating that the test items, under each of the constructs, produce consistent results.

Construct	Cronbach's alpha (α)
SMU	0.897
CIG	0.895
TS	0.898
PLO	0.895
Overall	**0.896**

SMU = social media usage; CIG = communication in group; TS = tie strength; PLO = Perceived Learning Outcome

Table 1. Reliability of Instruments

Table 2 shows the demographic characteristics of the study. This information is relevant for social policy development in institutions of higher educations. As indicated in the table, the number of male participants (75.2%) was higher than the number of female (24.8%) participants. This disparity can be attributed to the general perception that women hold for mathematics and science-related programs. It is evident that some female students in Nigeria perceive computer science as a difficult course and hence avoid it. From Table 2, it is not surprising that the majority of the participants were from the 18 to 25 years age bracket (77.9%). This is because university education in Nigeria has been structured in such a way that students enter the university at 18 years, except for exceptional cases. Details of the demographic characteristics of the participants are discussed in Section 5.

Variable	Frequency	Percentage
Gender		
Male	85	75.2
Female	28	24.8
Age		
17 or younger	7	6.2
18-25	88	77.9
26-35	17	15.0
35-45	1	0.9
45 and above	-	-
Year of study		
100 Level	8	7.1
200 Level	21	18.6
300 Level	72	63.7
400 Level	12	10.6
Device used for social media		
Smartphone	104	92.0
Tablet	5	4.4
Desktop	2	1.8
iPad	2	1.8
Social media used		
Twitter	5	4.4
Facebook	54	47.8
YouTube	4	3.5
LinkedIn	1	0.9
WhatsApp	49	43.4
Average time spent on social media per day		
1hr or less	43	38.1
2-4hrs	47	41.6
5-7hrs	15	13.3
8-10hrs	3	2.7
11hrs or more	5	4.4
Use of social media		
Chatting	48	42.5
Educational purpose	43	38.1
Calling	1	0.9
Social credibility	9	8.0
Enhanced learning management systems	9	8.0
Building relationship	3	2.7

Table 2. Demographics of Participants and Social Media Usage

Table 3 shows the descriptive findings of the various questions under each of the constructs. Specifically, the mean and standard deviation of each of the test items are computed. This explains the behavior of the data collected.

Code	Social Media Use	Mean	SD
SMU1	I use social media to find and spread information	3.93	1.10
SMU2	I use social media to keep in touch with friends	4.12	1.02
SMU3	I use social media to keep abreast of current events	3.99	0.94
SMU4	I use social media to socialize with people	3.95	1.00

Table 3. Purpose for Social Media Use

Within the group, discussions that are topical towards enhancing students' learning were recorded. Most of the responses show that the conversations are capable of revealing the perceptive knowledge of students regarding such a topic. Examples of these conversations are presented in Figure 2a-c.

Regarding the impact of social media on computer science students' learning experience, WhatsApp seems to provide useful support as students expressed their satisfaction in various forms. For example, some of the responses raised within the group show that their knowledge was enhanced (see Figure 3).

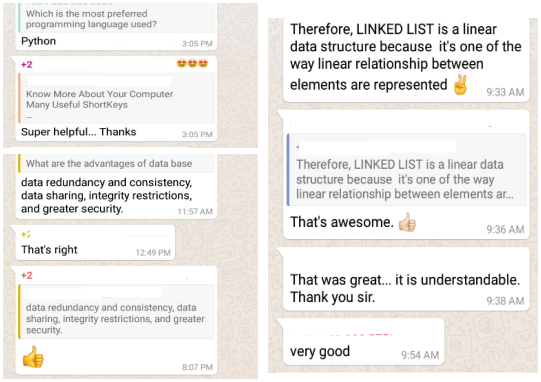

Figure 3. A Cross-Section of Posts Indicating Students' Perceived Learning Satisfaction

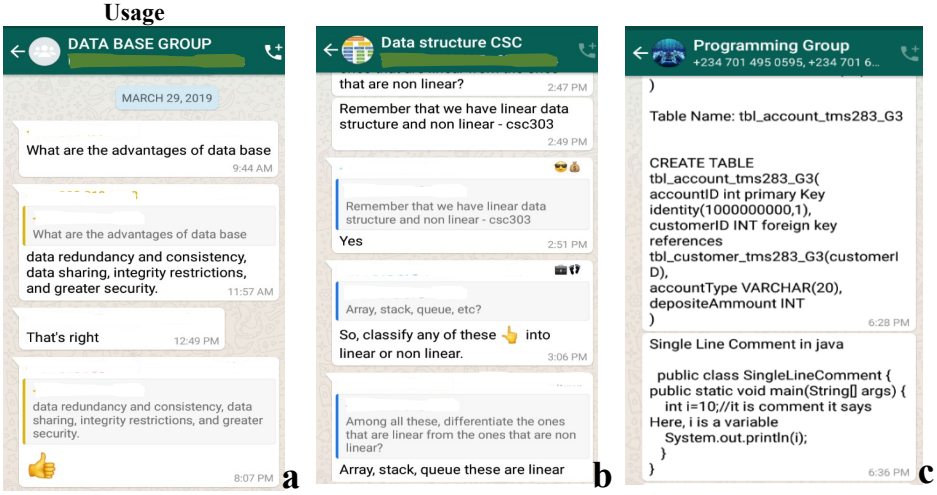

Figure 2a-c. Screenshots of Conversations Extracted from Three Groups Showing Useful Learning Content for Computing Education

Code	Group Communication and Information Sharing	Mean	SD
CIG1	The overall quality of group communication is good	3.88	0.93
CIG2	The outcome of group communication is satisfactory	3.58	0.89
CIG3	The forms of expression in communication have high variety	3.82	0.83
CIG4	The detailed messages in communication are very vivid	3.45	0.93
CIG5	The group communication is appropriate	3.55	0.86
CIG6	The group communication suits the topic	3.48	0.91
CIG7	Communicating openly with all members of the group is easy	3.51	1.00
CIG8	When people communicate in group. a great deal of understanding is achieved	3.64	1.00
CIG9	The information I receive is generally accurate	3.32	1.00
CIG10	The accuracy of information passed among group members does not need to be improved	2.70	1.09

Table 4. Perception on Group Discussion

Code	Group Members Relationship	Mean	SD
TS1	I have a strong relationship with most of my group members	3.01	1.00
TS2	I feel comfortable about asking most of my group members to loan materials	2.88	1.12
TS3	If I were looking for an assistance, most of my group members would be helpful	3.24	1.04
TS4	I would be upset if most of my group members block me on WhatsApp	3.26	1.28

Table 5. Perception on Social Characteristics

Code	Social Media Usefulness for Learning	Mean	SD
PLO1	If I left WhatsApp for another social networking site. I would bring most of my group members along	3.13	1.14
PLO2	Social media helps me acquire new information	4.32	0.82
PLO3	The use of social media for computing education paves the way for effective learning	4.25	0.83
PLO4	Social media enables sharing the knowledge	4.24	0.75
PLO5	Making study groups through the social media contributes to my learning achievement	3.98	0.89
PLO6	Teachers' sharing lesson contents on social media is effective (Video. Image. Animation etc.)	3.84	1.09
PLO7	Having information exchange about lesson topics on social media with my friends contributes to my learning achievement	4.08	0.77
PLO8	Using social media for computing education motivates students	3.88	0.92
PLO9	Using social media for computing education contributes to my university achievement	3.81	0.88
PLO10	The online lessons through social media provides permanence	3.72	0.89
PLO11	Using social media in computing education develops my communication skills	3.84	0.87
PLO12	Using social media for computing education provides active participation in the lesson	3.74	0.86
PLO13	The social media improves my cooperative learning skills	3.81	0.93
PLO14	Using social media for lesson enables learning	3.87	0.84
PLO15	I like it when my teachers share posts about the lesson on social media	3.82	1.02
PLO16	Establishing communication with teachers on social media contributes to my university success	3.65	0.99
PLO17	I like it when the activities related to the computing education on social media are made	3.97	0.80
PLO18	Exchanging opinions about lessons through social media paves the way for new ideas	4.12	0.74
PLO19	Using social media for computing education affects performance positively	3.74	0.97
PLO20	I contribute to discussions on various topics of interest in the social media group	3.72	1.05
PLO21	I ask questions to seek clarification on different topics in computing education	4.06	0.85

Table 6. Descriptive Analysis of Social Media Usefulness for Computing Education

5. DISCUSSION

This study investigated the perception of students regarding the use of social media – WhatsApp – for computing education in higher education. Similarly, the impact of using social media for learning was examined. The demographic results (Table 2) delineate that students participated from all levels studying computer science. However, the majority (63.7%) are from the third year, which shows that these students have undergone some computing courses sufficiently to give feedback. The age bracket found dominant in this study is between 18-25 years, and only 0.9% fall into the age of 35-45 years.

In addition, this study confirmed that most of the students possess smartphones as 92% of students use a smartphone. This amount of smartphone users provides the opportunity for leveraging the device for deployment of learning platforms aimed at enhancing the students' learning experience. Similarly, it is not surprising to discover that 47.8% and 43.4% use Facebook and WhatsApp, respectively, as their most preferred social media. This finding suggests support for the choice of WhatsApp as the social media platform to conduct the study. Other social media, such as Twitter, YouTube, and LinkedIn, received 4.4%, 3.5%, and 0.9% preference responses, respectively.

5.1 Use of WhatsApp as a Social Media Platform for Computing Education

This study revealed how students enrolled in computer science degrees use social media to enhance their computing knowledge. They do so by forming closed groups on WhatsApp where each group handles a specific computing topic. Each group appoints a leader who coordinates and moderates group activities. Part of the group leader's tasks are to add new members and to determine if a topic brought up for discussion by a member is within context. Each group member can bring up a relevant topic for discussion either by posing it as a question or an argument. Any group member intending to contribute to discussions on an ongoing question or argument uses the reply button to respond. This arrangement is a valuable set up that encourages students to engage in the use of the platform for educational purposes to achieve improved knowledge. In addition, the general purpose of using social media was investigated, and it was found that the majority of the students (M = 4.12; SD = 1.02) use social media to keep in touch with friends. In other words, students are generally interested in socializing with friends through these media. However, it is also interesting to discover from this study that social media helps to pave ways for effective learning among computer science students (M = 4.25; SD = 0.83). The students acknowledged in their responses that sharing knowledge about certain lessons after a class via social media contributes to their learning.

The use of WhatsApp for learning computing education was demonstrated by allowing each group to discuss topics in computing. Figures 2a-c delineate the nature of the communication that took place within the groups. Some posts on the chat board were asking specific questions regarding the previous lesson completed in the class. For instance, one of the participants asked, "how do I create a table and input data in Python?" Since WhatsApp allows replies to a specific post, many participants shared their knowledge regarding the questions. The results in Tables 4 and 5 clearly reveal the reflection of students' perceptions regarding group communication flow and group dynamics. For example, the students confirmed that their overall quality of group communication is good (M = 3.88, SD = 0.93). Although a majority of the students (M = 3.58; SD = 0.89) were satisfied with the outcome of the communication in their respective groups, about half of them (M = 2.70; SD = 1.09) acknowledged that the accuracy of the knowledge passed among group members needs to be improved.

5.2 Impact of WhatsApp on Computing Education and Students' Perceived Learning Outcomes

Regarding the impact of social media on computing education, Table 6 presents the results of responses from the students. This study found that social media contributes positively to students' learning achievement. Many of the students (M = 4.12; SD = 0.74) acknowledged that exchanging opinions, thoughts, and reflections about lessons concluded in the class paves ways for a new idea, which is in agreement with Junco (2012).

Besides, students found the use of WhatsApp motivating for computing education in terms of sharing knowledge and academic resources within the group. Many of the students (M = 3.88; SD = 0.92) indicated they were motivated to acquire more knowledge about different computing topics shared by members. As a way of showing satisfaction in the learning outcome, some students acknowledged some posts by quoting the authors (See Figure 3).

6. CONCLUSION AND FUTURE RESEARCH

In this article, the use of WhatsApp among students in a higher education institution in Nigeria has been explored and discussed; specifically, its purposes for learning computing education by computer science students. This study was designed in a way that students of computer science in a university formed different closed groups, and each group had a specific computing topic they discussed and interacted with for knowledge sharing within the group. Their discussions were in the form of posting questions, providing answers to questions, or expressing knowledge on the group topic. In addition, students' perceptions of group discussions, their social characteristics, and demographic variables were examined. The variables included gender, age, year of study, the device used for social media, average time spent on social media per day, the purpose of using social media, and the social media platform used. The study generally shows in what students invest their time and resources in terms of social media usage.

The substantial increase in the number of social media users has created the opportunity for educators and students to leverage social media for computing education (Huo et al., 2019). The use of social media for educational purposes is fast growing in tertiary institutions (Kimmerle et al., 2015). This study concludes that social media (WhatsApp) helps to provide ways for effective learning among computer science students while the sharing of knowledge about specific lessons after class via social media contributes to learning achievements as shown in this study. This is in agreement with Shariffuddin, Shaaidi, and Hashim (2017) who found students' preference to learn through WhatsApp and proposed that it should be extensively and constantly utilized. Similarly, the findings from

this study suggest that the use of social media for educational purposes is a strong approach in presenting instructions to the students because it creates the environment for collaboration and motivates learning. However, learning through a social media platform should adopt a closed-group communication approach. Additionally, the group activities should be monitored by making the teacher also a member of the group to ensure an optimal learning experience.

Researchers have argued that encouraging the use of mobile devices at the secondary school level is a motivating factor for its adoption, in terms of learning, in higher education. Conversely, while social media is perceived to be an important platform for learning computing education in this study, some other countries discourage the use of mobile devices in the secondary education level (Kolog et al., 2018). Several reasons have been attributed to that. This has called for a public policy debate on the need to allow students in secondary education to use mobile devices to learn. In Ghana, for instance, Kolog et al. (2018) reported that students who were not permitted to use a mobile device at the secondary school are reluctant to use a mobile device to learn at an institution of higher learning. We envision that these findings will guide policy development regarding the use of social media for learning computing education in a developing country.

This study contributes to the growing need for engaging students interactively and collaboratively. The implication of this finding accentuates the creation of motivating and engaging social media platforms for group collaboration instead of the current situation where students are using social media majorly for social interaction and networking. As shown in the study, the majority of students possess and use smartphones for social communication via WhatsApp. This finding creates an opportunity for teachers, universities, and higher education stakeholders to implement a cost-effective approach towards remote learning by adopting social media platforms such as WhatsApp.

This study's limitations are mainly the small sample size and the sampling of only computer science students. Further studies in this area are recommended to explore and investigate broader perspectives regarding the use of WhatsApp within the higher education context for educational purposes involving more respondents and gathering perspectives of students from different departments and fields. In addition, authors cannot generalize the findings from this study since only one university in Nigeria was considered. It would be important to consider replicating this study with students of computer science from multiple universities to compare the results from a wider perspective.

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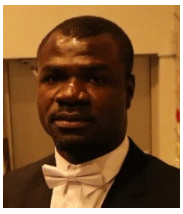

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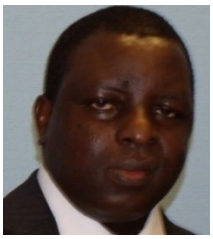

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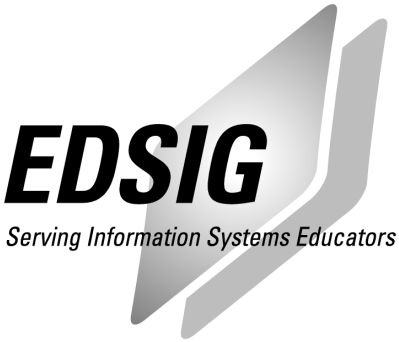

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