

# Design and Evaluation of an Application Software for Informal Peer Group Learning

Kenneth Thilakarathna  
UCSC, University of Colombo  
35, Reid Avenue, Colombo 7  
Sri Lanka  
kmt@ucsc.cmb.ac.lk

Chamath Keppitiyagama  
USCS, University of Colombo  
35, Reid Avenue, Colombo 7  
Sri Lanka  
chamath@ucsc.cmb.ac.lk

Kasun De Zoysa  
UCSC, University of Colombo  
35, Reid Avenue, Colombo 7  
Sri Lanka  
kasun@ucsc.cmb.ac.lk

Henrik Hansson  
DSV, Stockholm University  
Forum 100, 164 40 Kista  
Sweden  
hhansson@dsv.su.se

Prasadi Jasinghe  
Faculty of Education, University of Colombo  
Colombo 03  
Sri Lanka  
prasadi@edu.cmb.ac.lk

*Abstract:* Laptop computers are being increasingly used as a mediation artifact for informal peer group learning. However, since students often have informal peer group discussions at outside locations from the institute, they find it difficult to use several laptop computers interactively within a group discussion. Therefore, it is common to see that students only use single laptop computer for their group discussions. This not only under utilizes available computer resources but also reduces the benefits of group learning. We have developed an application software to overcome these limitations. In addition to that, we evaluated the tool for its usability and effectiveness when it is used for real world informal peer group discussions by university student groups. The results depicts that the tool can successfully be used for informal peer group learning.

*Keywords:* informal peer group learning, evaluation of learning tools, screen sharing applications

## 1 Introduction

In Sri Lankan universities, it is common to see student groups gather for informal peer group learning. This is a multi way reciprocal teaching phenomenon where peers dynamically change their roles as teacher and learner [8]. A research study has been conducted regarding these informal group discussions and we have found that these discussions are very popular among university students [12]. However, when conducting these informal peer group discussions it is evident that students have to face difficulties due to several reasons.

Students find it difficult to locate a place with educational artifacts for their learning activities. Interviews conducted revealed that students like to have vacant lecture halls to conduct these group discussions because, then artifacts such as white boards, computers, multimedia projectors, university provided network infrastructure, etc., are readily available to use for their discussions. However, it is hard to make a lecture hall reservation due to tight lecture schedules in universities. This has been confirmed by students who have just started their third year of study. They said that since their admittance to the undergrad-

uate studies, they had just two such opportunities to have informal peer group discussions because of non-availability of vacant lecture halls. Further, at times students arrange these discussions with a very short notice and then they do not have much time to search for a suitable location. Therefore, they used to have these discussions in locations such as cafeterias, students common rooms, pavilions, or even under trees where they used to have their social gatherings.



Figure 1: Informal peer group discussion under a tree

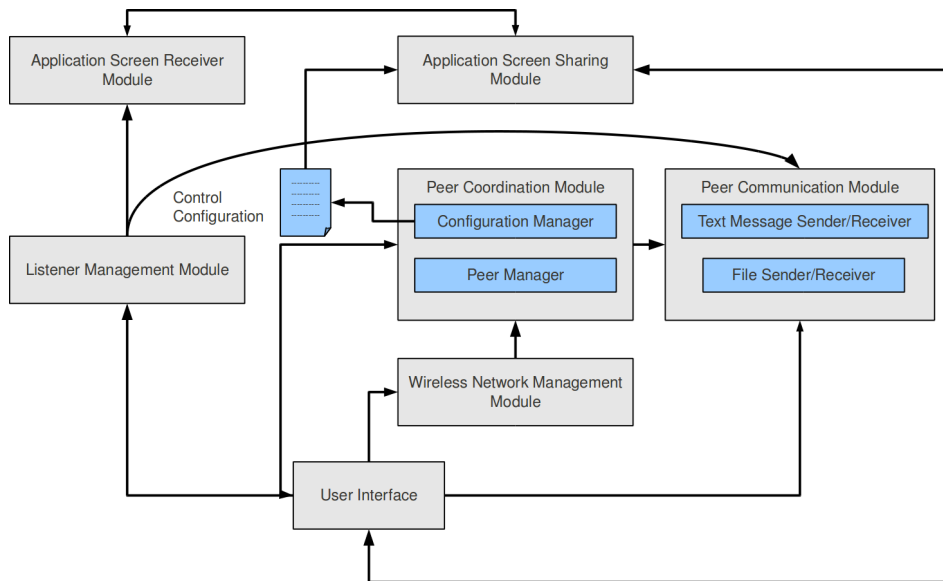


Figure 2: Architectural view of peer group discussion helper tool

Students tend to use laptop computers as an educational artifact at such locations. Furthermore, using laptop computers in their discussions has been mandated to some extent as most of the learning resources are provided in a digital form via Learning Management Systems(LMS). Even though a number of students have their own laptop computers, we observed that they use only a single laptop computer for group discussions. The screen is shown to others by turning the laptop around. At times, they even use laptops individually within a group. These compositional characteristics of existing informal group discussions are exemplified by Figure1. In such situations, students cannot benefit from group learning. Interviews with individuals revealed that the reason behind under utilization of laptops is due to the lack of technical expertise.

The study conducted using observations and interviews helped to shed light on the difficulties they face when using laptop computers in informal peer group discussions. A major difficulty is, when conducting an informal peer group discussion at an outside location, it is hard to share or visualize a single laptop screen among all the participants. Students have to stay close enough to the presenter so that they can see the presenter's laptop screen. In our publication on "Incorporating digital tools for informal peer group learning", we were convinced that we need to use screen sharing applications to give a solution to this problem and the existing screen sharing solutions do not help students to conduct their informal peer group learning discussions. We also found out that, there is no software application that can directly and easily be used to overcome these difficulties of the event [12].

## 2 Our Approach

Since, there are so many applications available for screen sharing, we decided to use an existing software by implementing additional features when necessary. This motive led us to use an open source software application for the purpose because, the source code is readily available. There are quite a few open source applications such as *x11vnc*, *RealVNC*, etc., which are widely used for screen sharing [2][11]. When studying about these software applications, we found out that *x11vnc* provides more features and options to manipulate the tool. Therefore, we opted to use *x11vnc*. However, there were several features that need improvements and more dynamic control mechanisms. The most important task was to create a software tool which can be used as a coordinator of all the available tools and technologies with implemented features that are required to help utilizing laptop computers for effective learning in peer group discussions. We have developed an application that eases the creation of wireless ad hoc network among wireless enabled laptop computers. Furthermore, we have integrated a set of services to the particular application which helps users to create discussion environment. The implementation is composed of five main components. Figure 2 illustrates the high level design of the application we developed.

### 2.1 Wireless Network Management Module

It is necessary to have an underlying network to establish connectivity between laptop computers. This can be done by creating an ad hoc network using the wireless networking capabilities of the laptop computers. Wireless ad hoc network is a communication network

created between sparsely connected network nodes where no preexisting network infrastructure is available [13]. Since, all the participants of an informal peer group discussion gather into the same location where they are able to see and talk to each other, they also fit into an area of wireless Wi-Fi radio range i.e. all the laptops are within direct wireless connectivity range from each other. Hence, no routing protocol is needed for the connectivity or communication. There can be several informal discussion sessions happening in a way that wireless networks intersect with each other. Since, service set identifier (SSID), which is a mandatory requirement to create a wireless network, separates wireless networks from each other, such collisions can be avoided by using different SSIDs for different groups of discussions. Every laptop computer connected to the wireless network need to possess an Internet Protocol address (IP) to communicate and identify other individual computers. Before assigning an IP address to a particular laptop computer, it is essential to check whether the chosen IP address is being used by nearby computers. There are several ways of doing this [7]. Avahi system provides a good solution for this problem and providing the source code[9]. Therefore, we incorporated avahi-autoipd to assign Link Local IP addresses to laptop computers. We developed the wireless network management module with the help of above mentioned technologies and applications and calling functions of Gnome Network Manager Application Programming Interface(API) through DBus [5].

## 2.2 Peer Coordination Module

In a perfect scenario of a peer group discussion, all group members will be present at the beginning of the discussion. However, in an informal discussion event, a student may join later for the discussion may be by seeing it going well. If all the participants are known at the beginning, it is easier to multicast information through the network. However, for this specific need, the tool should be equipped with capabilities of handling intermediate group joins. Peer Coordination Module (PCM) is responsible for maintaining information of listened peers for shared applications, creating required control files used by Application Screen Sharing Module (ASSM) and peer communication module, and spawning screen sharing application instances. Once, a participant opted to serve applications for the group, PCM module gets activated. PCM informs ASSM about participants who are willing to grab a shared application screen. In addition to that, when a new participant joins, PCM also informs other members about his presence by multicasting a message.

## 2.3 Peer Communication Module

In an informal peer group discussion, in certain situations, we identified a requirement where students may have to send some text messages or file to all other participants or to a particular participant. For example, there may be a situation where a student would like to request a particular file from a specific participant without interrupting the discussion. Then, the student should be able to send a simple message to the particular participant and get the file to his/her laptop computer because, even that sort of interrupt may cause considerable distraction. Peer Communication Module(PCoM) is responsible for sending messages or transferring files in-between connected peers to fulfill the requirement. It should be clearly mentioned that the implementation of text messenger is different from a conventional chat application. Considering the particular informal learning phenomenon, we decided not to incorporate a chat application. Because, it would dissolve the openness of the event by allowing members to have a private chat. Our intention of providing a tool is to try to improve the effectiveness of the phenomenon, not to change its natural way. Chatting through text message system has been discouraged by increasing the number of tap counts for sending a message.

## 2.4 Listener Management Module

After a peer creating or joining to an existing wireless ad hoc network and opted to stay as a listener for the discussion, Listener Management Module(LMM) is responsible for requesting participation from the available PCM. In addition to that, it will also launch a listener application instance to display shared applications shared by the PCM.

ASSM is simply *x11vnc*, an application which is capable of sharing screens of applications instead of the whole desktop. ASRM is a client application used to receive image information. In addition to that it also sends and receives mouse and key stroke information to and from ASSM.

## 2.5 User Interface

The application is presented to the user as a system tray applet. Figure 3 shows the menu of the applet which composed of self explaining menu items.

## 3 Evaluation

The popularity of the informal peer group learning activity depicts its effectiveness on learning. However, introduction of a new artifact should not dissolve the

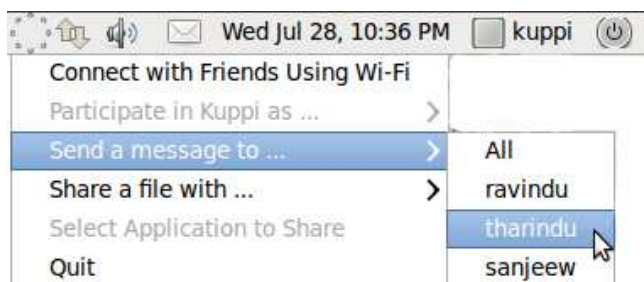


Figure 3: System tray applet menu of application

positive attributes of the pedagogical system. Therefore, the new approach must be researched for the impact on learning in an informal peer group activity. The evaluation of peer group learning helper tool is based on three research questions. a.) Is the tool usable in a peer group discussion? b.) Does the tool help to improve the efficiency of learning in a peer group discussion?<sup>1</sup> c.) Does the tool help to improve the effectiveness of a peer group discussion?

Primarily, any provided solution must be usable within the peer group discussion. Provided human computer interface (HCI) should be simple and provide comprehensible information of the functionality. The system should be easily adaptable to a peer group discussion without having to make significant modification to procedures of the event.

The evaluation process had to be planned carefully due to the informal nature of the event. Due to various considerations on external variables and accessibility limitations, we conducted the study on evaluating our tool on two groups of second year undergraduates from two different degree programs at the University of Colombo School of Computing. Considering the evaluation process and nature of informal peer group discussions, we opted to use action research methods with snowball sampling techniques[10][6]. When we conducted our study on popularity of informal peer group learning, at the end of the interview, we requested them to participate on evaluating the peer group learning helper tool by acting as gatekeepers to various student groups. After developing the tool, we contacted the students who have volunteered and asked them to introduce the tool to the group when they conduct or participate in an informal peer group discussion. Furthermore, they also informed us when and where they have an informal group discussion as it occurs. Since, this is a spontaneous event, we had to act to a very short notice to get ready for data gathering. We mainly used three methods to collect evaluation data. First by observation, Second by focus group discussions and Third by conducting a survey. The use

<sup>1</sup>Here, we considered improving the efficiency of learning by means of taking out the obstacles in the path towards an efficient informal peer group learning event

of three methods to collect data enabled us to triangulate collected data at the analysis stage to get reliable results.

We distributed the tool to the two groups to evaluate and here, we will briefly discuss the results of our evaluation of the tool. Before distributing the tool to groups, we gave detailed information about the tool and how it works to the student who act as the gatekeeper to the groups. This is done to avoid any continuous inconvenience a student group may experience due to the unfamiliarity of the tool because, it might make the informal discussion itself unsuccessful and disappointment of students regarding participation for the research.

### 3.1 Observation

At the initial stage of the informal peer group discussion, we observed that the students are very enthusiastic to find about the tool is capable of where most of them succeeded. Further, students behaviour was much relaxed than in a conventional discussions that we observed. At the beginning of the discussion, we noticed that the tool attracted their attention. However, after few minutes, students attained their focus to proceed with the discussion. This behaviour may have happened because, it was the first time they had experienced the tool. However, after an hour or so, we saw the inherited behaviour from conventional informal peer group learning sessions such as, pointing things in the screen using fingers rather than using the mouse pointer. However, students still used paper sheet to illustrate certain information.

### 3.2 Focus Group Discussions

At the end of each informal peer group discussion, the gatekeepers introduced us to the group as friends. Then, we detailed about our research and requested for their feedback to continue our research work. Analysing the data gathered through focus group discussions revealed detailed information which can be used for the evaluation of the tool (Table 1). First of all, we were curious about whether students know about such a tool that can be used to cope with their informal peer group learning. However, few of them knew a tool called netOP [3], where they used it for in class activities.

The most convincing act of students about the tool was that they all agreed and commented in many ways to elaborate how the tool was helpful for informal peer group discussions. Further, 96.3% of students mentioned at least one problem that they had in previous informal group discussions got solved by using this tool. One student commented saying that "This tool

Statement	Students(%)
The tool gave a new experience	92.85
The tool is helpful to conduct informal peer group learning discussions	100
The tool gave a solution to a difficulty encountered when participating in a peer group discussion	96.3
It is hard to use this tool	0
like to use this tool in future informal group discussions as well	98
The tool can be effectively used for informal peer group discussions	71.42

Table 1: Summary extraction of focus group results

gave a solution to the problem of having to look into a screen of a single laptop computer". We identified several more difficulties mentioned by students when participating for informal group discussions such as remembering the things discussed in a group discussion. However, it is more related to human cognition where we may be able to help by providing a recording facility in the tool. The likeliness of using this tool in future implies that the tool is effective for the purpose. A student gave a comment about this with a direct implication saying "If someone use this tool once, he/she will surely like to use it in his/her future informal discussion". Students comments on effectiveness of are very interesting. One student said that "There were some occasions where we could not take a note of the discussion, because, we had to be standing to have a look at the screen. This tool definitely solves it". Another student spelled out that "We had a syn-



Figure 4: Conducting focus group discussions

chronization problem, when we use several laptops. We had to coordinate that burden too. In this discussion, through out the session we were able to nicely synchronize with others". These comments clearly state that they have overcome considerable amount of difficulties by using this tool. Hence, the tool can be used to increase the effectiveness of informal peer group learning.

The effectiveness of pedagogical artifacts may increase the student learning efficiency by making the learning environment flexible and supportive [4]. Results of analyzing the evaluation data has implications for that the tool supports to improve learning efficiency. However, a very few students said that because of the tool they couldn't concentrate on the learning aspect. Then, they by themselves concluded that they haven't seen or used this type of tool anywhere and the distraction may be due to that. However, every student in each group agreed that the tool is simple and it does not take much time to get familiar with it.

Majority of the students stated that the tool cannot be used in every informal group discussion. They indicate that there are certain informal group learning sessions where students work individually. In such events, they seek for help from the group only when necessary. However, it appears that the comments were considering only screen sharing aspect of the tool. Students can use the tool for file sharing and message passing too. Overall, students like it using and they will continue to do so. One student in a focus group word out that saying "Students will definitely use this, I feel that at some point students wont be able to conduct an informal peer group discussion without this tool". That encouraged us a lot to step on future improvements.

### 3.3 Questionnaire Survey

Statement	Students(%)
Tool is usable in informal peer group learning	71.67
Tool helps to improve the efficiency of learning in an informal peer group event	82.5
Tool helps to improve the effectiveness of an informal peer group event	80.72

Table 2: Summary of questionnaire survey results

86% students from the two groups responded to the anonymous mailed survey. We used GoogleDocs

to create the survey and emailed link to the survey to students. Several questions were created for each research question with 5 Likert scaled options as answers. The results have been summarized in Table 2. These results conforms the results from observations and focus group discussions.

## 4 Future Work

A students raised an interesting feature requirement which we would like to incorporate in future. She said, "Earlier we grouped together around a single laptop. When using the tool we have the flexibility of being relaxed and sit comfortably to join the group discussion. It seems that the tool also needs a voice channel because, I observed that today I heard others bit less". In addition to that, we would like to make available Internet connectivity to whole group, even if only one student possess a connection by making that students computer as a router to others.

## 5 Related Work

NetSupport School is a software tool that is especially built to support computer aided formal learning on a LAN. This tool provides facilities to restrict and control users over the usage of applications, network etc. Although it is equipped with some of the features that are required to support considered informal peer group learning scenario, it does not have built in support to work in isolated environments from communication infrastructures [1]. netOP School is also a software tool built for the same purpose as NetSupport School with more or less same features[3].

## 6 Conclusion

In this paper, we presented the design and implementation information of a tool which gives a solution for difficulties arose to students participating in informal peer group learning. The tool has been given to selected student groups chosen by snowball sampling techniques. We incorporated action research methods for the evaluation process with three data collection strategies namely; observation, focus group discussions and questionnaire survey. The results of the tool evaluation process have implications for improving the effectiveness of informal peer group learning and hence improving students learning efficiency.

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