Investigating the Roles of Effective Communication Among Stakeholders in Collaborative Software Development Projects

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Abstract. The development of software includes multiple stakeholders since it is a multidisciplinary collaboration. Processes in software development demonstrate many problems relating to multidisciplinary collaboration. Communication has been recognized as an important factor for success in software development projects because previous researches on stakeholder analysis and collaboration has demonstrated the importance of communication. Hence, this study investigated and analyzed communication between stakeholders in collaborative software development projects with references to team activities as a social and intellectual practice. The objective of the study was to define factors that would influence and recognize the process of collaboration during software development. The study focused on communication between the software developers (Students) and project managers (lecturers) during the software requirements phase, interdisciplinary collaboration, team process, and inter-team, particularly between software engineers and technical communicators. First, a survey questionnaire was developed to gather data and analyze the effects and sources of communication among the involved stakeholders in software development projects. An experimental analysis was also performed to further test the supporting impact of client documents on requirements gathering. An experimental study was conducted to further test the supporting effect on requirement gathering of client documents. The results revealed that project managers are vital to software development progress, because they are the one that will provide the team with documents that support requirements gathering, thus improving team productivity and efficiency. Finally, software teams ensured that participants from all professional backgrounds were actively involved in the projects with a relatively centralized team structure.

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1 Introduction

Software development is a discovery and communication driven approach [1]. There is nothing in promoting inspiration but people's ideas, contact colleagues and the machine about those concepts and ideas [1, 2]. In complex circumstances, where multiple teams and integrated stakeholders are involved, the key drivers to projecting success are communication efficiency and the skills of team members [1, 3]. A communication breakdown within software project development teams can affect the outcome of the project if not properly managed [3]. Communication is very paramount to see clearly what needs to be done, thus bringing more self-confidence about what need not be done [2, 3]. Communication, skills, and community attention enables the project to be active and more responsive than focusing on the software process [1, 7]. Effective communication and teamwork are essential to achieving success in software development projects, especially in a collaborative environment. Effective communication and coordination between people in a software development project are enormous as workplace and resources [1]. The introduction of distributed software development as a substitute for standalone software development has increased demands for quality software products and services [24–26, 30]. The location and time limitations in distributed software development should be well managed to ensure knowledge management [27–31].

Software development is a team-up process inspired by various stakeholders from different disciplines [4–6, 8]. Software product planning marks the beginning of technical work and continues from requirement gathering until the software is no more functional [9–12]. The gathering of requirements from project managers is done by development teams and is based on the specifications design of the interface and implementation the project [12]. The implemented product undergoes an iterative process of usability testing before the final deployment. The collaborating stakeholders working together are organizations or people that may be impacted or influenced by a project [12–15]. The performance of software application development is based on the cooperation of stakeholders from different disciplines. However, this has created difficulties in interdisciplinary collaboration. The barrier of communication across disciplines was identified as the cause of many of the challenges.

The creation of software includes various individuals and departments and their respective knowledge and expertise. It's a labor-intensive and complex process [16, 17, 23, 31]. Therefore, new knowledge gathered in software development projects is crucial to handle the software output effectively, and it should be agreed that knowledge (i.e. know-how) should be successfully managed through the reconfiguration and exploitation of existing knowledge and project-related risks [18, 19]. Several scholars have stated and emphasized that project performance relates not only to the information stock or existing knowledge assets that members of the software development project team have [20–22] but also to their collective ability to understand how to evaluate the various multiple realities of key project-related issues. Also, how to critically, honestly,

essentially, and beautifully apply both their experience and knowledge [23]. It is therefore important to gather collective wisdom through a software development project team to summarize all the expertise and come out with a strong and critical decision, insight, and aesthetic skill, thus becoming fully successful during software development efforts [21, 23]. The rest of this paper is organized as follows: Sect. 2 discusses the methodology and research questions. Section 3 presents results and discussion. Section 4 concludes the paper and discusses future research directions for the realization of efficient Collaborative Software Development Projects.

2 Methodology

2.1 Study Background

Communication between software development teams and project managers were identified as an important factor for successful software development projects. This study supported literatures on more teams in a fully placed framework with focus on teamwork performance. The framework of this study was a computer science project supervised by a team of lecturers. The goal of the project was to develop an Android application and website for both students and lecturers in the virtual classroom, allowing anyone to use it to collect data and information for E-library and computer use. The final year students from the University of Ilorin worked as a team to develop the apps and websites for E-library and computer use. The study was based on supervising their 2019 development processes. This collaboration required students to have both skillful collaborative attitudes and task-relevant specialized skills by involving stakeholders with many disciplinary backgrounds and working with teammates from other departments. Questionnaire, semi-structured interviews, WhatsApp, and notes meeting were used for the analysis.

2.2 Research Questions

The study investigation focused on the effective communication and project manager participation of diverse development teams. The two research questions to be answered are:

Question 1: What are the main communication channels or methods that influence the software development process?
Question 2: How can we improve efficient communication in software development?
Hypothesis 1: The communication between software developers and project managers can predict the success of requirement gathering.
Hypothesis 2: The quantity and quality of communication between software developers and project managers can positively impact team performance during the development process.

2.3 General Methods

The study used a questionnaire approach to acquire the types and effects of communication and their importance during software development. Seventy-five copies of this questionnaire were distributed mainly to project students involved in the software development, one of the students served as the team leader and the lecturers as the project managers in the same university where the work was carried out. A total of the seventy-three questionnaire was completed and returned making a 97% response rate. The study focused on communication because it is a general belief that communication would be a key factor that would bring about improvements and efficiency.

3 Discussion and Results

The questionnaires were distributed to the team members during and after the project, to understand the communication within the team throughout the software development process. To better investigate the communication process, WhatsApp and meeting notes were used to collect information because the team members were spread out, and semi-structure interviews were also conducted with members of each team. The participants were to mention the communication process adopted by their team leaders and lecturers as well as answer questions such as how many meetings they had with the leaders and lecturers of their teams and what methods were adopted. To test the first hypothesis, the evaluation posed four different questions and assessed the amount of communication in all media. In the study, questions like "how many times do you meet with your lecturers within a month?" were asked and the response could range from" once a month"," twice a month"," thrice a month" and" four-time a month". The number of meetings held using the WhatsApp platform was calculated based on the discussions on the group and chatting. The documents the team received from lecturers and students assumed to be used for the application were also studied and their effectiveness and contribution to the design of the app were determined. Due to the number of meetings and communication with team leaders and lecturers, attention was focused on four groups, thus helping their software correctness and usability tests. To determine the records of the correspondence, the analysis of both content and pattern was exploited.

As shown in Table 1 and Fig. 1, a total of 23 (7.6%) of the respondents meet their lecturers once per month, 38 (12.7%) meet their lecturers twice per month, 73 (24.3%) meet their lecturers thrice per month and 166 (55.4%) meet their lecturers four times per month. This showed that 55.4% of the students meet their lecturers to discuss the progress of their projects and how to improve project development. The two projects were studies (App and website), the projects covered seven (7) months of the final year students and the projects were completed.

Table 2 and Fig. 2, showed that WhatsApp chatting is the most commonly used communication medium. The evidence showed that group 2 team had more communication, while group 1 and group 3 had the least. This was used to estimate the frequency of communication in the survey at the end of the project. Therefore, this allowed us to better understand the overall level of coordination within each team. To

Table 1. Distribution of respondents by meeting times per month

Chat type	Once a month	Twice a month	Thrice a month	Four-time a month
Group one	7	10	19	45
Group two	3	5	25	46
Group three	10	15	10	37
Group four	3	8	19	38
Total	**23**	**38**	**73**	**166**

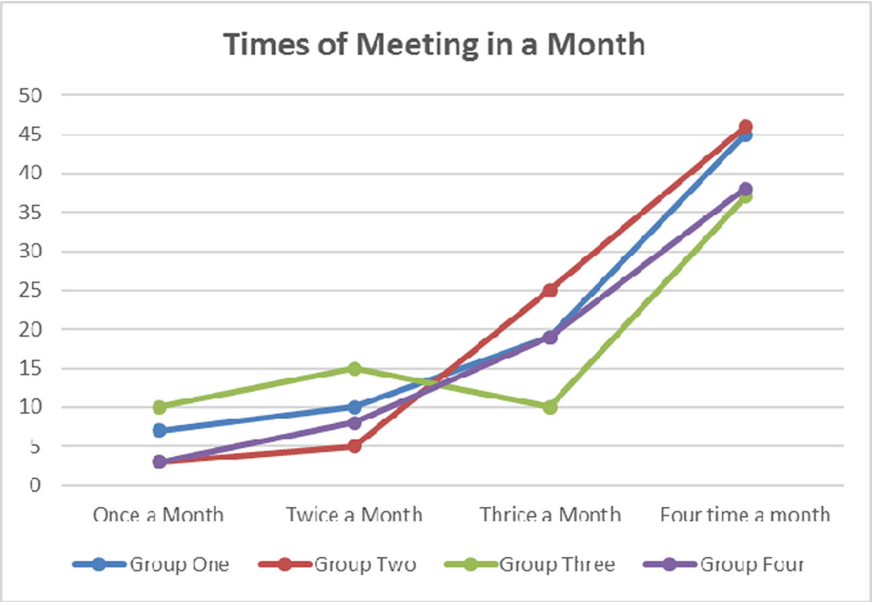


Fig. 1. Times of meeting per month

assess the frequencies of communication, the WhatsApp chat records were considered for the four teams between the students and lecturers during the four-month development of the app. It was found that the total number of WhatsApp group chat was 130. Table 2 summarizes the number of WhatsApp group chat, 130 agreeing to subject matter for each team. The group 2 team had 43 WhatsApp group chat in all, while no other team had less than 25 WhatsApp group chat. This number of WhatsApp group chat tested what students have appraised in the assessment, Table 2 and Fig. 2 showed that group 2 teams had more chats than other teams. In general, most of the chat wer about requirement gathering (39.5%) and project evaluations (34.8%).

Table 3 and Fig. 3, shows the WhatsApp group chat by quantities categories. From the table and figure, group 2 had 39.5% which was the highest in requirement gathering, group 1 had the highest percent of 17.3% for system design and coding, group 4 had 48.1% thereby making it the highest in project evaluations category and group 3

Table 2. Distribution of respondents by communication methods

Communication method	Group 1	Group 2	Group 3	Group 4
In-person	17	10	9	25
Phone	25	18	22	15
WhatsApp group	25	25	25	25
Texting	25	25	25	25
Skype	10	21	7	5

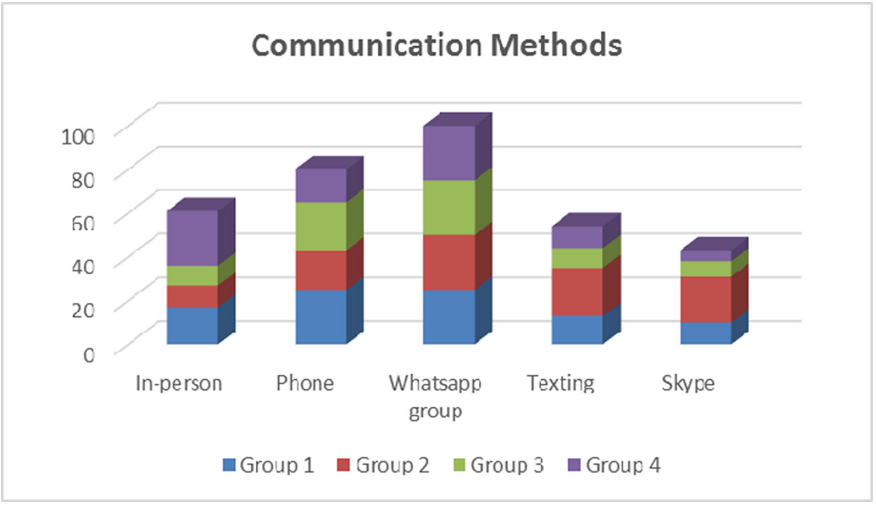


Fig. 2. Communication methods

had 12.9% making it the highest in task negotiation category. But in all, group 2 had the highest chat with 33.1%. The results showed that communication among the teams helped in requirement gathering and project evaluation processes.

Table 3. Distribution of respondents by summary of chat by quantities type

Chat type	Group 1	Group 2	Group 3	Group 4
Requirement gathering	6 (20.7%)	17 (39.5%)	12 (38.7%)	9 (33.3%)
System design and coding	5 (17.3%)	7 (16.3%)	5 (16.1%)	4 (14.9%)
Project evaluations	15 (51.7%)	15 (34.8%)	10 (32.3%)	13 (48.1%)
Task negotiation	3 (10.3%)	4 (9.4%)	4 (12.9%)	1 (3.7%)
Total	**29 (100%)**	**43 (100%)**	**31 (100%)**	**27 (100%)**

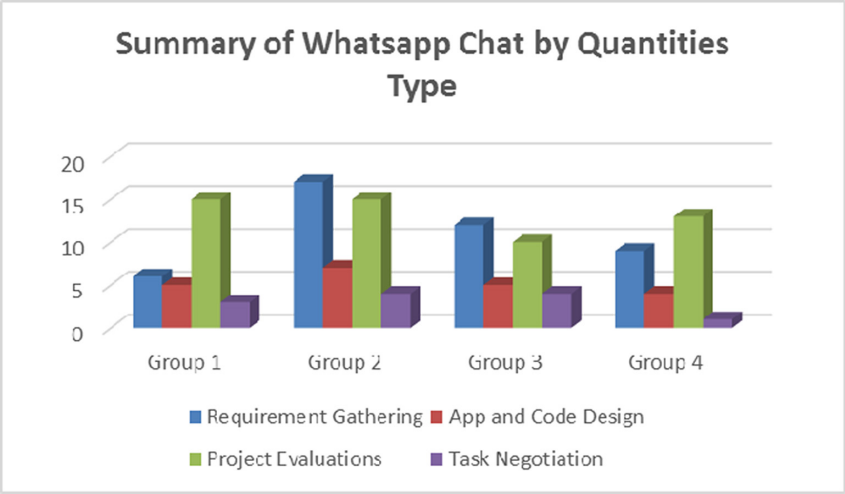


Fig. 3. Summary of chat by quantities type

The result of the questionnaire showed that group 2 chats more than the three other groups and their lecturers always responded by joining the group chat, responding during chats, scheduling meetings within the appointed time, and responding to chats on request within a short time. The responses of the other teams were slow, especially on requirement gathering and coding. Considering the number of meetings between lecturers and students, group 2 team had more group chat than other teams, therefore it suggested that the WhatsApp group chats were effective in arranging meetings for the group 2 team and that the group 2 scientists were available. The slip in requirement gathering from group 2 team indicates that group chat was a successful tool for collecting requirements, but not for project evaluations.

It was hypothesized that the communication between software teams and lecturers can forecast better requirement gathering. From the study, group 2 team showed that communication is critical to the requirement gathering phase. The delay in gathering requirements may be due to ineffective communication between software developers and clients. We also hypothesized that the quantity and quality of communication can impact team outcomes. The results showed that team performance did not depend on more communication among other team members and doesn't necessarily bring better team performance, thus it is quality, not the quantity of communication that positively influences team outcomes.

4 Conclusion

In software development, communication is a major factor that accelerates the developers' work. Communication has been proven to ensure quality, productivity, and facilitate the software development process. Communication is a vital process in sharing knowledge between the team members and coordinating a software

development project. The study examined the importance of communication in software development projects by describing factors that help good communication between developers and clients especially during requirement gathering and project developments. The result showed that communication between software teams and project managers can lead to improved requirement gathering. Also, team performance is not always necessarily dependent on more communication but the quality of communication positively influences team results. The general belief is that more communication might lead to better team performance. However, this is not always true as in the case of these teams, group 2 team communicated with their lecturers much more than the other three groups, but this doesn't produce a better team performance as expected compared to group 3. Also, the communication methods used were WhatsApp chat, e-mail, and group discussion, but WhatsApp chat was discovered to be more effective and suited for better software performance.

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