

Supporting Mobile Learning with WhatsApp based on Media Richness

Olutayo K. Boyinbode
Department of Computer
Science, Federal University of
Technology, Akure, Nigeria

Oluwatoyin C. Agbonifo
Department of Computer
Science, Federal University of
Technology, Akure, Nigeria

Aderonke Ogundare
Department of Computer
Science, Federal University of
Technology, Akure, Nigeria

ABSTRACT

With the proliferation of mobile devices, mobile learning has become a learning paradigm in education. The aim of this paper is to evaluate the media richness of various message delivery methods in mobile learning (m-learning) environment. This study evaluates media richness in respect to content timeliness, content richness, content accuracy and content adaptability in WhatsApp, Email, SMS, Twitter and BBM. One-way ANOVA analysis and Post hoc analysis show that: (i) SMS has better performance than WhatsApp, Email, Twitter and BBM on content timeliness; this implies that SMS may be more appropriate for delivering real-time information such as notifying or reminding of some time-sensitive matters, (ii) WhatsApp has better performance than Email, SMS, Twitter and BBM on content richness and so may be applied in information delivery that is rich in images and videos, (iii) WhatsApp has better performance than Email, SMS, Twitter and BBM on content accuracy and content adaptability. WhatsApp due to its media richness is more appropriate for supporting learning activities in a mobile learning environment. This study suggests that developers and designers of an m-learning environment could adopt WhatsApp as a suitable information delivery medium to support corresponding learning activities in a mobile learning environment.

Keywords

Mobile Learning, Media, SMS, WhatsApp, Twitter, Email, BBM.

1. INTRODUCTION

The tremendous effect of Information technology on society is undeniable. This is evident in education as it relates to active learning, blended learning, electronic learning, mobile learning and ubiquitous learning. Mobile phones are becoming popular as many people can afford to buy one. Currently the uses of mobile devices have gone just beyond the traditional communication role, but are also being used in supporting teaching and learning in educational settings. Mobile devices deployment in education has given much popularity to mobile learning [2].

The rapid growth and access to mobile devices around the world especially in Africa and Middle East regions have contributed to increased usage of these devices to improve teaching, learning and institutional efficiencies, which has enabled national educational transformation [19]. According to [2], m-learning applications can facilitate students' learning at convenience and also collaboratively, anytime and anywhere. The development of m-learning as a new strategy

for education has positive implications for the way students and instructors, in educational institutions interact.

The deployment of mobile devices in learning is called m-learning. M-Learning is the acquisition or modification of any knowledge or skill through the use of mobile technology, anywhere, anytime, which results in the modification of behavior [7]. M-Learning is a learning strategy that allows learners to obtain learning materials anytime, anywhere using mobile communication and the internet. Information delivery media, which can be adopted in m-learning environment, includes WhatsApp, Email, SMS, Twitter, and BBM to inform learners of the learning activities. The main purpose of this study is to evaluate media richness of these delivery methods in m-learning environment and adopt appropriate information delivery mechanisms to enhance learning activities. This study will determine which medium is more suitable for improving learning activities among WhatsApp, Email, SMS, Twitter, and BBM. Table 1 shows the strengths and weaknesses of these media.

Markett et al. [22] indicated SMS as an application used by learners to send short, text-based messages at any time; this is not user-friendly because it has a content limitation in terms of the maximum allowed characters. Malaga [21] described email as easy to use channel for learning activities though; the shortcoming is that the content sent by email does not automatically notify the receiver of any current information. Lan and Sie [20] indicated RSS as having better performance than SMS and Email on content accuracy and adaptability, but the limitations are there is no way of showing whether the learner has read or received the message and RSS feeds also generate bigger traffic and this can be bandwidth implicative. In all, factors relating to content presentation, media richness, and transmission efficiency will affect the learning activities and process. Therefore, there is need to adopt a suitable information delivery medium to solve the shortcomings highlighted above.

To evaluate the media richness of various message delivery methods in m-learning environment. The research question for this study is: Which medium is most suitable for supporting mobile learning activities among SMS, Email, Twitter, BBM and WhatsApp based on media richness theory?

The rest of the paper is organized as follows: Section 2 describes some related works, Section 3 gives reviews of the theoretical foundations, Section 4 describes the system implementation, and Section 5 presents the research methodology in this study, including research instruments, experiments, data analysis and results. Finally, discussion and concluding remarks are made in Section 6.



2. RELATED WORKS

Fattah [14] determined the effectiveness of using a WhatsApp Messenger as a tool for enabling mobile learning; he indicated that “Learning environment is making use of the rapid incredible development in information and telecommunications technologies”. Most learning institutions try to adapt their systems to involve these technologies: Mobile technologies play a fruitful role in this regard. Several researchers have attempted to prove applicability and supplementary methods of mobile learning in modern days teaching and learning [23, 13]. Riyanto [27] claimed that apart from socializing with friends using WhatsApp, it can be used to study and even learn a new language: This study aimed at determining the effectiveness of using a WhatsApp Messenger as a tool for mobile learning to develop students' writing skills. The quasi-experimental design was used in this study, where a sample of fourth level students in English department studied writing course called “Essay” and were assigned to experimental and control groups. A pre/post test was conducted to measure the effectiveness of the program. The result of this experiment was reported as WhatsApp being able to improve student writing skills.

Plana [26] examined the use of WhatsApp in English language studies; this study was conducted among students in Spain. The students reported a rise in motivation and a greater enthusiasm for reading in a foreign language. The research conducted by Amry [1] demonstrated the effectiveness of WhatsApp social networking, in comparison with face-to-face learning in the classroom. WhatsApp has become a shared platform that enhances accessibility, collaboration, cooperation, and motivates students to take an active part in academic pursuits [2, 5, 9]. WhatsApp as a platform for instant messaging has grown in popularity; one of its unique functionality is its ability to enhance communication within a group. WhatsApp groups are used for four main purposes: communicating with students; nurturing the social

atmosphere; creating dialogue and encouraging sharing among students; and as a learning platform.

During the last decade, communication was through various channels: Email, SMS, Facebook groups, Twitter, and recently WhatsApp (see Table 1). Each one of these tools has different characteristics that influence its suitability for learning purposes. Lan and Sie [20] discussed about using RSS to support mobile learning based on media richness theory. Dunlap et al. [12] described, how Twitter, a microblogging tool can enhance social presence in an online course to enhance free-flowing, just-in-time interactions. Besides the benefit for enhancing the potential for positive social presence during online learning opportunities, Twitter may not be suitable for all learning situations, it can be time consuming, and it can also encourage bad grammar as a result of its 140 characters limit. Traditional Short Message Service is in danger of losing its reign as the king of mobile messaging due to the advent of instant mobile messaging applications. Applications like WhatsApp allow mobile users to send real-time text messages to individuals or groups of friends at no cost.

SMS was created over 20 years ago. SMS is a ubiquitous capability embedded in GSM wireless standard which allows short 160 character text messages to be sent to and from any GSM mobile handset, regardless of service providers. SMS has since evolved to include messages containing image, video, and sound content, known as MMS or Multimedia Messaging Service, these tend to cost more than simple text messages[6].

WhatsApp on the other hand as shown in figure 1 is a Mobile Instant Messaging application for smartphones. It allows you to send and receive images, video, audio and location-based messages to individuals or groups of friends using your pre-existing data plan and at no cost. It provides delivery notifications, when a message is sent to the recipient's device.



Fig 1: WhatsApp Messenger on Mobile device

3. THEORETICAL FOUNDATIONS OF THIS RESEARCH

Some theoretical perspectives of this study are briefly described with regard to learning theories, m-learning, WhatsApp, media richness theory.

3.1 Learning Theories

Learning theories refer to the conceptual frameworks describing how information is absorbed, processed, and retained during learning. Conventionally, teaching strategy learning process generally uses objectivism (instructor-centric). Objectivism involves learners passively receiving knowledge from an instructor. Instructor prepares learning materials in advance and learners study in class at the same time. An alternative to this is constructivism (learner-centric), this allows learners to control the pace of their learning and construct personal knowledge. The constructivism theory ensures knowledge is actively constructed by each individual, and social interactions with others are also influential in the constructive process [4, 29]. Of recent, constructivism has become an important paradigm for guiding research and practice in education [3, 15, 28, 31].

Increasingly, more portable (handheld) devices are integrated into the constructivist learning environment. Constructivist learning activities are needed to encourage effective use of portable devices in a mobile learning environment [32]. To avoid the defect of only adopting constructivism in teaching strategy, Cronje [8] reported a combined learning process composed of objectivism and constructivism learning theories. According to this teaching strategy, in the first part the instructor gives learners the foundational knowledge to support the upcoming learning activities based on Constructivism learning theory. This study adopts Cronje's learning process to support learning strategies in the m-learning environment.

3.2 M-Learning

Learning is referred to as m-learning if learners make use of mobile devices such as PDAs, Smart Phones, Android phones, etc. to obtain learning materials and to support their learning activities, anytime and anywhere. Wang et al. [30] described m-learning environment as enabling learners to learn at any time and any place. The use of mobile learning activities in teaching and learning is an innovative educational technology in universities [1].

The need to take learning out of classroom and not limit it to the four corners of a classroom has brought about the initiative of mobile learning. Mobile learning offers methods which decrease the limitations of traditional education [24]. Learning can come in a variety of ways: students can use mobile devices to access educational resources, connect with others, or create content, both inside and outside classrooms. Learning results from social interactions between students in collaborative learning environments. These social interactions usually involve social media like SMS, WhatsApp, Facebook, Twitter, BBM etc.

3.3 SMS

The Short Message Service (SMS) is defined within the GSM digital mobile phone standard that is popular in Europe, the Middle East, Asia, Africa and some parts of North America. It has several unique features: SMS can be up to 160 characters of text in length. These 160 characters can comprise of words or numbers or an alphanumeric combination (see in Table 1). Short Message Service (SMS) can also be defined as the transmission of short text messages to and from a mobile

phone, fax machine, and/or IP address. It contains no images or graphics. SMS is a relatively simple messaging system provided by the mobile phone networks [6, 7]. These messages are supported by GSM, TDMA and CDMA based mobile phone networks currently in use. Though services based on SMS have been feasible for many years, the recent mobile phone penetration and large scale adoption of the existing services by users have made the SMS based services even more attractive to service providers. Once a message is sent, it is received as a Short Message.

3.4 Twitter

Twitter is a micro blogging service, an online social networking service. Twitter is one of the most popular micro blogging websites in the world. Students use Twitter apps on their mobile phones to collect, share, and comment on authentic design found in their daily lives [17]. Users can send a 140-character message (a tweet) as seen in Table 1: forward other users' tweets (retweet), mark other users' tweets with the @ sign (tag), reply to tweets, send direct and private messages to other users, create lists of users, and publicly identify usernames in tweets by including the @ sign (mentions). Twitter was created in March, 2006 by Jack Dorsey, Evans Williams, Biz Stone and Noah Glass and was launched in July 2006. This service gained worldwide popularity with more than 100 million users posting 340 million tweets a day in 2012. As at January 2016, twitter has 332 million active users. Twitter Incorporation is based in San Francisco and has more than 25 offices around the world. It is available in multilingual languages. Twitter users follow others or are followed. Unlike other online social networking sites, such as Facebook or MySpace, the relationship of following and being followed requires no reciprocation. A user can follow any other user, while the user being followed need not follow back. A follower on Twitter means that the user receives all the messages (called tweets) from those the user follows. Users tweet through twitter website or compatible external applications such as smart phones. The practice of responding to a tweet has evolved into well-defined markup culture: RT means retweet. Ovadia [25] specified that since Twitter maintains tweets in chronological order, it offers a great platform for designing and conducting academic studies; especially in social and behavioral sciences. This well-defined markup vocabulary has a strict limit of 140 characters per posting conveniences users with brevity in expression. Retweet mechanism empowers users to spread information of their choice beyond the reach of the original tweet's followers.

3.5 WhatsApp

WhatsApp is a social network and an American proprietary cross platform instant messaging client for smartphones [26]. WhatsApp was founded 2009 by Jan Koum and Brian Acton. As at February 2016, WhatsApp had a user base of one billion, making it the most popular messaging application. WhatsApp is one technology that is mostly used on specific mobile phones and computers. Ever since smartphones became popular, many messaging services were launched, but WhatsApp has become very popular among them [33]. WhatsApp Incorporation is based in Mountain View, California, United States and it was acquired by Facebook Inc. on February 19, 2014 for approximately 19.3 billion US dollars. The most popular application among smart phone users is WhatsApp messenger. WhatsApp messenger has the following features: Multimedia, Group chat, Unlimited Messaging, Cross Platform Engagement, Offline messaging, free of cost, No use of pins and username [2] see Table 1.

3.6 Email

Email means Electronic mail. The use of email as a communication tool in teaching is due to both the nature of the email technology and how the instructor plans to use it in the course [16]. The first email system of this type was MAILBOX used at the Massachusetts Institute of Technology from 1965. Also, early program to send messages on the same computer was called SNDMSG. Before the advent of internetworking began, email could only be used to send messages to various users of the same computer but since computers began to communicate over network, a problem arose with the default form of mailing. As at 1974, there were hundreds of military users of email because APARNET eventually encouraged it. With the World Wide Web, email began to be made available with friendly web interfaces by providers such as yahoo and Hotmail.

3.7 BBM

BBM stands for BlackBerry Messenger, is a proprietary internet-based instant messenger and video telephony

application included on BlackBerry devices that allows messaging and voice calls between BlackBerry, iOS, windows phones and android users [18]. It was invented by Thorsten Heins; BlackBerry Limited, formerly known as Research in Motion Limited (RIM) and was first released in 2005, it's available in multilingual. It was officially released on iOS and android on 21 October 2013, on February 2014, blackberry officially confirmed BBM for windows phone and Nokia X. Communication using BBM was only possible between BB devices until 2013, when BBM was released on iOS and android systems. As at 2015, there were more than 190 million BBM users. Messages are sent over the internet and use BlackBerry pin system. The features of BBM includes: Send and receive messages with unlimited length, share photos, videos and more with multiple contacts at once, send files such as documents, photos, music, videos up to 16MB, free calls, etc. On daily basis about 300 million stickers are shared, 150,000 BBM calls are placed.

Table 1. Strength and Weakness of different media

Media	Type of files supported	Size of documents, videos and picture supported	User unique Identity	Does it support group chat?	Does it have read receipt	Number of chat per day	Character Length
WHATSAPP	Pdf, doc, ppt, xls, mp4	16MB, but can be extended to 2GB by editing the xml file	Phone Number	Yes	No	Unlimited	unlimited
BBM	Pdf, apk, exec, doc, mp4	16MB	Pin	Yes	Yes	Unlimited	160
TWITTER	Mp4 (video), doc, pdf	512MB	Twitter Handle	No	No	250 messages per day. 1000 tweets per day(including retweet)	140
SMS	None	None	Phone number	No	No	Unlimited	70 / 160 depending on the language used
E – MAIL	All	Varies with vendor. Gmail – 25mb Hotmail – 10mb Yahoo mail – 25mb	Email address	No	No	Unlimited	Unlimited

3.8 Media Richness Theory

Media Richness is described as the ability of information to change understanding within a time interval [10, 11]. Communication is termed to be considered rich if the communication framework can overcome different frames or reference or clarify ambiguous issues to change in a timely manner. Also, it is termed low if the communication requires a long time to enable understanding or cannot overcome different perspectives [20]. In summary, richness pertains to the learning capacity of a communication: Media Richness Theory (MRT) was introduced in 1984 by Richard L. Draft and Robert H. Lengel. It mainly used to describe and evaluate communication media within organization in terms of their effectiveness. Lan and Sie [20] defined media richness in

terms of content timeliness, content richness, content accuracy, and content adaptability.

3.9 Research Model

From the description on the media richness theory, this study harnessed media richness theory to analyze the capabilities of media richness among WhatsApp, Email, SMS, Twitter, and BBM in an m-learning environment. To answer the research question of this study: which medium is most suitable for supporting mobile learning activities among SMS, Email, Twitter, BBM and WhatsApp based on media richness theory? Four factors of a media: content timeliness, content richness, content accuracy, and content adaptability were identified to evaluate delivery performance as shown in figure 2[20]. These factors correspond to the four criteria in terms of

the richness of a media. According to these factors, Table 2 provides the definition of the research variables. This study proposes four major hypotheses relative to the media selection of information delivery way in a mobile learning environment [See figure 2]:

H1: WhatsApp is more appropriate as a delivery medium than BBM, Twitter Email and SMS in a mobile learning environment regarding content timeliness

H2: WhatsApp is more appropriate as a delivery medium than BBM, Twitter Email and SMS in a mobile learning environment regarding content richness

H3: WhatsApp is more appropriate as a delivery medium than BBM, Twitter Email and SMS in a mobile learning environment regarding content accuracy

H4: WhatsApp is more appropriate as a delivery medium than BBM, Twitter Email and SMS in a mobile learning environment regarding content adaptability.

Table 2. Research Variables and Definitions

Research Variables	Definition	Strategies of supporting learning activity
Content Timeliness	This is the degree a user thinks a message received is time sensitive or has immediate feedback	<ul style="list-style-type: none"> Learners could receive message immediately when the instructor post an announcement When one student replies a discussed topic, others could receive the replied message immediately
Content Richness	This means the degree a user thinks a message received includes various media types	<ul style="list-style-type: none"> Announcement could be presented in text format Topic of discourse could consist of text and picture to describe a question Instructor and student could integrate picture, text, video and audio
Content Accuracy	This means the degree a user thinks a message received can be expressed or easy to understand	<ul style="list-style-type: none"> Student can be informed of future learning plans
Content Adaptability	This means the degree to which a user thinks a message can be adapted to other formats.	<ul style="list-style-type: none"> Discussed topics can be chosen in text or picture to show the subject The material can be presented in different viewing modes

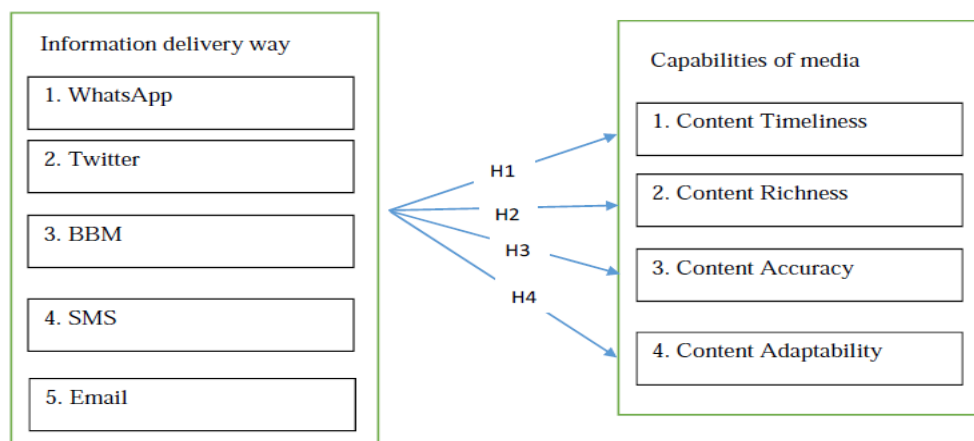


Fig 2: Research Method

4. SYSTEM IMPLEMENTATION

A Mobile Learning Application was developed to pull traffic (learners) to the group created on different social media (WhatsApp, Email, SMS, Twitter, and BBM) and it also allows learners have access to learning materials on various social media using their mobile devices. The Mobile Application (Learning App) was implemented using Phone gap. Phone gap is a mobile development framework that

enables software programmers to build applications for mobile devices with the use of JavaScript, HTML5, and CSS3, instead of relying on platform-specific APIs like those in iOS, Windows Phone, or Android. It enables wrapping up of HTML, CSS, and JavaScript code depending upon the platform of the device.

To support the m-learning environment of this research, learners used their mobile devices to surf the curriculum

content and to receive their learning status related to learning activities. Also, instructors participated in the m-learning system to guide learners to access accumulated resources and learning materials. The Learning App helped to pull traffic (learners) to the group created on social media and it also allows learners have access to materials on various social media. When the learning app is launched, the user sees a login page; a registered user can login with correct details and

have access to the learning material on different media, while a new user will click on new user link to register (figure 3b). Once a user registers, the “admin” uses the details supplied to add the user to the learning group. The admin is an instructor; he announces the availability of materials to the group, so that students can be aware of it and download it on various media (Figure3a).

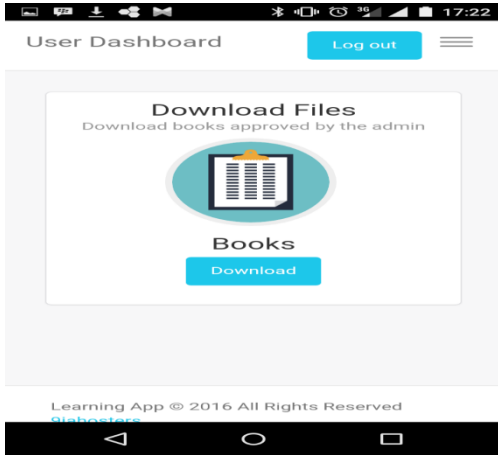


Fig 3a: Download Screen

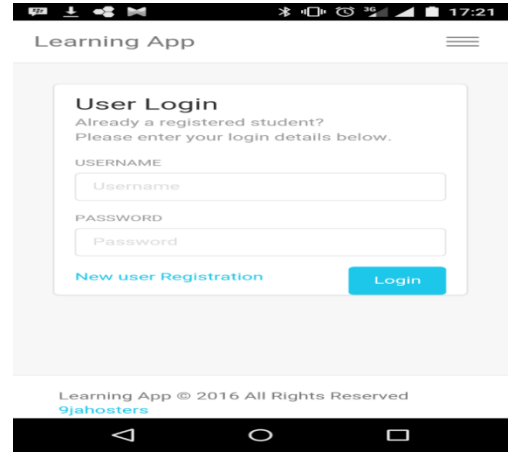


Fig 3b: Learner’s Interface

5. METHODOLOGY

Before the experiment, a survey was taken to assess learners’ computer experience. According to the result, all learners have a mobile phone and subscribe often to different social media. To explore which information delivery method is most suitable to support learning activities in the m-learning environment among WhatsApp, Email, SMS, Twitter, and BBM based on media richness theory. The following research procedure was taken.

5.1 Research Procedure

The participants of this experiment were 25 undergraduates attending the “Fortran” course at the Computer science, Department of the Federal University of Technology, Akure, Nigeria. All participants were familiar with WhatsApp, Email, SMS, Twitter, and BBM media.

The learning process was the same across the media, the instructor and students had an interactive discussion, topic of discourse was raised by both instructor and students. Also some features were used to support learning such as voice note, pictures, and documents.

The learning process is divided into 5 phases:

Phase 1 (Motivation): students were motivated to be in touch with their instructor through the various social media

Phase 2(Creation of Learning Group): the group was named (FORTRAN Group) and created by the admin and students were added to the group with their permission (see figure 4a and 4b).

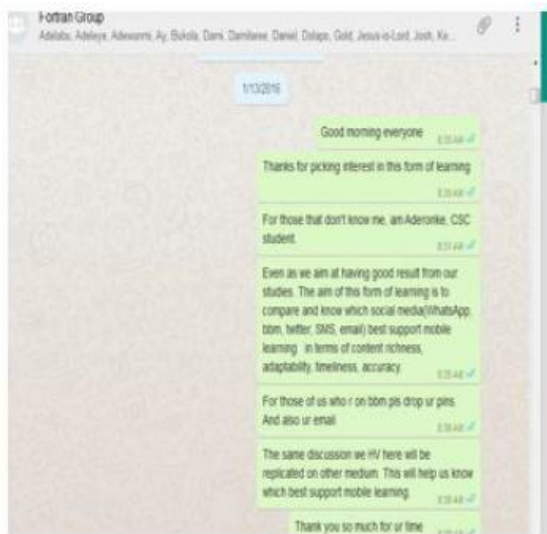


Fig 4a: Fortran group



Fig. 4b: Fortan group2

Phase 3 (Teaching Ethics): learning ethics was communicated to the students, this includes:

- i. No use of absurd language
- ii. No personal remarks

Phase 4 (Implementation): messages are sent and received through the learning app on their mobile devices using various media (WhatsApp, Email, SMS, Twitter, and BBM).

Phase 5 (Feedback): students were asked to give their feedback about the experience in the use of social media to support mobile learning through questionnaire (bit.ly/RonkeMobileLearningQuestionnaire), as shown in figure 5. The questionnaire was developed using multiple choice method and three (3) points Likert Scale: Very Good (5), Good (3) and Fair (1) were adopted.

Edit this form

QUESTIONNAIRE

This questionnaire aims at evaluating the media richness of various message delivery medium in a proposed mobile learning environment.

Which medium do you use often?
 That is, the one you are active on and your reading partner or coursemates reaches you on often

WhatsApp
 Twitter
 BBM
 SMS
 Email

In terms of Content Timeliness, rate the medium
 Content Timeliness: this is the degree to which user thinks a received message is time sensitive or have immediate feedback That is instant messaging and quick replies.

	Very Good	Good	Fair
WhatsApp	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Twitter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BBM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SMS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Email	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In terms of Content Richness, rate the medium

Fig 5: Screenshot of the questionnaire

5.2 Data Analysis and Result

The analysis was carried out using SPSS and it's provided mathematical analysis. To test the hypothesis H1- H4 regarding the effects of the media richness and information delivery way to support learning activities, this study was conducted using four repeated-measures one-way analyses of variance. Table 3 shows the relevant descriptive statistics among WhatsApp, BBM, Twitter, Email and SMS regarding content timeliness, content richness, content accuracy, and content adaptability. Furthermore, result of ANOVA (Analysis of Variance) was summarized in Table 4. The results revealed that there exists significant effects of the media richness, regarding: content timeliness (sig. = 0.00). Here, the sig. is less than 0.05, so we have all statistical reasons to reject this hypothesis (the null hypothesis), which states "WhatsApp is more appropriate as a delivery medium than BBM, Twitter Email and SMS in a mobile learning environment regarding content timeliness" and the alternative is considered which is the negation of the null hypothesis. A post hoc multiple comparisons with LSD method analysis was conducted and the result was summarized in Table 5, this helped to determine the medium that is appropriate amongst others. Conclusion was drawn from this table using sig. and

confidence interval. The result of the post hoc shows that SMS is more appropriate regarding content timeliness.

Also, the sig. of other dependent variables in Table 4 shows that statistically H0 (the null hypothesis can be accepted, since the sig. is greater than 0.05). The result from ANOVA shows that Content richness has (sig. = 0.959), then we have all statistical reasons to accept this hypothesis which says WhatsApp is more appropriate as a delivery medium than BBM, Twitter, Email and SMS in a mobile learning environment regarding content richness. Not only that, content accuracy has (sig. = 1.00), then we have all statistical reasons to accept this hypothesis which says WhatsApp is more appropriate as a delivery medium than BBM, Twitter, Email and SMS in a mobile learning environment regarding content accuracy. To add with, content adaptability has (sig. = 1.00), then we have all statistical reasons to accept this hypothesis which says WhatsApp is more appropriate as a delivery medium than BBM, Twitter, Email and SMS in a mobile learning environment regarding content adaptability. This shows that the results of this experiment support hypothesis H2, H3, H4. That is, WhatsApp is more appropriate as a delivery medium than BBM, Twitter, Email and SMS in a mobile learning environment regarding content richness, content accuracy and content adaptability.

Table 3. The Descriptive Analysis of media richness among WhatsApp, Twitter, BBM, SMS and Email

Research variable	WHATSAPP		TWITTER		BBM		SMS		EMAIL	
	Mean	sd	mean	Sd	mean	sd	mean	sd	mean	Sd
Content Timeliness	13.3	5.55	6.44	1.62	9.9	4.41	6.37	0.49	6.78	1.8
Content Richness	6.67	5.7735	6.67	2.52	6.67	5.69	6.67	3.51	6.67	6.66
Content Accuracy	6.67	6.11	6.67	2.51	6.67	3.06	6.67	4.51	6.67	5.03
Content Adaptability	6.67	5.51	6.67	6.51	6.67	3.05	6.67	5.51	6.67	3.51

Table 4. The ANOVA analysis of media richness among WhatsApp, BBM, Twitter, Email and SMS

Research Variable	Source	Sum of Squares	Df	Mean Square	f	sig.
Content Timeliness	Between Groups	713.244	4	178.311	15.140	0.000
	Within Groups	1059.977	90	11.778		
	Total	1773.221	94			
Content Richnes	Between Groups	13.762	4	3.440	.148	0.959
	Within Groups	209.167	9	23.241		
	Total	222.929	13			
Content Accuracy	Between Groups	.000	4	.000	.000	1.000
	Within Groups	197.333	10	19.733		
	Total	197.333	14			
Content Adaptability	Between Groups	.000	4	.000	.000	1.000
	Within Groups	249.333	10	24.933		
	Total	249.333	14			

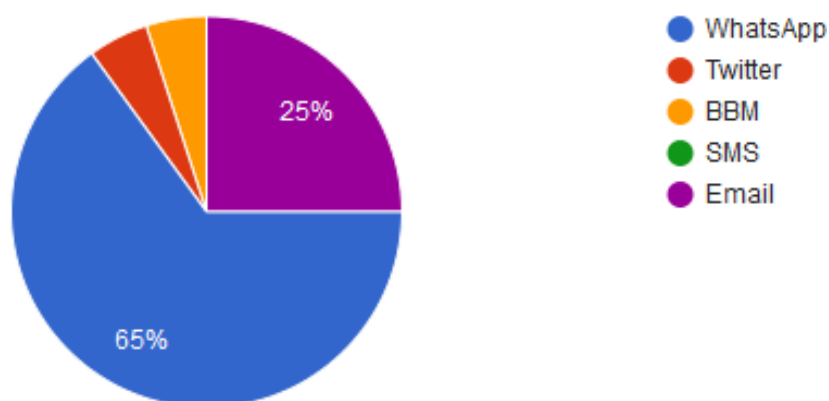


Fig 6: Respondent views

Table 5. Post Hoc Multiple comparisons (LSD Method) for Content Timeliness

(I) Medium	(J) Medium	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
WhatsApp	Twitter	6.85556*	1.11498	.000	4.6405	9.0707
	BBM	3.40000*	1.08524	.002	1.2440	5.5560
	SMS	6.93158*	1.09943	.000	4.7474	9.1158
	Email	6.52222*	1.11498	.000	4.3071	8.7373
Twitter	WhatsApp	-6.85556*	1.11498	.000	-9.0707	-4.6405
	BBM	-3.45556*	1.11498	.003	-5.6707	-1.2405
	SMS	.07602	1.12879	.946	-2.1665	2.3186
	Email	-.33333	1.14395	.771	-2.6060	1.9393
BBM	WhatsApp	-3.40000*	1.08524	.002	-5.5560	-1.2440
	Twitter	3.45556*	1.11498	.003	1.2405	5.6707
	SMS	3.53158*	1.09943	.002	1.3474	5.7158
	Email	3.12222*	1.11498	.006	.9071	5.3373
SMS	WhatsApp	-6.93158*	1.09943	.000	-9.1158	-4.7474
	Twitter	-.07602	1.12879	.946	-2.3186	2.1665
	BBM	-3.53158*	1.09943	.002	-5.7158	-1.3474
	Email	-.40936	1.12879	.718	-2.6519	1.8332
Email	WhatsApp	-6.52222*	1.11498	.000	-8.7373	-4.3071
	Twitter	.33333	1.14395	.771	-1.9393	2.6060
	BBM	-3.12222*	1.11498	.006	-5.3373	-.9071
	SMS	.40936	1.12879	.718	-1.8332	2.6519

6. DISCUSSION AND CONCLUSION

In this study, along with questionnaire, data was also collected through interviews. It was discovered that students preferred WhatsApp to be used to support mobile learning because of its large users, support for multimedia, and prompt delivery. Using SMS to support learning was not efficient because of its character limit, often times, abbreviations were used, which actually forfeited the goal of learning and is also expensive. For email, some students rarely check their mails; this tends to slow down the virtual interaction between teachers and students. From the result of the evaluation, the students' preferences for the media that will best support mobile learning are as follows: 65% for WhatsApp, 25% for Email, 10% for Twitter, and 10% for BBM (See figure 6).

However, most of the learners agreed that using WhatsApp in learning is much more convenient. Most learners attested to the fact that they chat with friends through WhatsApp on their mobile device every day in contrast to the other media. According to the result of Table 5, SMS has higher transmission efficiency regarding content timeliness, but the content presented with SMS only has text-based messages. Due to this, SMS may be appropriate for real-time information delivery such as notifying or reminding of some time-sensitive matters. Table 4 shows that WhatsApp can provide rich content presentation including various media types such as text, picture, audio and video and also support attachment of files such as pdf, doc, txt, ppt and xls. WhatsApp is also rich in content adaptability and content accuracy.

These results obtained showed that the designer of an m-learning environment could adopt WhatsApp as the suitable information delivery medium to support the corresponding learning activities in mobile learning. In other words, they could adopt WhatsApp to support various front-end mobile devices to access and present learning content, because

WhatsApp has superior content richness, accuracy and adaptation; however, they could adopt SMS to notify the learners of the latest news, particularly; frequently updated information.

In summary, mobile devices, wireless networks, and WhatsApp application could greatly support learning activities and achieve the goal of mobile learning. Some limitations and future research directions can be drawn from this study. The experiment result may differ according to different participants' characteristics such as prior m-learning experience, information literacy, media selection preference, and gender. Also, the advancement in technology in the nearest future may bring variance in result.

7. REFERENCES

- [1] Amry, A.B., 2014. The impact of whatsapp mobile social learning on the achievement and attitudes of female students compared with face to face learning in the classroom. *European Scientific Journal*, 10(22).
- [2] Bere, A., 2013. Using mobile instant messaging to leverage learner participation and transform pedagogy at a South African University of Technology. *British Journal of Educational Technology*, 44(4), pp.544-561.
- [3] Bopry, J., 1999. The warrant for constructivist practice within educational technology. *Educational Technology Research and Development*, 47(4), pp.5-26.
- [4] Brooks, Jacqueline G., and Martin G. Brooks. "The Case for Constructivist Classrooms (Alexandria, VA: Association for Supervision and Curriculum Development, 1993)." *Constructivism in Education*.
- [5] Calvo, R., Arbiol, A. and Iglesias, A., 2014. Are all chats suitable for learning purposes? A study of the required characteristics. *Procedia Computer Science*, 27, pp.251-260.

- [6] Church, K. and de Oliveira, R., 2013, August. What's up with whatsapp?: comparing mobile instant messaging behaviors with traditional SMS. In Proceedings of the 15th international conference on Human-computer interaction with mobile devices and services (pp. 352-361). ACM.
- [7] Cavus, N. and Ibrahim, D., 2009. m-Learning: An experiment in using SMS to support learning new English language words. *British journal of educational technology*, 40(1), pp.78-91.
- [8] Cronjé, J., 2006. Paradigms regained: Toward integrating objectivism and constructivism in instructional design and the learning sciences. *Educational technology research and development*, 54(4), pp.387-416.
- [9] Chipunza, P.R.C., 2013. Using mobile devices to leverage student access to collaboratively-generated resources: A case of WhatsApp instant messaging at a South African University. In International Conference on Advanced Information and Communication Technology for Education ICAICTE.
- [10] Daft, R.L., Lengel, R.H. and Trevino, L.K., 1987. Message equivocality, media selection, and manager performance: Implications for information systems. *MIS quarterly*, pp.355-366.
- [11] Daft, R.L. and Lengel, R.H., 1986. Organizational information requirements, media richness and structural design. *Management science*, 32(5), pp.554-571.
- [12] Dunlap, J.C. and Lowenthal, P.R., 2009. Tweeting the night away: Using Twitter to enhance social presence. *Journal of Information Systems Education*, 20(2), p.129.
- [13] Evans, R., 2008. The sociology of expertise: the distribution of social fluency. *Sociology Compass*, 2(1), pp.281-298.
- [14] Fattah, S.F.E.S.A., 2015. The Effectiveness of Using WhatsApp Messenger as One of Mobile Learning Techniques to Develop Students' Writing Skills. *Journal of Education and Practice*, 6(32), pp.115-127.
- [15] Fosnot, C.T., 2013. *Constructivism: Theory, perspectives, and practice*. Teachers College Press.
- [16] Hassini, E., 2006. Student-instructor communication: The role of email. *Computers & Education*, 47(1), pp.29-40.
- [17] Hsu, Y.C. and Ching, Y.H., 2012. Mobile microblogging: Using Twitter and mobile devices in an online course to promote learning in authentic contexts. *The International Review of Research in Open and Distributed Learning*, 13(4), pp.211-227.
- [18] Ifeanyi-obi, C.C., Olatunji, S.O. and Akpala, J., Perceived Effects of Facebook on Academic Activities of Agricultural Students in University Of Port Harcourt.
- [19] Isaacs, S., Vosloo, S. and West, M., 2012. Mobile learning for teachers in Africa and the Middle East: Exploring the potential of mobile technologies to support teachers and improve practice.
- [20] Lan, Y.F. and Sie, Y.S., 2010. Using RSS to support mobile learning based on media richness theory. *Computers & Education*, 55(2), pp.723-732.
- [21] Malaga, R.A., 2002. Additional methods when using email for teaching. *Communications of the ACM*, 45(8), pp.25-27.
- [22] Markett, C., Sánchez, I.A., Weber, S. and Tangney, B., 2006. Using short message service to encourage interactivity in the classroom. *Computers & Education*, 46(3), pp.280-293.
- [23] Naismith, L., Lonsdale, P., Vavoula, G. & Sharples, M. (2004) Literature Review in Mobile Technologies and learning. NESTA Future lab. Series. Report 11. NESTA Future lab.
- [24] Ogundipe, T. and Boyinbode, O., 2016. Exploring the Suitability of Handheld Devices for Mobile Learning.
- [25] Ovod, S., 2009. Exploring the potential of Twitter as a research tool. *Behavioral & Social Sciences Librarian*, 28(4), pp.202-205.
- [26] Plana, M. G. C., Escofet, M. I. G., Figueras, I. T., Gimeno, A., Appel, C., & Hopkins, J. Improving learners' reading skills through instant short messages: A sample study using WhatsApp. 4th World-CALL Conference, Glasgow, 10-13 July 2013.
- [27] Riyanto, A., 2013. English Language Learning Using WhatsApp Application". khmadRianto, Love for All, Hatred for None. WordPress, the Splendid Theme.
- [28] Terwel, J., 1999. Constructivism and its implications for curriculum theory and practice. *Journal of curriculum studies*, 31(2), pp.195-199.
- [29] Tsai, C.C., 2001. The interpretation construction design model for teaching science and its applications to Internet-based instruction in Taiwan. *International Journal of Educational Development*, 21(5), pp.401-415.
- [30] Wang, M., Ci, L., Zhan, P. and Xu, Y., 2007, August. Applying wireless sensor networks to context-awareness in ubiquitous learning. In *Natural Computation, 2007. ICNC 2007. Third International Conference on* (Vol. 5, pp. 791-795). IEEE.
- [31] Wen, M.L. and Tsai, C.C., 2003. Misconceptions and misuses of constructivism. *Educational Practice and Theory*, 25(1), pp.77-83.
- [32] Wurst, C., Smarkola, C. and Gaffney, M.A., 2008. Ubiquitous laptop usage in higher education: Effects on student achievement, student satisfaction, and constructivist measures in honors and traditional classrooms. *Computers & Education*, 51(4), pp.1766-1783.
- [33] Yeboah, J. and Ewur, G.D., 2014. The impact of whatsapp messenger usage on students performance in Tertiary Institutions in Ghana. *Journal of Education and practice*, 5(6), pp.157-164.