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Inquiry-based learning: Emirati university students choose WhatsApp for collaboration

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Abstract

Considerable research has shown the value of Inquiry-Based Learning (IBL) regarding student engagement and motivation, depth of learning, and cognitive flexibility. Student collaboration is one component of this approach, since students must communicate and work together inside and outside of class time when engaging with an IBL project. Choosing a mobile learning tool can benefit student collaboration in so far as the tool enables anytime/anywhere collaborative learning. This study looked at how 118 Emirati undergraduate students in a government-sponsored university in the United Arab Emirates chose to collaborate in an IBL semester-long assignment. Unlike some approaches that dictate the technology selection to students (Barczyk & Duncan, 2013; Prescott, Wilson & Becket, 2013), in this project course instructors gave the students autonomy to choose the best mobile learning tools for their group. The study used a mixed-methods approach to collect data on which tools students perceived as best for IBL. Participants were surveyed three times about which tool they preferred for university work: a pre-project survey, a mid-project survey, and post-project survey. Results show that students changed their preferred tool to WhatsApp over the course of the semester. A focus group with each course section provided qualitative data as to why students preferred WhatsApp. The students also delivered poster presentations as to how WhatsApp helped them complete their community-based IBL projects. This study will show how WhatsApp can be a successful mobile learning tool for student collaboration in IBL.

Introduction

Inquiry-based Learning (IBL) has been described as an umbrella term (Aditomo et al., 2013; Spronken-Smith et al., 2011) to designate a variety of pedagogical approaches where

> students learn content as well as discipline-specific reasoning skills and practices (often in scientific disciplines) by collaboratively engaging in investigations.
> (Hmelo-Silver et al., 2007, p. 100)

The core elements of an IBL approach as described by Spronken-Smith and Walker (2010) include: (1) learning is stimulated by questions or problems, (2) students actively learn by doing and increasingly take responsibility for their learning, and (3) the role of the teacher shifts towards that of a facilitator. IBL approaches include varying levels of structure. The most supervised is a *structured inquiry*, where a teacher presents a problem or issue as well as guidance on how to address it. Less supervised is a *guided inquiry*, where students are more self-directed in how they address the teacher provided questions. The least structured is an *open inquiry*, where students generate both the questions and the approach to answering it.

IBL is often considered an overarching model for authentic student learning (Blumenfeld et al., 1991); therefore, IBL approaches are widely advocated in higher education (Aditomo et al., 2013), although not without critique. Kirschner et al. (2006) state that "minimally guided instruction is likely to be ineffective" (p. 76), and review a long history of controlled studies in educational research that support direct instructional practices as being more effective. Responses to this critique concede that results of an IBL approach in terms of students' acquisition of skills when assessed by traditional knowledge assessments can be weak but they argue that IBL supports learning other important skills which are not captured in these types of assessment (Hmelo-Silver et al., 2007). Critical thinking, problem-solving, and taking responsibility for learning as well as the skills "to ask good questions, analyze and interpret evidence, and to select and justify the best solution to a problem" (Lee, 2010, p. 153) are promoted through IBL approaches. Considerable research has also shown the value of IBL regarding engagement and motivation, depth of learning, and cognitive flexibility (Aditomo et al., 2013; Lee, 2012). Through a meta-analysis of enablers and constraints for the use of IBL approaches in undergraduate education, Spronken-Smith et al. (2011) note that effective IBL course design must, among other factors, demand active engagement of students as well as considerable collaboration between them.

Communication richness

IBL projects are often structured as group projects with the direction of the inquiry and the type of evidence required determined by the instructor, by the group, or somewhere in between. In many cases, group members need to determine what the project is about, what it is they need to deliver (for example a paper or a presentation), and how they will work together. The latter question, how the group will work together, is often determined by both the project elements and the availability of group members to schedule time to work together. Daft and Lengel (1986) distinguish *equivocality* in the project elements from *uncertainty* as the group works together. When a project or task is clearly defined, there may be very little equivocality; but in cases where the project is less clearly defined, it becomes equivocal, thus requiring group members to discuss and determine or define their project for themselves. For example, an IBL project description may clearly define the task as 'write a paper describing service learning' or the description may be broader and more equivocal, e.g., 'engage in a service learning project of your choice and write a paper describing the experience.' The second element, uncertainty, is related to the information or data that would make up the project. In the earlier example, writing a paper to describe service learning removes much of the uncertainty around the project content and final output.

Daft and Lengel (1986) overlay this with the concept of *communication richness*, suggesting that by combining elements of equivocality and uncertainty that are present in a group task and the concept of communication richness, it is possible to determine the most appropriate communication support for a given task. The richest communication channels are synchronous and include multiple ways of presenting information (e.g., visual, oral, etc.), whereas the least rich are asynchronous and tend to present information in only one way (e.g. text) – see Figure 1 (note that Instant Messaging straddles both synchronous and asynchronous).
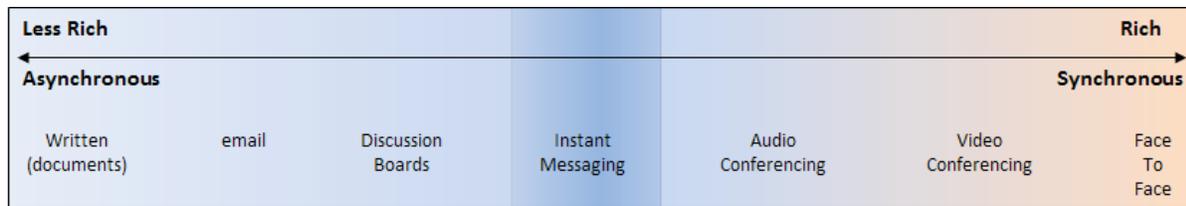
Less Rich						Rich
Asynchronous						Synchronous
Written (documents)	email	Discussion Boards	Instant Messaging	Audio Conferencing	Video Conferencing	Face To Face

Figure 1: Communication tools mapped to synchronicity and richness of communication channels.

In this model, communication includes both the exchange of information and the ability to determine whether the information was received and understood. The *latency* of a communication exchange (i.e., how long it typically takes from the initial message to a response) can also have an impact on how well and how quickly information can be exchanged. Richer communications are those that include multiple channels of communication with low latency. The richest form of communication is face to face, where all channels of communication are present, and the exchange of information is immediate.

The efficacy of the model proposed by Daft and Lengel (1986) is that it affords a mapping of tasks to communication richness based on task needs and thus to the selection of communication support. Tasks that involve rich communication requirements benefit from synchronous and multi-channel support whereas tasks with less rich communication requirements benefit from asynchronous support. As uncertainty and equivocality of a task increase, so too does the need for richer communication support.

Valicich and Dennis (1999) suggest an alternative view similar to, but somewhat different from, media richness theory: *media synchronicity*. In this perspective, there are two primary types of communication when involved in problem-solving activities and support for any type of communication must be consistent with its characteristics. The first type of communication is *conveyance* and is characteristic of data gathering and information sharing (i.e. exploring and processing new ideas and information). The second type of communication is *convergence,* with characteristics that include meaning-making and consensus building (i.e. coming to a mutual understanding or decision). Conveyance can best be achieved when the communication is asynchronous as it allows participants to share their ideas and data and also allows these to be archived. Convergence activities have much shorter latency requirements and are best achieved using synchronous or near-synchronous communication tools.

Who does the mapping?

The communication richness model above suggests that the selection of communication support for projects should map to the needs of a project or tasks within a project. The selection of communication media to support a task depends on a good understanding of the needs of the tasks and the ability of any selected media to support it. Also, given the pace of technology change and communication options available, it may be difficult to provide the latest media support in a timely fashion. One approach to this dilemma is to make use of the communication tools that group members have in their hands, for example their mobile phones or tablets. The Educause Center for Analysis and Research has been conducting surveys since 2004 regarding the kinds of technology students have and how they use them (Brooks, 2016). Their latest findings show that student ownership of smartphones in the United States has grown from 92% to 96% and a majority of students indicated that they agreed or strongly agreed that technology helps them when working on group projects. While the survey does not indicate the specific technology that students were using, it is clear that students do see technology as an important factor in their learning.

Student choice

A common thread in the literature around the use of mobile devices and social networking systems (SNS) as part of coursework is that the instructor makes the decision on the particular tool(s) and how students will utilize them. Research often recommends that instructors 'manage' the interactions that are a part of a course to avoid overwhelming students (Barczyk & Duncan, 2013), or be mindful that students do not want to use certain technologies as a part of formal learning (Prescott et al., 2013). Having the instructor choose the tool(s) is somewhat at odds with an IBL approach, where students are encouraged to make their own decisions about how they will approach solving a problem. In line with an IBL approach, rather than forcing students to adopt a common communication platform such as the university learning management system or numerous other mobile learning options, we propose that instructors should encourage the students themselves to choose how they would meet and collaborate. This type of IBL approach is in line with Spronken-Smith et al.'s (2011) requirement for students to be actively engaged.

Social networking systems (SNS) as collaboration tools

There is growing interest in the field of higher education in the use of mobile devices to support collaboration between students. One model by Koole (2009) highlights social technology as an affordance of mobile learning, with an emphasis specifically on collaborative, social activities. Use of social networking systems (SNS) is becoming widespread among both students and faculty in their personal lives, and increasingly in educational institutions (Johnson et al., 2014). Educators are intrigued by the potential of SNS to improve communication in learning environments, and "understanding how social media can be leveraged for social learning is a key skill for teachers" (2014, p. 8). Educational researchers are considering the use of many common SNS in their classes, including Facebook, YouTube, Instagram, Twitter, and many others (2014).

One of the advantages of using SNS, particularly with the use of mobile devices, is the instant messaging capability of these tools providing a text-based, near synchronous mode of communication. In some cases, instructors use SNS for one-way messaging such as sending content or reminders to students (Davis et al., 2014) or university administration uses them to communicate information related to emergencies (Dabner, 2012). Interesting work has also been done on how SNS can help with connecting students to each other to support in their adjustment to college (DeAndrea et al., 2012). These practices, while useful from an institutional communication perspective, do not necessarily leverage the unique communication capabilities of mobile devices and SNS to encourage student-to-student collaboration in learning.

Student attitudes towards SNS

Research is emerging about student attitudes towards using SNS as a part of their university course work. Hurt et al. (2012) found that using Facebook for online discussions over a university-sponsored tool improved students' attitudes towards the value and functionality of online discussions. While somewhat less positive, Barczyk and Duncan (2013) found that students were neutral to mildly favorable towards having their courses make use of Facebook, although some showed concern for privacy. However, Prescott et al. (2013) state that students are cautious about the use of Facebook in formal learning settings because there is a "blurring between its use in an individual's personal and professional life" (p. 348). While students appear to enjoy the functionality with using familiar SNS for learning, there is a tension experienced when formal learning environments enter their personal digital social spaces.

Twitter has also been used as a part of classes and, like Facebook, has had variable success. Junco et al. (2011) report increased engagement and grades by students who were required to participate in Twitter discussions initiated by the instructor. They trained students in the experimental groups to use Twitter, and then used the feed to encourage students to participate in out of class discussions, to give students a space to ask questions, and to send out reminders. Students also used the Twitter feed to organize themselves for group projects and study groups. While the experience for these students seemed positive overall, results from another similar study showed students reporting frustration with the stream of seemingly irrelevant tweets and finding it difficult to follow conversations; a small number of participants also raised concerns around privacy (Lin et al., 2013). While authors suggest ways to mitigate the concerns such as requiring student participation and not requiring students to follow each other, they found that the Twitter feed was largely a one-way communication channel.

While Facebook and Twitter are the more common SNS tools used in course work, research is also emerging on using WhatsApp Messenger, a cross-platform mobile messaging app that uses internet data plans to send free instant messages from smartphones without having to pay for SMS messages (WhatsApp, n.d.). The app allows users to create groups and send images, videos and audio messages to each other (WhatsApp, n.d.). Research in this area has tended towards investigating the effectiveness of using the app for teacher-led discussion groups (Bouhnik & Deshen, 2014; Rambe & Bere, 2013; Willemse 2015).

SNS as group communication tools

Given the importance of communication to IBL projects, the mobile instant messaging capabilities of SNS are of interest. In a recent comparative study of students using online discussion boards, computer-based instant messaging or mobile instant messaging in an IBL project, the use of mobile instant messaging was found to have a positive effect on the teamwork skills of participants, particularly with social and affective interactions pertinent to the beginning of the project (Kim et al., 2014). While this study found these effects over a brief project, they recommend the investigations of how student interactions change over time through a longer project.

Overview

IBL strategies that include group projects introduce a need to support group interaction. IBL projects typically include conveyance (exploratory) tasks as well as convergence (synthesis) tasks which will interact with communication needs regarding communication richness. Students may be in the best position to select communication modes and tools based on their perception of the communication needs of the project and the group. Given project time constraints, it may be useful to provide a set of tool choices that meet a range of communication criteria and needs. This combination of group autonomy and task/tool matching should result in greater student satisfaction levels with the group component of the project. This leads to the following hypotheses:

1. Hypothesis - 1: Student selection of a communication tool will converge on the most appropriate tool for the IBL tasks.

2. Hypothesis - 2: Personal autonomy will result in a more appropriate fit measured by levels of satisfaction

Methodology

Testing the above hypotheses took place in the context of an IBL project in six sections of a business communication 200-level course at the undergraduate level. Two instructors taught different sections of the course: one instructor taught four sections while the second instructor taught two sections of the course.

In this course, the guided inquiry project required students needed to identify a need in their community and work together in groups to help their community. The focus was to apply the business communication theory and skills presented in the course to do something beneficial for others. Students undertook various projects, including a fund-raiser to benefit sick children or help the poor, or to support orphans through the Red Crescent. Other student groups chose to help the community by organizing a toy-drive for a local hospital, creating an awareness campaign regarding special needs students, organizing a blood drive or visiting retirement homes and conversing with the lonely and forgotten. The instructors used the class time to teach students the elements of business communication, but students needed to work in groups outside of class to apply the business communication skills in completing their project. Students were required to work in groups to complete the project.

Students were asked to use one of four suggested communication tools (Table 1): Instagram, Twitter, KIK, and WhatsApp. These were selected as they had been popular with students the previous semester, (Snapchat had yet to emerge as a common tool). They were free to change from one tool to another throughout the project should communication needs change or tool selection not meet the communication needs. Survey data were collected on each of the three surveys indicating which tool they were currently using.

Table 1: Communication tool suggestions.

Tool	Description
Instagram	Primarily a photo sharing application that allows users to share content publically or privately.
Twitter	Social media service where users publically post and interact with short 140-character messages ("tweets") or send private messages.
KIK	Mobile instant messaging application, where users can send messages and photos directly to other registered users. Allows users to stay anonymous as they don't need to provide a telephone number to register.
WhatsApp	Mobile instant messaging application, where users can send messages and photos directly to other users who register with their mobile number.

Before the beginning of the study, full ethical clearance was obtained from the university's Research Ethics Committee on June 2nd, 2014 and was valid until June 1, 2015. Informed consent was obtained from students at the beginning of the course using a combination of a verbal overview of the study and a review of the written consent form. It was explained that participants would be asked to complete three surveys during the course. Also, it was outlined that both participants and non-participants would conduct focus groups and complete a project as a part of the coursework, but only data from

participants that consented would be included in the data analysis. Students were assured that their grade would not be affected by their participation (or non-participation) in the study. Students agreed that they understood what was being asked of them and all of them agreed to participate in the survey.

Data collection was undertaken in the Spring Semester, from February to May of 2015. From February to May 2015, samples were collected using a mixed methods approach by means of surveys and various forms of qualitative data.

Participants

The sample for this study was made up of 118 Emirati students. The campus is segregated by gender, and 97 females participated in the project over five sections, with only one section of male students (21 males). The smaller number of males is reflective of the smaller size of the male undergraduate program. The vast majority of students ranged from 18-23 years old, with only four students over the age of 24. The students are native Arabic speakers and they are completing their undergraduate studies in English.

After inclusion in the study, the research team confirmed that all participants owned mobile devices that they used as a part of their schoolwork. Therefore, they were in a position to choose the most appropriate technology that would meet their needs and the needs of the guided inquiry project.

Quantitative data collection

Quantitative data was collected primarily through an online survey administered at three different points during the semester. Prior to beginning the research project, the two course instructors discussed the various issues and types of data that would help inform this research project and subsequent projects. Through discussion with students and instructors, and through the instructors' experience with previous IBL projects, a 27-item survey was developed. The survey collected information for various research questions not related to this paper, including basic communication skills in reading, writing and speaking; intercultural communication skills; community engagement, social media; and students' perception of learning. The following four survey items directly related to the students' choice of social media tools for collaboration:

Table 2: Survey question and response options.

Question	Response options
How often do you use social media for completing school work?	A four-point Likert scale was used to measure frequency with one indicating "never" and four indicating "all the time"
What did you use most often when communicating for school work?	Four options were provided: Instagram, Twitter, WhatsApp and KIK
Do you feel your project was successful?	"yes" or "no"
How well did people in your group work together?	Four options were provided: Extremely well, very well, moderately well, slightly well, not at all well. A comment box was added for further explanation.

Survey Monkey (https://www.surveymonkey.com/r/PV6VXZX) was used to deliver the 27-item survey to the students near the beginning of the project, at the mid-point of the project, and after the project was complete. Each of the three surveys was identical, with only verb tenses changing to indicate future (pre), present (mid) or past (post) and the addition of a comment box on the third survey.

Qualitative data collection

Participants provided qualitative data on their selection and use of social media tools in their IBL guided inquiry project in the following ways: student-led focus groups, poster presentation videos and final reflective group reports, and a survey comment boxes in survey three.

Focus groups

The intention was to have students conduct their own focus groups so they would be able to speak openly about their experiences, rather than have them participate in a focus group led by a member of the research team. They would be given a semi-structured protocol to follow, and be given training on note-taking, facilitation, and thematic analysis. After some discussion with the participants, we found that many students had never participated in a focus group before. To give them an example of the experience, a research assistant ran a sample large group focus group first. Through this, the procedures of a focus group were modeled for students, including the use of the semi-structured protocol, appropriate note taking, and allowing for participation from all participants. After the model, the steps for conducting a focus group were reviewed with the students. They were then put into new smaller groups, with no students that had worked together on their project put into the same focus group, again to allow them to speak as openly as possible about their experiences. The protocol had the students discuss the project in detail and recount how social media facilitated group collaboration. Each group nominated a person to take notes, a leader to facilitate the discussion based on the focus group guide, and a person to record the focus group using a digital recorder. After they finished their focus groups, the researcher led the larger group through an exploration to uncover emergent themes.

Poster presentations

Qualitative data was also collected through poster presentations, where students summarized the outcomes of their projects and commented on their group communication. The students presented the poster presentations by video format for 3-5 minutes each. They posted their videos on a secure network, WebDav, provided by the university for faculty and students. Students were enthusiastic to discuss their projects in detail and share what they had learned. The content of the poster presentations was transcribed later and reviewed for mention of social media and group communication tools.

Group reports

Qualitative data was also collected through the final written group reports. These reports were a required part of the project and a summative assignment. In these reports, students provided evidence of how they used business communication to complete the project. It also had a reflective component for students to comment on what tools they found useful for group collaboration. Screenshots of WhatsApp conversations were included in many final reports with comments as to why and how they used the tool.

Survey

On the third survey, students were provided with a comment box if they wanted to expand on their answers for all of the questions listed above. However, very little qualitative data was collected from this source.

Results and discussion

The goal of this research project was to investigate which communication media participants would choose and how well that choice would support their communication needs.

Hypothesis 1: Student selection of a communication tool will converge on the most appropriate tool for the IBL tasks

Participants gravitated towards social media to help with school-related communication. The participants' desire to use social technology supported the model by Koole (2009). The model highlights social technology as a crucial component of mobile learning, with an emphasis specifically on collaborative, social activities. Figure 2 shows how often students use social media for completing school-related work across the three different surveys. The data shows that there is a trend towards increasingly using social media for school-related reasons. In survey 2, 57% of the participants indicated they sometimes use social media, while 23% reported they use social media "all the time". However, by the end of the project, there was an increase in the number of participants who now use social media all the time for school-related communication. The results indicate that 51% of students use social media sometimes and 41% use it all the time
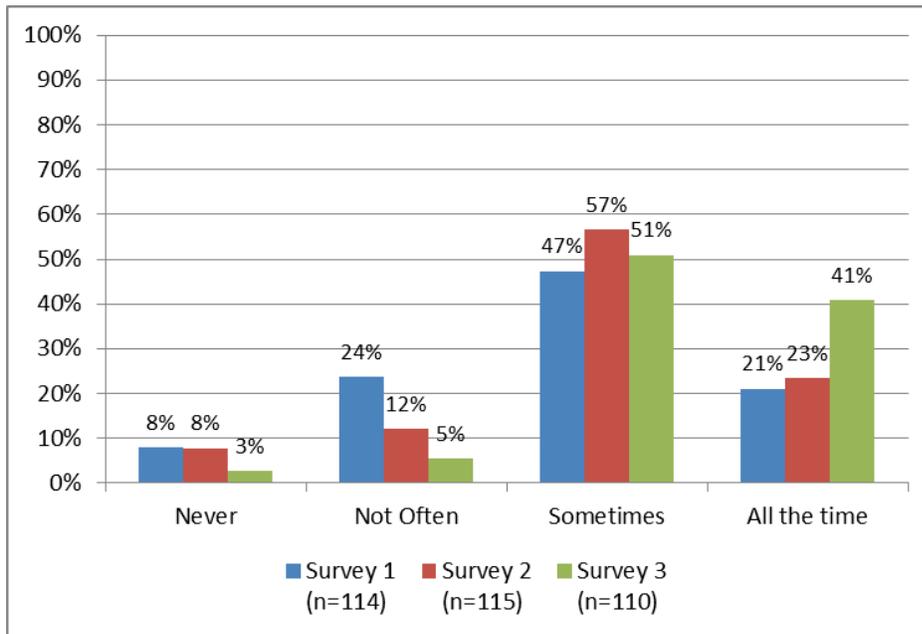

Figure 2: Reported frequency of use of social media for school-related group communication (percentage of students in each survey).

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Communication constraints

Participants reported that there were three major communication constraints that made it difficult to meet in person during the project: 1) geographic constraints, 2) social constraints, and 3) scheduling constraints. These three constraints were largely related to an emphasis on family relationships over study needs.

1) *Geographical constraints* were one concern for participants. Since participants needed to collaborate, it was difficult to find a place to work together because finding a meeting place was a challenge. Participants live and have family in geographically disparate areas and meeting face-to-face was reported as a challenge for many. For example, on weekends it is common from participants to travel to another Emirate for large family gatherings. Also, participants live in various towns, villages and city areas and must commute to attend university.

2) *Social constraints*: in the Gulf region, some students come from socially conservative families that do not permit their daughters to meet other students outside of the physical location of their homes or university campus. This impacted group collaboration should one student in a group be restricted from meeting outside of university hours.

3) *Scheduling constraints*: participants have different schedules and family commitments, so finding a common time to meet was a difficulty.

Participants needed to find a way to overcome the geographical, social and time-related constraints in order to collaborate on the group project. These constraints reinforced the need for a communication tool that they could use throughout the project. These constraints also supported Valicich and Dennis's (1999) theory of media synchronicity. Conveyance, the first type of communication, involves collecting data and sharing information. The results from this study support Valicich and Dennis' (1999) theory that conveyance can best be achieved when the communication is asynchronous, as it allows participants to share their ideas and data and also allows these to be archived. WhatsApp allowed for participants to choose a communication tool that helped them share ideas and gather data.

Tool selected

Participants demonstrated that they were able to choose autonomously the best learning tool for their needs. The projects were designed by the instructors to ensure students were given an opportunity to practice and apply their communication skills outside of the classroom; thus, by design, students had inadequate class time to work on their projects. One student, not familiar with WhatsApp and having never heard of the application, quickly and easily adapted to the group and was pleased with the results. She reported, "Before the start of this project I did not have the value of social media; whereas, now I understood that it the best tool to communicate with others and easier way to communicate. WhatsApp is the best tool to make things easier and make the work done faster".

Figure 3 shows the social networking system (SNS) that students selected and how their selection converged over the length of the project on 'WhatsApp'. It demonstrates the students' increased utilization for WhatsApp as a collaborative tool for IBL projects.
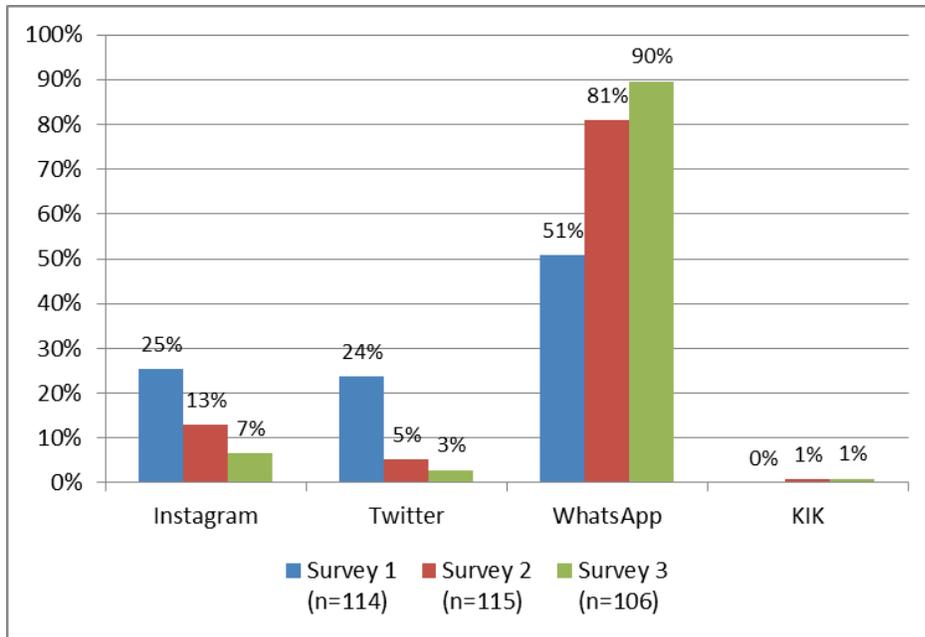
Figure 3: Communication tool selection (percentage of students in each survey).

All participants reported in their focus groups that they used WhatsApp for project-related communication. Comments also revealed that they used WhatsApp because it is fast and many participants enjoy the 'anytime/anywhere' aspect of the app. One participant was abroad during the Spring Break when her group was working on the project. She says, "WhatsApp helped us get tasks done and communicate electronically". Even if the students remained within the local geographic area, the groups preferred discussing the project after university hours and the app provided a platform for them to discuss the project in a time-saving manner. Other comments from the focus groups and final reports indicated that participants liked WhatsApp because they could easily share photos they took about the project, and save complete conversations as a text file.

Participants also reported that they used WhatsApp for forming groups, sharing materials, and discussing the project. As one group of participants wrote in the focus group report:

> we found out that 100% of group students use WhatsApp program as a communication tool to communicate with other [sic] because it has different features such as sending videos and photos, recording instead of typing, creating group [sic] to discuss with many people and making free calls.

During the focus groups, the following quote from a group of students explained how they chose their communication tool:

> 100% of the student [sic] said that WhatsApp is a great tool to use, because it is easy to download, you can create a group so that every member can participate.

It is clear that students chose WhatsApp because it is easy to use and provides a way for everyone to participate.

By the second and third surveys, WhatsApp had gained popularity as the best social media tool for collaboration, whereas Instagram and Twitter fell in relative popularity. This demonstrates that students can autonomously choose a SNS group communication tool by assessing their own needs. In the final report, students were asked to reflect on their IBL experience and report on what they learned.

Students reported WhatsApp was conducive to group work because they were able to share images and video, save the text of discussions, and use audio recordings to facilitate sharing of ideas. Students captured images of their WhatsApp conversations and included the images in their final reports. The images show that students were able to share videos they had created about their projects using their phone cameras. They were able to communicate in the language they felt most comfortable in (i.e., primarily Arabic). They were able to share documents in the form of class notes and PowerPoints they were preparing for their group presentations. It was also interesting to note that often students audio recorded their comments and shared them through the app.

What is it about WhatsApp?

The participant comments and survey responses indicated that WhatsApp met their communication needs for the project. This decision appears to have been based on the following features as articulated above:

Table 3: WhatsApp features used by participants.

Feature	Description
Cross-platform	All of the participants had smartphones but not all had the same make. Most had iPhones but some had Android phones and several had Blackberry's. WhatsApp had versions for all three makes of phones.
Language support	WhatsApp supported Arabic as well as English.
Group support	It was easy to create group discussions.
Media support	Participants could share audio, video, images, and text.
Message latency	WhatsApp is an instant messaging tool. It is near-synchronous and supports exporting (downloading) the text of messages.

The first three features enabled all participants in a group to easily join and participate in the group work regardless of what type of smartphone they had or which language they preferred to use to communicate. The final two features, media support and message latency, were more directly related to communication richness. Boyinbode et al. (2017) reported similar findings when comparing WhatsApp, Twitter, Blackberry Messaging, SMS and email: they found that participants differentiated between the different tools based primarily on message latency while rating them roughly the same on media support.

Hypothesis 2: Personal autonomy will result in a more appropriate fit measured by levels of satisfaction

The final survey added an extra question about students' perception of the success of their project (see Figure 4). The pie chart indicates that the vast majority of the students perceived they were successful with the project.
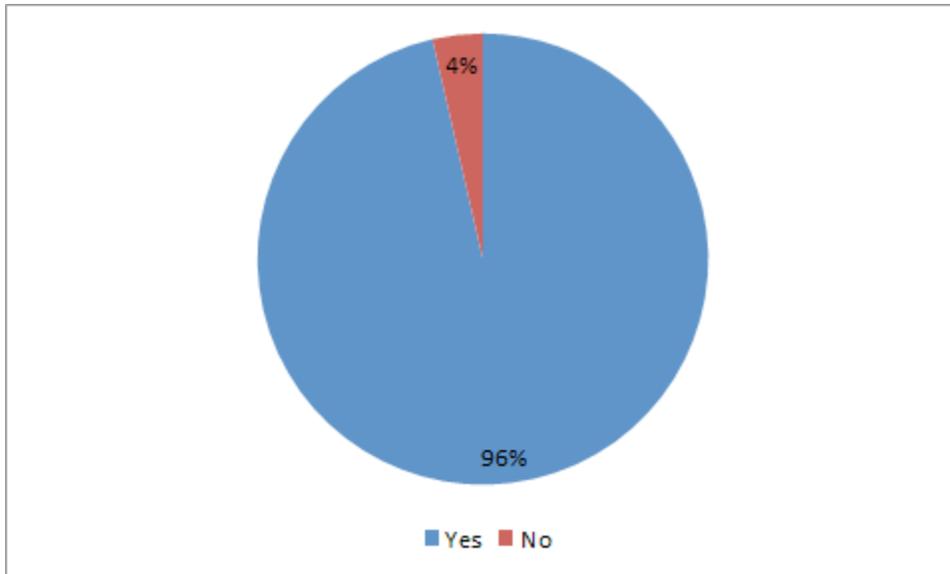
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Figure 4: Students' perception of their project's success.

The success of their project was related to teamwork and group dynamics. Although students complained in their comments about the amount of work the project entailed, they reported they were able to complete their work because the group worked well together. Figure 5 indicates that the majority of students were happy with their team and how they worked together.
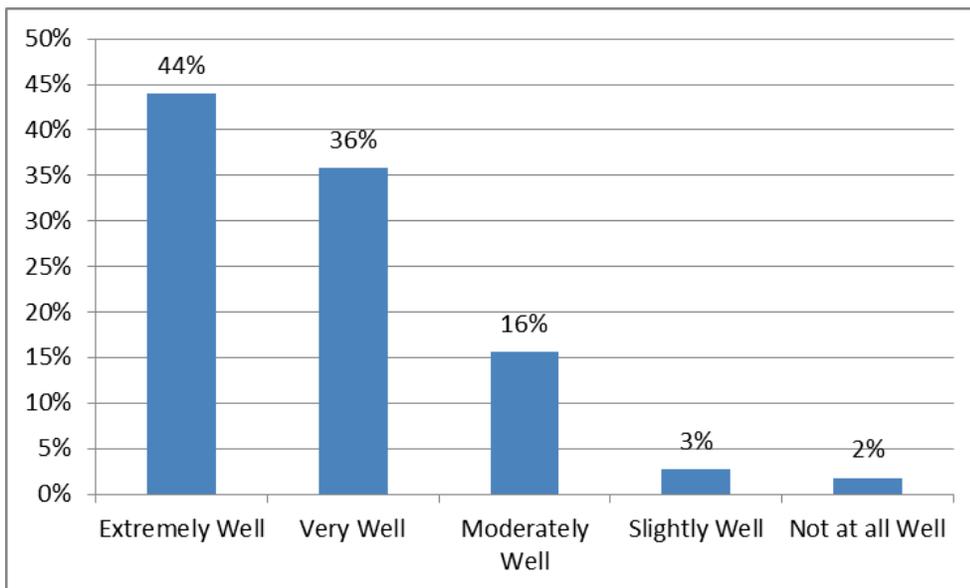

Figure 5: Satisfaction with group dynamics.

44% of the students felt their group worked extremely well together and36% indicated they worked very well together, indicating that 80% of the participants reported that groups worked very well or extremely well. The students also reported satisfaction with their projects in their final reports and focus groups.

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Overall, the study found that group dynamics were supported by WhatsApp. These findings seem to support the model seen in Figure 1 and the findings by Daft and Lengel (1986) with regards to equivocality and uncertainty. The students needed strong group dynamics because the project was not clearly defined by the instructor. The group members were required to discuss what part of the community they wanted to help and how they wanted to help the community; they also had to determine the best way to complete their project for themselves. The findings also support Daft and Lengel's concept of communication richness. The group dynamics in this study show that by combining elements of equivocality and uncertainty it was possible for the student to autonomously determine the most appropriate communication support for their project. Their choice of WhatsApp, as an instant messaging tool that is both asynchronous and synchronous, provided richer communication support to overcome the uncertainty and equivocality of the task they were given.

In the student-led focus groups, the students expressed that WhatsApp made collaboration easier. The data showed a growing appreciation for social media in general and WhatsApp in particular. It is interesting to note that during the project group dynamics were not always perfect. There were two instances of complaints from group members where they sought out assistance from the course instructor; both groups complained that an individual member was not participating. Despite the complaints, the use of WhatsApp helped with group dynamics in the end because these WhatsApp group conversations provided evidence of poor participation from a group member to the instructor. The instructor was able to intervene and show the non-participating student evidence that her group effort was lacking.

Conclusion

In conclusion, research in the area of WhatsApp as an effective SNS app has generally been applied for teacher-led discussion groups (Bouhnik & Deshen, 2014; Rambe & Bere, 2013; Willemse 2015). This study investigated WhatsApp as a successful mobile learning tool for student collaboration in a guided inquiry IBL project. The data indicates that by giving students the autonomy to select an appropriate tool, rather than the teacher dictating the tool, students were able to gravitate towards a suitable choice that they all invested in and felt met their needs. The students did not require teacher intervention to determine a tool to be used for collaboration. In this project, some students were unaccustomed to using social media, but the students taught each other. There was one mature student who was not accustomed to social media. Her group members showed her how to download the app and encouraged her to use WhatsApp. She found it easy to use and convenient, according to her final report. As a result, this study saw a growing trend towards using social media to complete school related work. The students enjoyed the anywhere/anytime aspect of using social media for collaborative purposes. Although they were free to choose any way to collaborate, there was a trend for students to gravitate towards WhatsApp because it is easy to use. The students all had smartphones and could easily download the app for their group work. They also reported that they liked that the app was free and found it useful that they had various ways they could share information with WhatsApp. For example, they were able to share documents, videos, photos, voice recordings and PowerPoints, to name a few. Therefore, the students chose WhatsApp because it best suited their needs and helped them overcome the geographical and cultural constraints often faced when engaging with group projects. The results of this project show that most students felt they were successful in their IBL guided inquiry project. They were also happy with their groups and their ability to work well together. The quantitative and qualitative data indicates the students felt they worked well together because social

media gave them a chance to work together at anytime and from anywhere and they chose WhatsApp as their collaborative tool of choice.

Although there were some unique findings from this study, there are also some limitations which could be addressed in future research. As there were only two teachers and 118 students involved at a particular university, the findings may not be generalizable to undergraduate IBL projects elsewhere. As well, as the research involved self-reporting by students, and although the research design attempted to mitigate the issue, their reporting may have been limited by social desirability bias. Furthermore, students were graded on their reports so there is a risk students may have embellished their comments in hopes of getting a better grade. The instructors had assured students that their work was graded on supporting evidence, whether positive or negative. To avoid possible embellishment in student comments, teachers may want to create a word count of 300-500 words and grade the assignment on a "complete" or "incomplete" basis. This approach would ensure students provide a thorough answer, but the grade is not based on their actual comments.

Future research in IBL projects may look further into group collaboration and interaction with communication richness. Specifically, future research projects may include how students choose the communication tools that best suit their needs for the project and the group. In addition, research into whether or not these tools improve student achievement of learning outcomes could be another possibility.

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References

Aditomo, A., Goodyear, P., Bliuc, A., & Ellis, R. A. (2013). Inquiry-based learning in higher education: Principal forms, educational objectives, and disciplinary variations. *Studies in Higher Education*, *38*(9), 1239-1258. http://dx.doi.org/10.1080/03075079.2011.616584

Barczyk, C. C. & Duncan, D. G. (2013). Facebook in higher education courses: An analysis of students' attitudes, community of practice, and classroom community. *International Business and Management*, *6*(1), 1-11.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, *26*(3-4), 369-398. http://dx.doi.org/10.1080/00461520.1991.9653139

Bouhnik, D. & Deshen, M. (2014). WhatsApp goes to school: mobile instant messaging between teachers and students. *Journal of Information Technology Education: Research*, *13*, 217-231.

Boyinbode, O., Agbonifo, O., Ogundare, A. (2017). Supporting mobile learning with WhatsApp based on media richness. *Circulation in Computer Sciences, 2*(3), 37-46.

Brooks, C.D. (2016) *ECAR study of undergraduate students and information technology, 2016*. Research report. Louisville, CO: ECAR, October.

Dabner, N. (2012). 'Breaking ground' in the use of social media: a case study of a university earthquake response to inform educational design with Facebook. *The Internet and Higher Education*, *15*(1), 69-78. http://dx.doi.org/10.1016/j.iheduc.2011.06.001

Daft, R.L. & Lengel, R.H. (1986). Organizational information requirements, media richness and structural design. *Management Science*, 32, 554-571.

Davis, C. H. F., Deil-Amen, R., Rios-Aguilar, C. & González Canché, M. S. (2014). Social media, higher education, and community colleges: A research synthesis and implications for the study of two-year institutions. *Community College Journal of Research and Practice*, *39*(5), 409-422. http://dx.doi.org/10.1080/10668926.2013.828665

DeAndrea, D. C., Ellison, N. B., LaRose, R., Steinfield, C. & Fiore, A. (2012). Serious social media: On the use of social media for improving students' adjustment to college. *The Internet and Higher Education*, *15*(1), 15-23. http://dx.doi.org/10.1016/j.iheduc.2011.05.009

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller and Clark (2006). *Educational Psychologist*, *42*(2), 99-107. http://dx.doi.org/10.1080/00461520701263368

Hurt, N. E., Moss, G. S., Bradley, C. L., Larson, L. R., Lovelace, M., Prevost, L. B. & Camus, M. S. (2012). The Facebook effect: college students' perceptions of online discussions in the age of social networking. *International Journal for the Scholarship of Teaching and Learning*, *6*(2), 10.

Johnson, L., Adams Becker, L., Estranda, V., & Freeman, A. (2014). *NMC horizon report: 2014 higher education edition*. Austin, Texas: The New Media Consortium.

Junco, R., Heiberger, G., & Loken, E. (2011). The effect of Twitter on college student engagement and grades. *Journal of Computer Assisted Learning*, *27*(2), 119-132.

Kim, H., Lee, M., & Kim, M. (2014). Effects of mobile instant messaging on collaborative learning processes and outcomes: the case of South Korea. *Journal of Educational Technology & Society*, *17*(2), 31-42.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*(2), 75-86. http://dx.doi.org/10.1207/s15326985ep4102_1

Koole, M. L. (2009). A model for framing mobile learning. In M. Ally (Ed.), *Mobile learning: transforming the delivery of education and training* (pp. 25-47). Athabasca, AB: AU Press, Athabasca University.

Lee, V. S. (2010). The power of inquiry as a way of learning. *Innovative Higher Education*, *36*(3), 149-160. http://dx.doi.org/10.1007/s10755-010-9166-4

Lee, V. S. (2012). What is inquiry-guided learning? *New Directions for Teaching and Learning*, *129*, 5-14. http://dx.doi.org/10.1002/tl.20002

Lin, M., Hoffman, E., & Borengasser, C. (2013). Is social media too social for class? A case study of twitter use. *TechTrends*, *57*(2), 39-45.

Prescott, J., Wilson, S. & Becket, G. (2013). Facebook use in the learning environment: do students want this? *Learning, Media and Technology*, *38*(3), 345-350. http://dx.doi.org/10.1080/17439884.2013.788027

Rambe, P., & 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), 544-561. http://dx.doi.org/10.1111/bjet.12057

Spronken-Smith, R., Walker, R., Batchelor, J., O'Steen, B. & Angelo, T. (2011). Enablers and constraints to the use of inquiry-based learning in undergraduate education. *Teaching in Higher Education*, *16*(1), 15-28. http://dx.doi.org/10.1080/13562517.2010.507300

Spronken-Smith, R. & Walker, R. (2010). Can inquiry-based learning strengthen the links between teaching and disciplinary research? *Studies in Higher Education*, *35*(6), 723-740. http://dx.doi.org/10.1080/03075070903315502

Valicich, J.S. & Dennis, A.R. (1999). Rethinking media richness: Towards a theory of media synchronicity. 32nd Hawaii International Conference on System Sciences, Maui, Hawaii.

WhatsApp. (n.d.). Retrieved December 11, 2015, from https://www.whatsapp.com/

Willemse, J. J. (2015). Undergraduate nurses reflections on WhatsApp use in improving primary health care education. *Curationis*, *38*(2), 1-7.