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Creating m-Learning Opportunities to Facilitate Collaborative Learning: A Mobile SMS based Twitter Implementation

Uvasara Dissanayeke[*#1], K.P. Hewagamage [#2], Robert Ramberg[*3], G.N. Wikramanayake[#4]

[*] *Department of Agricultural Extension, University of Peradeniya, Sri Lanka*
[1]uvasarad@pdn.ac.lk

[#] *University of Colombo School of Computing, 35, Reid Avenue, Colombo 07, Sri Lanka*
[2]kph@ucsc.cmb.ac.lk
[4]gnw@ucsc.cmb.ac.lk

[*] *Department of Computer and Systems Science, Stockholm University, Sweden*
[3]robban@dsv.su.se

***Abstract*— Mobile learning opens up for collaboration and sharing of contents. This study discusses the outcome of a mobile SMS based twitter implementation to facilitate collaborative learning among a group of young farmers. The mobile learning approach (mLA) was developed in collaboration with the study community using a design based research process for a period of two years.**

The objectives of the study were to analyse the learning process based on constructivism learning theories, study the learner interactions in the mLA, the impact of mLA, and the potential uses of the mLA in collaborative learning. Data were collected using questionnaires, follow up discussions and through logged data in the devices. The data were analysed using descriptive methods, qualitative data analysis methods, and network analysis methods respectively.

The mLA assisted learners to construct knowledge, and obtain useful feedback to reinforce learning through the interaction within mobile learning environment. The participants were satisfied with the mobile learning experience however there were some drawbacks needed to be addressed in the future. Since participants didn't have adequate previous experience, they faced some technical difficulties in receiving tweets in the mobile phones. Difficulty in moving for higher order learning skills and limited opportunities for collaborations due to SMS based platform and interface were the other drawbacks. Learners needed more technical support and assistance together with better interface to promote collaborative learning opportunities in the future.

***Keywords*— Mobile learning, Twitter, SMS, Collaborative learning**

I. INTRODUCTION

The non-formal system of education for the farming community is challenged due to its time consuming nature, cost and time involved in travelling and difficulties in scheduling group classes as farmers are generally pre-occupied with other activities. After a carefully planned problem analysis and learning solution development phases, we implemented a mobile SMS based Twitter implementation as a potential m-Learning approach (mLA) to promote collaborative learning [1]. The mLA was implemented using an iterative testing procedure with the aim of investigating what are the potential uses of the mLA model in facilitating collaborative learning. This study was conducted to answer the following research questions: i.) How does 'learning' take place within the mLA environment? ii.) How do learners interact with others in the mLA? iii.) What influences does the mLA have on its users? and iv.) What are the potential uses of the mLA model in facilitating collaborative learning?

II. LITERATURE

A. Learning theories

1) Constructivism: Constructivism theory has been widely used to explain the concept of 'learning' happening within e-learning [2]–[4] and mobile learning [5] experiences. According to the constructivism theory, learners construct their own understanding and knowledge about the world through experiencing things and reflecting on those experiences. We have built upon a constructivist perspective in the design and development of the mLA as well as in explaining the processes of learning taking place in the mLA.

Constructivism, as a learning theory, is characterized by several features; encouragement of multiple perspectives of concepts and contents, teachers role as a facilitator, student playing a central role in mediating and controlling learning, knowledge construction through collaboration, developing higher-order thinking skills, and deep understanding through problem solving are to name a few [6].

2) Collaborative learning: Collaborative learning is broadly defined as 'a situation in which two or more people learn or attempt to learn something together' [7]. It requires people working together toward a common goal [8]. In this study, the learners collaborated with each other in discussing answers for a series of questions posted in the mLA. The questions were posted by an instructor, who also provided necessary feedback and guided learners in finding the answer. In our conceptualization, group members collaborate with each other within the m-learning system as well as outside the system using methods such as SMSs, calls and face-to-face discussions.

3) M-learning, informal learning and non-formal learning: M-learning can be simply defined as the learning across multiple contexts, through social and content interactions, using personal mobile electronic devices [9].

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The context of learning referred to in our work, tailors mostly guided informal learning as related to improving knowledge on general agriculture practices and technologies of the farmer community. The study group was selected from a community of learners who already participate in a non-formal system of education with the same objective.

'Informal learning is one of the forms of lifelong learning, in which an individual other than the learner, sets learning goals while the learner decides how it is to be learned' [10]. Thus the individual has partial control in the decision making process of when and how to learn. In non-formal learning systems a learner has partial control over the method of learning [10]. Non-formal learning is mostly conducted in the form of workshops, training programmes or field demonstrations. The learner initially decides what s/he wishes to learn, however the instructor decided how it is to be taught.

B. *Twitter in mobile learning*

Twitter is one of the widely used, freely available, online micro-blogging services. Twitter users can read or send short text messages, which usually limited to 140 characters. Users can access twitter through the interface of a website, SMSs or mobile device apps. Micro-blogging enables a real-time interaction between users, using different devices, technologies and applications [11]. Twitter has previously been used to promote active and informal learning, marketing, and assessment of training [12]-[14]. Potential educational use includes creating learning experiences and learning networks [11]. Using twitter in educationally relevant ways has increased student engagement and improved grades [15]. However a formative evaluation study, which used Twitter, reported that participants were less committed to online peer-to-peer collaborative learning as the presence of the trainer shifted their dependence away from the peers [14]. Thus it is important to develop learning activities that promote information exchange and collaboration among participants, when using twitter for educational purposes.

C. *Activity Theory*

Activity Theory is considered as a powerful and clarifying descriptive tool which provides an ideal framework to study the major dimensions of m-Learning [16]. It has been widely used in m-Learning research both in designing and evaluation of m-learning interventions [17]-[19]. Activity theory explains the process of 'learning' as an *activity* in which a *subject* (Learner) seeks to achieve a particular learning *object* (learning goal). The relationship between the *subject* and *object* is mediated by *tools* such as learning resources, teaching-learning methods mobile phones, SMSs etc. In this study the mLA and its features and functionalities identified as the tools which mediate student learning. The *community* consists of mainly teachers and peers those who help the learner in achieving the learning goals.

III. METHODOLOGY

A. *Research approach*

A design based research method was used throughout the study. Accordingly, the mLA was developed in four consecutive phases [20] namely *i)* situation analysis, to establish the problems and limitations in the non-formal education system; *ii)* designing learning solutions in collaboration with the stakeholders, e.g. establishing a mobile based communication and interaction system, and twitter based m-learning platform; *iii)* iterative testing and refinement of solution with the stakeholders until they were confident in using the system; *iv)* evaluation to see whether the system performed adequately in solving the problems and limitations that were there in the earlier system.

The researchers collaborated with the practitioners or actual users in all four phases of the research process following design based research principles. Some of the important design considerations agreed during these collaborations were;

I. developing a learning solution that could be operated using basic phones and SMS facility since majority of the users have basic phones
II. simple technology due to novice users
III. affordability of the learning solution with low or no development and maintenance costs for the users

Mobile SMS based Twitter platform was used in designing the mLA based on the above considerations. Three iterative cycles of testing (namely mLA1, mLA2 and mLA3) were completed with practitioners.

B. *Data collection and analysis*

Participatory methods [21] were mostly used in the data collection namely follow-up interviews, focus group discussions, and observations. Quantitative data collected using questionnaire, namely questionnaires, logged data in the devices, and twitter profile data. in addition, the documentations available in the YFC, mLA application screenshots, and artefacts produced by learners e.g. notes were also used in data collection. These methods were used in each of the four stages to collect data. Quantitative data coming from the questionnaires were analysed following descriptive methods using the SPSS 19.0. in statistical analysis. Qualitative data were analysed manually, in relation to Activity theory as the main analytical framework. Logged data in the mLA were analysed to see who the learners interact with, the different types of use of the mLA and number of interactions. NodeXL version 1.0.1.251 was used in analyzing and visualizing mLA network data.

Activity theory has been used as the main conceptual tool in defining the learning context, inform design of learning interventions, analyzing the learning environment and in presenting the findings.

C. *Subjects and community*

Twenty five farmers from a young farmers club (YFC) of Ankumbura in the central part of Sri Lanka, participated in the study as learners. There were two instructors; a researcher (I1) and an agriculture instructor (AI). The researcher posted lessons in the mLA initially during the first two iterations, i.e. mLA1, and mLA2. During the last iteration i.e. mLA3, the AI posted the lessons. Both I1 and AI interacted with the subjects during first two iterations i.e. mLA1 and mLA2. The third iterations was completely moderated by the AI.

D. Tools / mLA

The mLA was designed using mobile SMS based Twitter facility. Participants accessed the mLA using their own mobile phones. Participants were trained on how to use the mLA using a series of workshops during each iteration.

IV. FINDINGS AND DISCUSSION

A. *How does 'learning' take place in the mLA?*

The learning activities were designed to impart cognitive skills at the first two levels of Blooms' Taxonomy of cognitive domain, i.e. knowledge and comprehension. The instructor initiated the learning process by posting a simple question at the mLA (Fig. 1). The learners then tried to find the answer for the question using one of the following three options: read or refer from a learning resource available with them, discuss with a friend, or discuss with the instructor. When the learner experienced that he knew the answer to the question he could post it in the mLA to receive feedback. The instructor would post a model answer in the mLA at the end of each session (Fig. 2). This process enabled the individual learner to construct his own knowledge about the subject matter. The other learners and the instructor assist the learner during the learning process.

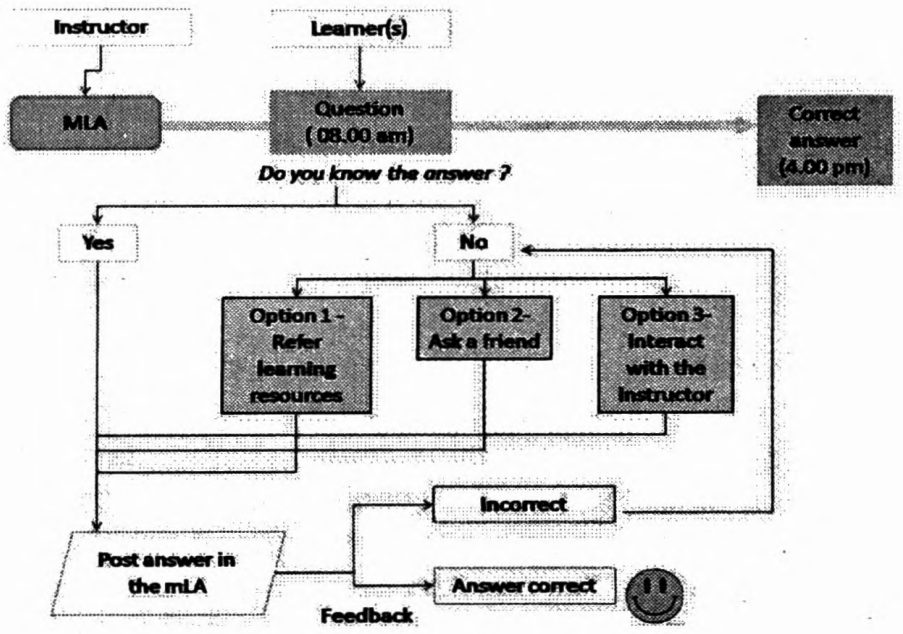

Fig. 1 The learning process

Most learners were able to find the correct answer through the interactions and were able to post it in the mLA. The model answers and the feedback offered by the instructor helped in reinforcing the learning process.

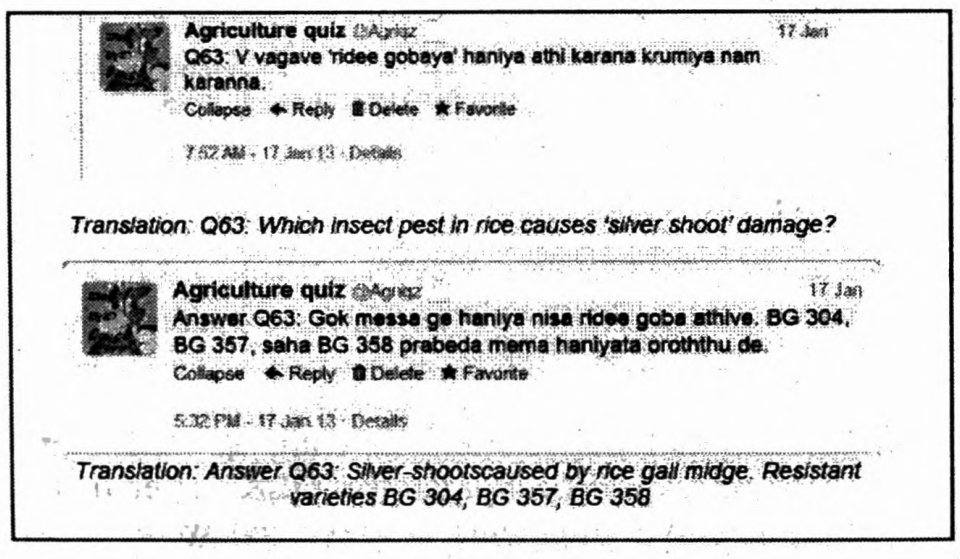

Fig. 2 Format of a short lesson, consisting of a question and a model answer, posted by the AI

Use of a question and answer (Q&A) format had several benefits e.g. motivating the learners to find answers, easier to get attention, and stimulating the learning process. Q&A format also was helpful in breaking the lessons into two meaningful sections which also found to be effective in overcoming the barrier of 140 characters per tweet offered in Twitter platform.

This learning process falls well within informal learning proposed in [10] in which the instructor sets the learning goal by posting a simple question, while the learner decides how to learn. The learner would adhere to one of the options available for him, should the learner fail in providing the correct answer he can go back any number of attempts to reach the correct solution. The individual learner decides which of his colleagues to contact to get a given piece of information. It was observed that many learners made calls and send text messages to their colleagues, to those who participated in the mLA as well as to outsiders, to those colleagues knowledgeable on the subject looking for information to answer the mLA question. MCQ based assessments were conducted both within the mLA and also using paper based tests to assess knowledge gain and these tests had shown positive results.

B. *Learners' interactions in the mLA*

Figures 3 and 4 show the results of the analysis of mLA network, generated using the NodeXL application. L1 –L25 shows the learners.

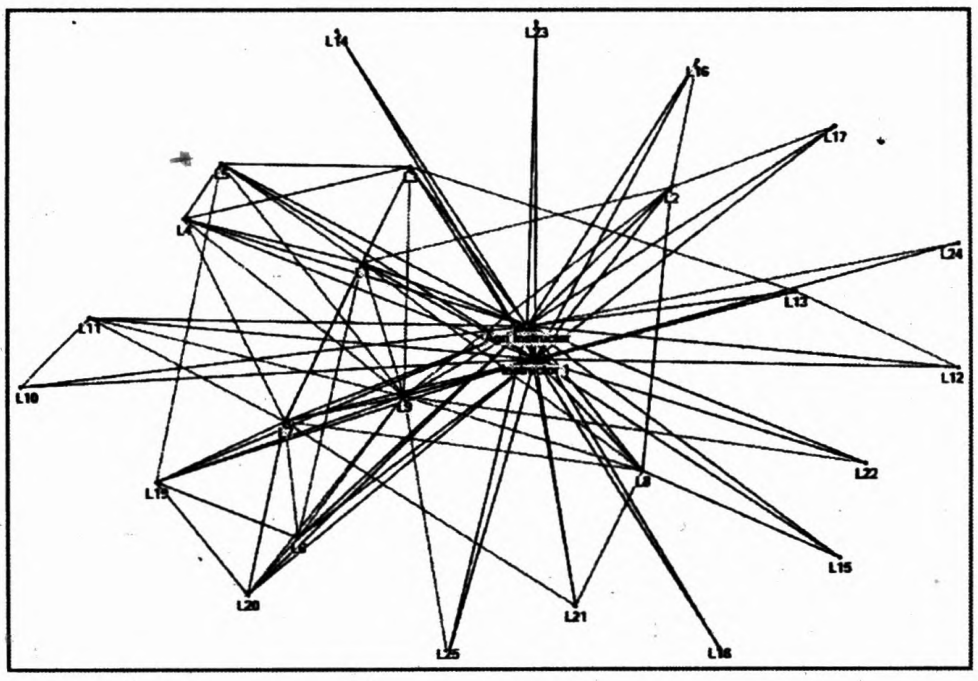

Fig. 3 The mLA network including the Instructors

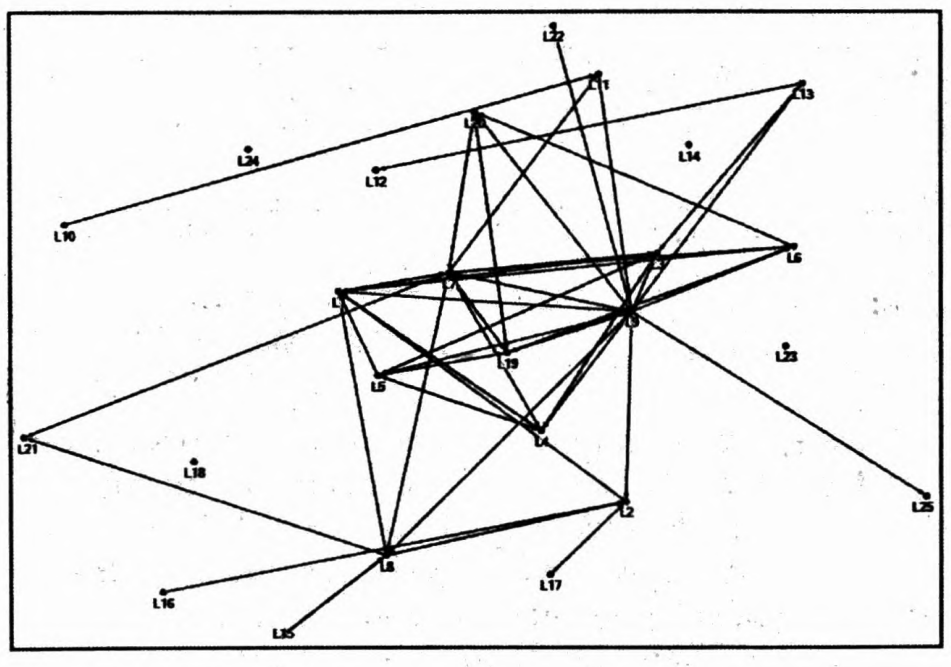

Fig. 4 Learner interactions in the mLA

The graphs show how the users have selected to interact with each within the mLA environment. The graph metrics are presented in Table 1. There were 25 farmers and 2 instructors in the mLA and most of them accessed the mLA using the Mobile SMS based Twitter application. As seen in the fig. 3, the instructors played a central role in the mLA network as all the learners were following them and vice versa. The two instructors formed the basis for the mLA model, thus any new learners who entered the learning system would do so by following the two instructors.

Fig. 4 shows the interactions among the learners in the mLA when the two instructors are excluded. The average number of peers following a given learner was 2.28 (Table 1). Since twitter relationships are asymmetric in nature, a directed graph was used in the analysis, which allowed pin-pointing the key individuals in the community.

TABLE I
GRAPH METRICS FOR THE MLA

Indicators	Graph metrics of mLA	
	Including the instructors	Learner community
Graph Type	Directed	Directed
Vertices	27	25
Unique Edges	158	57
Total Edges	158	57
Reciprocated Vertex Pair Ratio	0.6631	0.2954
Reciprocated Edge Ratio	0.7974	0.4561
Connected Components	1	5
Single-Vertex Connected Components	0	4
Maximum Vertices in a Connected Component	27	21
Maximum Edges in a Connected Component	158	57
Maximum Geodesic Distance (Diameter)	2	4
Average Geodesic Distance	1.6652	2.0725
Graph Density	0.2250	0.095
Minimum In-Degree	2	0
Maximum In-Degree	26	8
Average In-Degree	5.852	2.280
Median In-Degree	4.000	2.00
Minimum Out-Degree	1	0
Maximum Out-Degree	26	14
Median Out-Degree	5.852	1.000
Average Out-Degree	4.000	2.280

A few learners were more popular in the network as seen in fig. 4 e.g L20, L9 and L7. The maximum number of learners following a particular learner was 8. In discussions with these learners we investigated the reasons behind selecting a particular learner to follow in the mLA. The respondents come up with reasons such as 'these farmers are more knowledgeable, and having access to the Internet and other learning resources'. Further they have selected their friends with whom they usually discussed answers for questions. Since our learner community was coming from the same locality and were members of the same farmers' society, they had a fair understanding on each other's educational background and access to the Internet and other learning facilities.

The geodesic distance or the diameter of a graph shows the distance between two learners along the shortest path between them. The average geodesic distance among all learners was 2.07 indicating that this is a very closely knitted group. Thus there is a high potential to promote collaborative learning among the members. The diameter of the network with the instructors was 2, indicating that instructors playing a central role in connecting the learners.

C. *What influences does the mLA have on its users?*

The users' feedback regarding the mLA was obtained using a questionnaire. Since the implementation of the mLA was conducted within the context of a research project we wanted to see whether the user community would continue to use it even after the research project was formally ended. Out of the eight members who answered this question, two answered that they would continue to use it for sure, while six learners said they would probably continue to use it. Interesting to note however is that the mLA is functioning to-date within the learner community, even though the researchers left the mLA to the community one year ago. One possible reason for the continued use of the mLA could be our use of a participatory design based research approach, ensuring the participation of practitioners throughout the design and implementation process.

The learner experiences of using the mLA3 was measured using five statements on a 5 point Likert scale, in which 1= highly unfavourable and 5=highly favourable. The table 2 below shows the average ratings given by the learners on various aspects of mLA experiences. It is seen that the majority of the learners were highly satisfied with the performance and use of the mLA3.

TABLE 2
LEARNERS' REACTION TO MLA LEARNING EXPERIENCE

Statements	Rating (n=8)
mLA was helpful in improving knowledge	4.875
Mobile learning can be successfully implemented among young farmer communities	4.875
I am highly satisfied about the mLA experience	4.75
The agriculture instructor played a mediating role that was very important for the success of mLA	5
It is important that the learners and instructors having a good mutual understanding for the successful implementation of mLA	4.875

We further asked the learners to compare their non-formal education experiences with the mLA experiences. Some of the positive comments we received were 'mLA can be used whenever I am free', 'it offers very short lessons in question answer format, which is easy to learn and remember', 'saves your time and cost for travelling', 'it

makes learning more enjoyable activity', 'easiness in connecting using mobile phones', and 'we can participate in the programme without disturbing our day-today work'. One of the users commented that 'participation in the mLA makes me feel that we belong to a group and a wider community'.

There were however, drawbacks too in the mLA. The main drawback was due to the technical difficulties in receiving tweets in the mobile phone. Some users reported that they did not get any messages while a few said they would not get messages from particular members. This problem was addressed by contacting the service providers; however for certain users the situation could not be improved. Secondly the non-formal classes have given the learners opportunity to discuss with the instructor and clarify information, which has helped them to move to higher order learning skills, which was a limitation in the mLA. Thirdly the effective number of learners that can be followed in mLA was limited to a few (e.g. 5-7), due to its SMS based platform. Following more members means that the users would get a number of SMSs everyday making it difficult for them to manage with their daily commitments. The instructors mainly operated their mLA accounts using a web based platform, however most learners did not have this facility.

D. *Potential uses of the mLA in collaborative learning*

The learners have used the mLA mainly for four purposes:

i. To read the lessons and post answers for the questions
ii. To receive information on training and development opportunities – (these were usually posted by the instructors)
iii. to plan and schedule YFC activities
iv. to share educationally relevant information (fig 5)

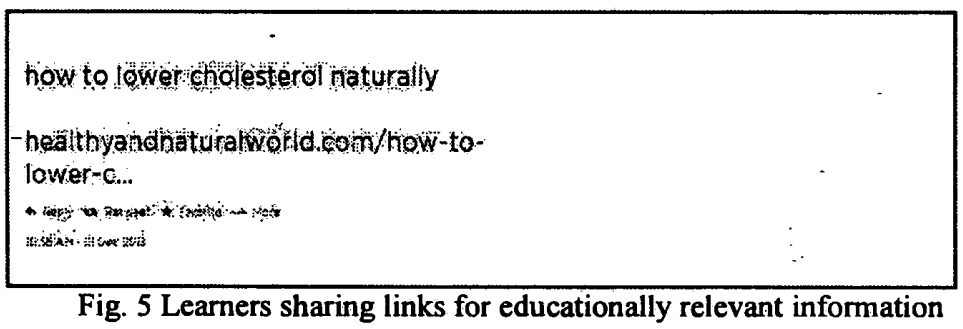

Fig. 5 Learners sharing links for educationally relevant information

It was further observed that the learners mostly used the mLA to interact with instructors and as a means to get to relevant contents rather than collaborating with peers. This was similar to the observations made in [14]. Most of the collaborations have happened outside the mLA, i.e. by using calls, text messages and face to face discussions while only a few members have used the mLA to interact with other members, and some of them have used the twitter direct message option, thus these interactions were hidden from the others in the network.

Other reasons for less use of the mLA for collaboration could be that many learners accessed the mLA using basic phones, thus the contents were accessible to them in a short message format. This in turn made it difficult for them to get a clear picture on what was happening in the mLA only using SMS based interactions, as compared to using a smart phone or a web application. The learners who had access to smart phones were the ones who mostly interacted and collaborated with other learners in the mLA.

The reasons for less involvement and collaborations in the mLA activities were studied using a questionnaire. Reasons reported were pre-occupied with activities other than learning, reading and replying to messages from peers is time consuming, and technical problems such as not receiving the messages on time.

V. Conclusions

The mLA is found to be effective in imparting cognitive skills at the first two levels of Blooms' Taxonomy of cognitive domain namely knowledge and comprehension. It further helped learners to construct knowledge, provided opportunities to interact with instructors and obtain useful feedback in reinforcing learning, through such interactions.

Mobile SMS based Twitter platform was used in designing the mLA, thus users interacted with each other by simply following other members. The mLA helped in creating a very closely knitted network of users, including both learners and instructors, providing a fair potential in promoting collaborative learning. The users were satisfied with the mobile learning experience however we identified that there were some drawbacks too. Technical difficulties in receiving tweets in the mobile phone, difficulty in moving for higher order learning skills, limited opportunities for collaborations due to SMS based platform were the main problems.

In future research it is necessary to extend this system in facilitating more interaction and collaboration opportunities for learners in mobile environment. For example, a mobile application in smart phones could be developed to create better learning experience by extending the mobile learning approach (mLA) presented in this paper. Authors are planning to publish the results of those experiments in next few months.

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