

Implications of Mobile Technology Usage on Learners in a Learning Process

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Summary

Making students/learners to learn on the move at any place and at any time is new challenge solved by using the mobile devices of the learners. Mobile technology support has envisioned the concept of mobile learning that includes a wide variety of applications and new teaching and learning techniques. This paper discusses a study on the effect of mobile technology usage on a learner in a learning process. The results of the study show acceptance of the mobile devices into the learning process with appreciable support of the learners.

Key words:

Collaboration, Context, Mobile Learning, Learning Content

1. Introduction

Research in mobile learning has gained increasing amounts of attention during the last few years, like those that explore the potential of mobile and wireless devices to support learning, such as JAPELAS[1] or Ketamo's [2]. With the mobile technologies developing rapidly and becoming widespread, students' and teachers' mobility also increases using more portable devices such as PDAs, Smartphones, mobile phones and tablet PCs with computationally enriched learning environment.

The most valuable goods nowadays is Time, And people tend to be too busy and are spending more time in traveling and the inability to be at one place brings the need of supporting learning activities at any time, place and through different devices; This is the origin of mobile learning [3], whose main purpose is to allow high degree of mobility for learning. Learning taking place in mobile uncontrolled environments is mostly informal [4]. Activities are not bound to only one specific environment e.g., classroom, nor are the activities prestructured. Regarding such learning activities, Goodyear [5] has stated "there may be good reasons for allowing and perhaps encouraging learners to create their own 'learn places', configuring the physical resources available to them in ways they find most comfortable, efficient, supportive, congenial and convivial".

One of the most straightforward application of the usage of mobile devices as educational supporting tool is messaging. In some papers interesting positive aspects of using mobile technologies are highlighted, i.e., the participants are excited and want to try the "newness". Some other findings show that introducing new forms of teaching make students spend more time in the learning activities. Also overall student's results are becoming better [6].

The evaluation and the analysis of mobile learning projects until now show mainly positive results, And this has motivated us to carryout a study that involves mobile technology usage by the learners in a learning process among our students, institutional and environmental setup. Many people are trying to understand how mobile devices will help for betterment of education, and our study is one in that line of work.

The remainder of this paper is organized as follows. In Section 2, we give some more details of the works in the area of mobile technology supported learning and finer aspects of those work which are used as foundation stones of our study. In Section 3, we present the case study and its process. In Section 4, we elicit the design aspects of the study. In Section 5, we present the Analysis and Results of the study and finally, in Section 6, we conclude the paper.

2. Mobile Technology Supported Learning

In an m-learning system, the suitability of learning activities for learners varies depending on the learner's features and his/her particular situation. Individual learning, and by means of collaborative activities learners can not only learn but also develop multi skills. The system [3] by Martin et al, supports the management of users and activities in mobile environments in which the user can accomplish activities either individually or collaboratively, in different contexts each of them can be located in arbitrary places, have different time available and use different physical mobile devices.

There have been a few prototype systems [7,8,9,10,11] that support learning by utilizing context. Most of this contextual information, such as learning place, timings and live learning activities, has to be gathered, abstracted and transmitted by teachers' or even by students[12]. There are many proposed taxonomies and definitions of context. Dey, Abowd and Salber [13] gave four categories: Identity, Location, Status and Time. A definition of learning context[12] is given as "any information that can be used to characterize the situation of learning entities that are considered relevant to the interactions between a learner and an application".

At Stanford Learning Lab [14] an exploration of mobile learning has been done and they envisioned that a good approach would be to fill the gaps of time by short (form 30 seconds to 10 minutes) learning modules in order to use the highly fragmented attention of the learner while on the move.

At Kingston University, an experiment was done to research the effectiveness of a two-way SMS campaign in the university environment [15, 16] and the conclusions of the experiment were that the students preferred SMS as medium to email or web-based announces. They felt that the data is more personal and SMS could be efficiently used in education (m-learning) as a complementary media.

In a project [17] on evaluation of SMS to support undergraduate students at Sheffield Hallam University, the findings were overwhelmingly positive with students perceiving the system to be 'immediate, convenient and personal'. One of the commonly stated characteristics of mobile learning content is that it should be delivered in short 'nuggets' rather than large units of information, which can be supported by appropriate use of different media types.

The leaning experience of a mobile learner supported by a mobile device and the elements involved in the study are shown in figure 1. The learning content can be of any format (media); it could be plain text, audio, video or an image/picture that is delivered to the learner's device. The contextual elements considered here are the learner's identity, physical activity of the learner, place where he/she is, Day (working or holiday) and Time. The learner's profile and preferences were also considered in delivering the learning content to maximize the learning experience of the learner. The frequency of Access of the learning content by the learner is also a major factor in the learning process and in overall impact on the learner's learning experience.

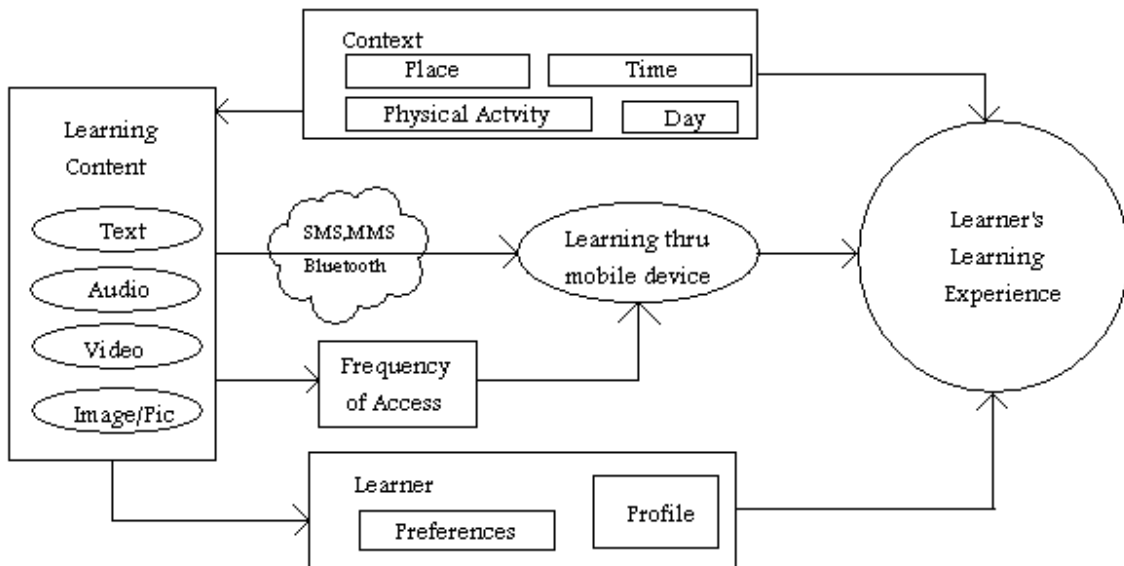


Figure 1 : Learning Experience in an m-learning scenario

3. Case Study

Our Study was conducted as an experimental case study to identify the mobile technology impact on a learner and on his/her knowledge by observing learning activity with a mobile device. By studying learner's attitude and interests over the learning content in a learning activity supported by a mobile device, we try to identify by how much the impact of the mobile technology usage would be on a learner and on his/her knowledge and also examined whether this would improve the overall learning experience of the learner. We also examined and identified where and when the learners spent most of their time in learning activity using a mobile device; the results of which show interesting and positive trends among the learners.

Method

The study consists of mobile phone usage by the participants who took the role of learners. During the study, the participant carries a mobile device and during the day or night he/she receives learning content in the form of SMS or MMS or through Bluetooth transfer. The learning content is delivered to the learner as per delivery schedule which is elicited in the next section. The participants were asked not to switch off their mobile devices during the study period as the learning content is delivered at different points of time in any given day of the study period.

The study began by introducing the concept of mobile usage in the learning process to the participants and also educating them the technical aspects of the activity they would carryout and the cards they have to fill during the study period. At the end of the study period, the data was collected and they were asked to fill in a general questionnaire and another one which is learner's learning activity dependent question form that helped in identifying

the level of new information and knowledge he/she acquired during the study period.

Participants

A total of 28 students were selected as learners for the study. All of them are final year undergraduate students from the department of computer science. And all of them were working on their final year projects. Nearly 8 project works were under progress by these 28 participants which involve technologies like JAVA, JSP, Servlets, VC++, and databases. The learners had mobile phone ownership ranging from 7 months to 4 years. Among the participants there were 6 female and 22 male students were present. 13 of the learners live outside the campus. The mobile phones used in the study were equipped with the technology features like SMS, MMS, GPRS and Bluetooth.

In the study, we have grouped the learners into 7 different groups and also taken care that the same project team members don't fall into the same group. Each group consists of 4 learners and with varying interests in the course subject papers. Among all, only 2 learners claimed to be little familiar with the term mobile learning.

Duration

The duration of the study was around 30 days (4 weeks approx). The study period was selected taking into consideration that it covers the days that include working days, holidays, project work allotted days and Sundays. The intention behind taking such a variety of days into the consideration is to identify whether the day has effect on the learning activity of the learner over the delivered learning content and to identify the differences among those days. The results are presented in the analysis and results section.

4. Design Aspects of the Study

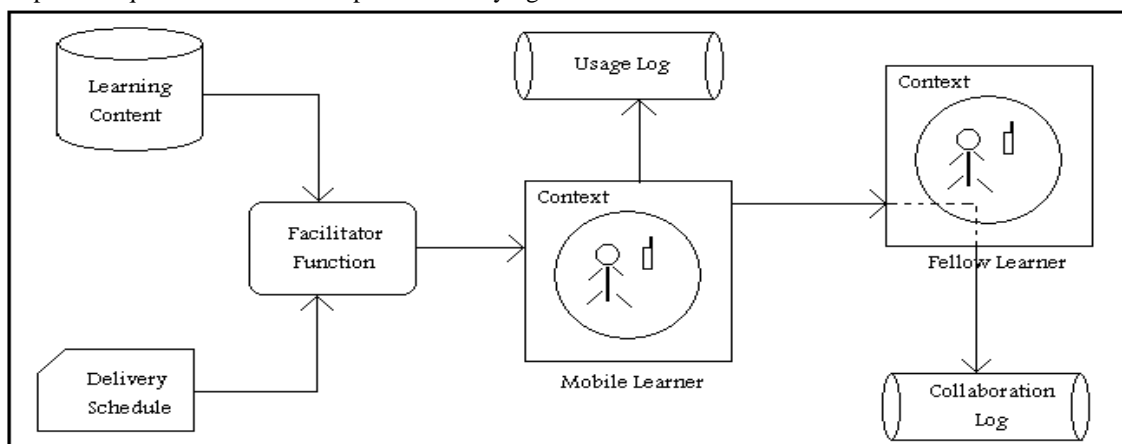


Figure 2 : Information/Data Flow in the Study

In figure 2, the information and data flow of the study are depicted pictorially. The mobile learner is any participant of the study with his/her mobile device and may be in their own context which may be similar or different to other mobile learner's context. The facilitator function does carryout the task of inspecting the content delivery schedule and delivering the learning content to the learners. The other aspects are elicited in the subsections that follow the text.

Learning Content

The learning content was prepared in 4 different course subject papers (Networks, Operating Systems, Data Warehousing and JAVA) which are of most useful to the learners carrying out their project work. The learning content was prepared by 4 faculty members of the department and all of them were given prior information on how the learning content structure should be. The learning content was developed in such a way that when it is read (text) or viewed (image/video) or heard (audio), the learner spends nearly 30 seconds to 5 minutes of time duration in the learning activity. Each learning content nugget/packed/capsule is assigned a content-code that was used in analysis of the collected usage data in the results.

When the learner performs the learning activity, he/she will gain new knowledge in a particular aspect that is sent to his/her mobile device. The text form of the learning content dominated all other forms in the study. As the learners (participants) are also carrying out their project works, the learning content was developed in such a manner that, when the learner performs the learning activity over the delivered learning content, he/she would gain knowledge that could be useful to solve the problems associated with his/her project work.

Learning Context

As the mobile learner is not static/stationary, keeps on moving and performing different activities at different times in different places, the context plays role in the learning activity of the learner.

The contexts that were considered in the study come under two streams. First, the set of all contextual elements with their values when the learning content is received by the learner. Second, the set of all contextual elements with their values when the learner performs learning activity with the delivered learning content. The set of these contextual elements are a) Time b) Day c) Mode d) Physical Activity of the learner and e) Place of the learner.

The intention behind considering two streams of context

with their contextual elemental values is to identify individual learner's preference for performing learning activity in different contexts which may be other than the contextual elemental values when the learning content is actually delivered.

Usage Data Log

The information about the learner's learning activity is collected in Usage Data Log. Whenever the learner performs/carryout the learning activity with the delivered learning content using his/her mobile device, the Usage Data Log gets populated with the data that is generated. Some aspects of the Usage Data Log are the contextual elements like day, activity and place. The values/data for these contextual elements are collected from the learner by passive context awareness [18]. The dataset for the Usage Data Log is identified for the learning content by using the content code designated for each learning content nugget/packet that is delivered to the learner.

The dataset structure of the Usage Data Log is given below:

```
<Code,From,Received<Date,Time,Day,
Mode,PhysicalActivity,Place>,
ActionPerformed, LearningActivity<
Date,Time,Day,Mode,PhysicalActivity,Place>
,PercentPerformed, TimeSpent >
```

The learning content to the learner comes from two sources. First, the facilitator responsible for sending the learning content to the learner as per delivery schedule. The other is any learner in need to collaborate in a learning activity.

Few sample values were taken out of the collected data from the study are presented here for information. It has been observed from the collected data, that 'Physical Activity' has taken values like 'stationary', 'walking', 'traveling' and 'in a group'. For 'Place', the values were like 'class', 'lab', 'home', and 'public place'. It has been observed from the collected data that the ActionPerformed had sequence of interactions against the learning content by the learner.

Collaboration Data Log

As the learners are also carrying out the project works team wise, they share knowledge among themselves to solve issues that pop up in the solution process. The learning content delivered to the learners is not same for all the learners and in particular not to the learners of same

team. The learner collaborates with the project member to solve the problems/issues they face as part of the project work. The collaboration data populates the Collaboration Data Log whenever he/she collaborates with the other learner through his/her mobile device.

The dataset structure for Collaboration Data Log is given below:

```
< Code, Sender, Receiver, Sender<Date,
Time, Day, Place, PhysicalActivity> >
```

The Collaboration Data Log gets populated whenever a learner collaborates with other learner through mobile device. The values of the contextual elements are collected by passive context awareness [18].

Delivery Schedule

The delivery schedule deals with the learning content delivery to the learners based on the specific design attributes taken into consideration. First, the timings of the day has been slotted into 8 different slots as i) Class Hours ii) Interval Hours iii) Lunch Hours iv) Early Morning Hours v) Morning Hours vi) Evening Hours vii) Night Hours and viii) Late Night Hours. Second, the designation of timings and the selected hours has been designed by taking into consideration the different contexts that the learners would be, in these slots. Third, the schedule is designed and executed in a group wise fashion. Each of the 7 groups are considered group-by-group when the learning content is delivered, for over 30 days and covering 8 slots of every day. It is also designed taking into account that the learners are carrying out their project work as teams, and to identify their collaboration in solving the problems related to the project work with the new knowledge they gain from the delivered learning content to their mobile devices.

5. Analysis and Results

Once the study period was completed, the data has been collected from the learners / participants. On observation it is found that one student failed to show any interest during the study period and hence we have considered the data of the remaining 27 learners for further analysis. The following text presents the usage statistics, result analysis and learners' interests & reactions collected as part of the study.

5.1 Learner Preferences

The graphs in the figures 3, 4 and 5 depict the identified preferences of the learners in different contexts of the

learner and his device. The results have shown wider and variety preferences of the learners in reference to physical activity versus learning content and place of the learner versus learning content. We also present the device context versus learner's place details which were useful in delivery of the learning content that can have less response time of the learner in a learning process.

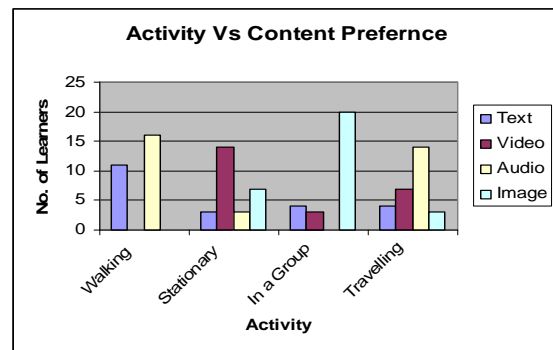


Figure 3: Physical Activity Vs Learning Content

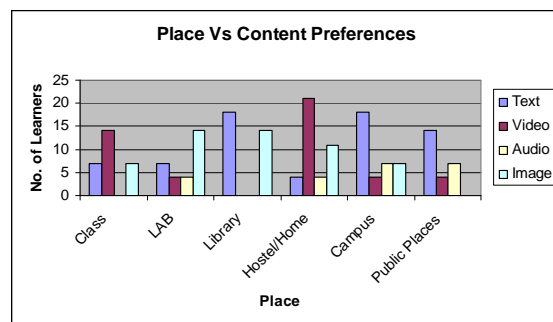


Figure 4: Place Vs Learning Content

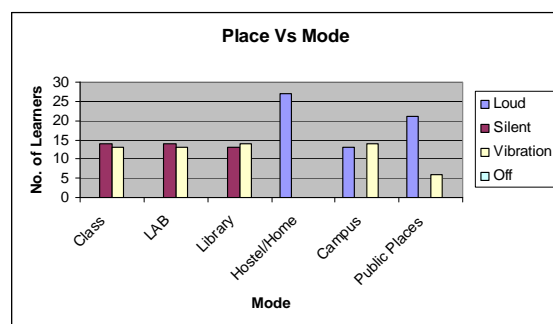


Figure 5: Place Vs Device Context

As instructed, the learners did not switch off the mobile devices during the study period which can be observed from the graph in the figure 5. Most of the learners preferred video form of learning content when their place context is home/hostel. A few learners have preferred

more than one form of the learning content for the same context.

5.2 Learning Activity

The learning activity of the learners during the study period was found to be on the increasing path. The graph in the figure 6 shows the learning activity of all the participants during the period of 4 weeks. Third week has produced more learning activity and on observation we found that week having 3 holidays in it. The learners have spent most of their leisure time with their device for learning purpose.

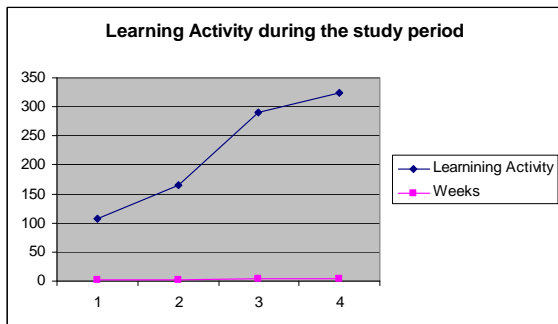


Figure 6: Learning Activity during the study period

After a short exam in the form of a learner specific questionnaire to the learners was conducted, we found the results encouraging (Figure 7). Among the 27 participants, 20 had success in terms of increase in percentage when compared to their regular academic percentage. 2 of them had shown no difference and 5 of them has got less percent of success than their academic percent. On the whole, the study has shown 74% positive results on using mobile devices in the learning process.

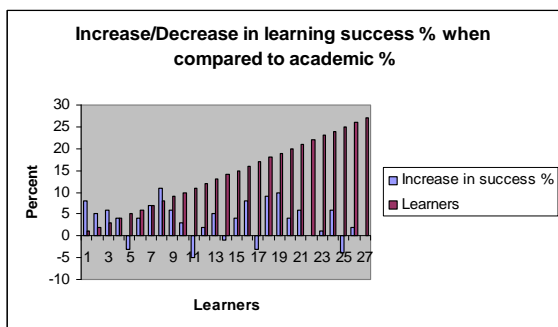


Figure 7: Success percent compared to academic percent

Regarding the response time, the learners have exhibited immediate response by carrying out the learning activity when the content got to the mobile devices. The graph in figure 8 shows the mean values of the time gap (response

time) between the learning activity time and the receiving time, for all the learners. 63% of the learners are carrying out the learning activity within the first 10 minutes (mean) after they receive the learning content.

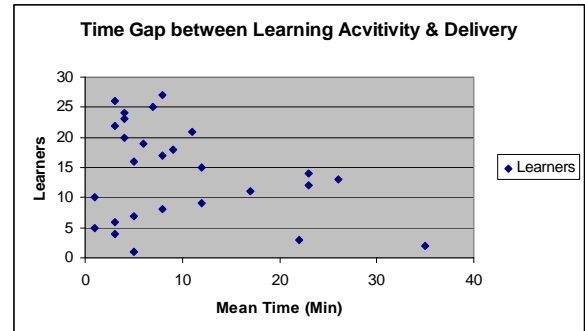


Figure 8: Response Time

Further analysis of the collected data has shown positive signs in terms of collaboration among the learners of the project teams. The team members are spread among different groups in the study and get knowledge individually; which could be shared by collaboration through their mobile devices for solving issues in the project work they carryout. Members of team three (figure 9) have shown very less collaboration when compared to other teams. When asked, they have reported the high cost of SMS/MMS their mobile service provider is charging as the main cause. Teams seven and one too have shown less collaboration. It has been observed that the cost for different services is a factor in carrying out collaborated learning activity through the mobile devices.

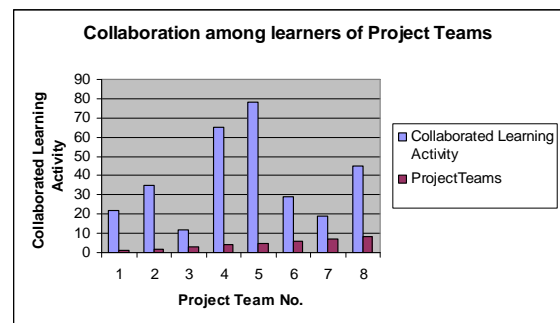


Figure 9: Collaboration

5.3 Learner Interests and Reactions

The learners' interests and reactions are collected from the general questionnaire and targeted interaction with the learners. Table 1 shows the mean time (in minutes) the learners are willing to devote in learning activity over different forms/types of the learning content that is delivered to their mobile devices. As expected, the

learners are willing to spend 1 to 2 minutes for text type and 8 to 18 minutes for video type of learning content. When asked the learners about their unwillingness to spend more time (e.g., hours), the common reaction was "its mobile device, we can't spend so much time with it continuously".

Learning Content	Mean Time(Min)
Text	1.2
Audio	6.1
Video	9.7
Image/ Diagram	2.4

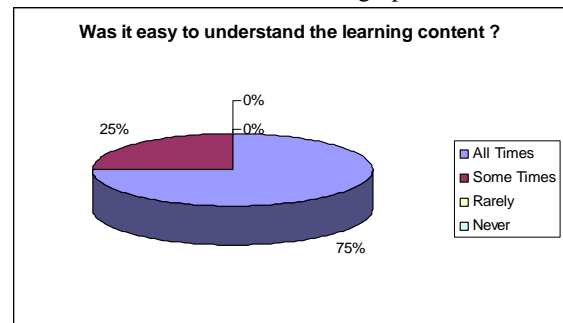
Table 1: Content Type Vs Duration

The values of the table 2 give us the information regarding the preference of the learners over learning content type and different timings of a given day. The values indicate wider interests of the learners between content type and timings. Against to our expectations, good number of learners spend their time to carry out learning activity in the early morning hours, and also more number of them interested in diagrammatic information. It has been observed that, learners are not interested in spending time to carry out learning activity during the late night hours. Except in the evening hours, the learners have exhibited interest in all other forms/types of learning content over different timings of the day almost evenly. There was less preference to audio type in the forenoon and afternoon hours (generally these are working hours).

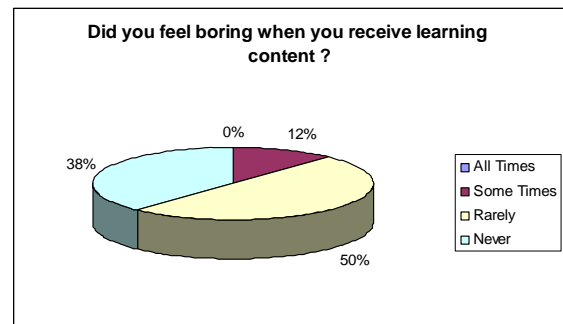
Session	Learning Content Type			
	Text	Audi o	Vide o	Imag e
Early Morning	7	7	0	11
Morning	11	16	0	0
Forenoon	7	0	13	7
Afternoon	5	0	11	11
Evening	1	11	14	1
Late Evening	8	8	8	3
Nights	10	10	7	0
Late Nights	6	3	0	3

Table 2: Time Vs Content Type

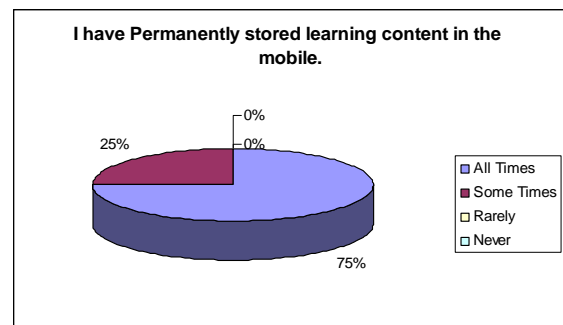
Nearly 75% of the learners reported that the learning content was easy in all cases and 25% indicated difficulty in few cases, which can be seen in the graph below.



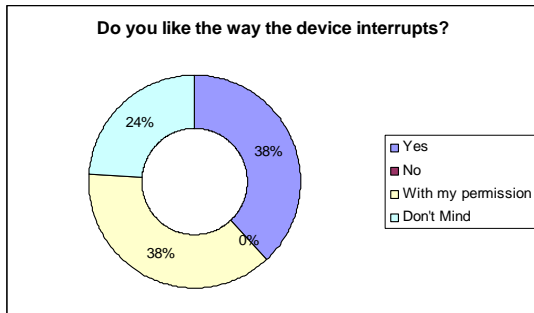
Only 12% of the learners felt boring in some cases regarding the learning content they receive.



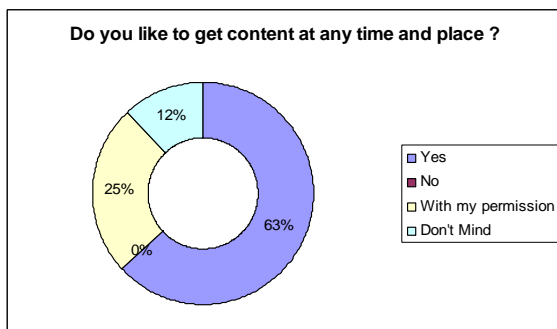
To our surprise, 75% of the learners have shown interest in permanently storing the received learning content in their mobile devices even after performing the learning activity successfully.



From the graph below, we can conclude that 38% of the learners want to set their own timings and places to perform learning activity with their mobile device and don't want to get interrupted without their permission.



The learners have indicated acceptance to carryout learning activity through mobile devices at any time and any place. From the graph below, we can observe the acceptance of the learners for any contextual values of time and place. 63% of them have shown positive sign.



Below are some learner comments about the usage of mobile devices in our study:

- Knowledge gaining without any wastage of time.
- Some times irritative but what to do, it is helpful.
- Messages during late nights is very irritative, don't do that.
- It was very difficult not to switch off the phones all the time.
- The cost of SMS/MMS is to high with out provider, so it is not possible to collaborate at all times.
- Send the subject content which we like and helpful in the future.
- A new platform to learn and refresh the subjects and basics.
- It is very good and easy to understand, very informative and lots of benefits, less time more information.
- Whenever we want, we can go through the information.
- It's amazing, I found myself the learning in this fashion very useful.
- I have learned some new points.
- When content is small it makes us to think and have to spare much time.

6. Conclusion

The results of our study indicate the growing interest of the students towards the usage of mobile devices in the learning process. It has resulted as an alternative form of knowledge acquisition in the learning process. The results reveal several significant aspects of contextual elements and the possible values they take; that should be considered in an m-learning approach. More intensive and longer period learner study would be of more help in identifying some more new trends in the acceptance of mobile supported learning; by taking a large number of learners as its subjects.

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