

A Student Centric Approach for Mobile Learning Video Content Development and Instruction Design

Kumar Mandula*, Srinivasa Rao Meda[†], Muralidharan.V*, Ramu Parupalli*

**Centre for Development of Advanced Computing, India*

[†]Jawaharlal Nehru Technological University Hyderabad(JNTUH), India

mkumar@cdac.in, srmeda@gmail.com, muraliv@cdac.in, ramup@cdac.in

Abstract—With the recent advancement in mobile computing technologies, there has been a paradigm shift from electronic learning(e-learning) to distance learning(d-learning) to mobile learning(m-learning). M-learning not only provides educational opportunities through handheld devices, but also facilitates just in time information required at the right time and right place. Though m-learning provides mobility and instant access to education, there are some implementation challenges and issues like limited processing capability and small screen display that needs researchers attention.

Keeping in view the latest trends in Information, Electronics and Communication Technologies(IECT) and the increased usage of mobile phones in India, this paper discusses mobile learning technologies, opportunities and challenges for successful implementation of m-learning. It is observed that most of the students in India use low cost mobile phones that too with different hardware capabilities and features. Researchers and developers in education domain should consider these mobile capabilities and challenges before developing m-learning video content. Pilot experiment was conducted to study different mobile video presentation styles, file formats and their playback capabilities using students mobile phones. Students from various finishing schools were involved in carrying out this experiment. Based on pilot results, instructional design strategy and mobile video content development guidelines were formulated catering to the requirements of student community in India.

Keywords-Mobile Learning; Ubiquitous Learning; Mobile Video; Instruction Design; Video Content

I. INTRODUCTION

Today, information is gathered from the internet by most of the people. Usage of smart phones, handheld devices and mobile gadgets for seeking information as well as for doing day-to-day transactions has become increasingly common. With a teledensity of 74.71% and wide spread usage of mobile phones[1], these devices has become part of every day life and are being used not only for making voice calls but also for other activities like banking, shopping, ticket booking etc. Therefore, using mobile devices for learning is simply an extension of what is widely accepted and used. In recent times, a new phase of learning methodology called mobile learning(m-learning) has evolved where in students are able to access learning material any where, anytime using any device. Students can use their personal devices like mobile phones, PDA, i-Pods, digital media

players to access educational content. Now a days, due to increased device features and its capabilities, mobile devices are used not only for accessing the content but also used for generating the content. For example, students can capture real world events(images, audio, videos) when they visit botanical gardens, museums and share with other students who do not have access to such places.

This paper is organised as follows: Section-II deals with m-learning opportunities and challenges. Section-III deals with related works in the area of m-learning content. Section-IV discusses guidelines for m-learning video content development and instructional design. Section-V deals with proposed approach including user requirement gathering, pilot experiments, feedback analysis and implementation results, followed by conclusions.

II. M-LEARNING OPPORTUNITIES AND CHALLENGES

The term m-learning, or “mobile learning”, has different meanings for different communities. Although related to e-learning and distance education, it is distinct in its focus on learning across different contexts. One definition of mobile learning is: any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies[2]. M-learning brings strong portability by replacing books and notes with small memory footprint devices filled with tailor made contents. In addition, it is also simple to utilize mobile learning for a more effective and entertaining experience. Also, content quality can be adapted dynamically according to network and device capabilities.

Although the latest smartphones have in-built applications for viewing documents, PPTs, excel sheets and text files, accessing these files on a low and medium range mobile phone poses a serious challenge because of varying device features in terms of hardware and software capabilities. For example, desktop based video streaming requires a minimum bandwidth of 256Kbps which is quite common in broadband connections provided to home networks. Compared to wired networks, mobile wireless channels are very dynamic in nature and bandwidth provided by these networks are not sufficient for multimedia streaming based m-learning[3].

Technology challenges include limited connectivity, battery life, small screen size, low memory, file format support, local language support, cost for data transmission etc. Apart from technology challenges, there are social, pedagogical and educational challenges including access to learning material outside classroom, intellectual property rights of content, instruction design, content development and device support that are to be considered before developing any m-learning application.

III. OTHER WORKS

Prof.Sridhar Iyer [4] discussed about techniques for video adaptation for mobile devices with respect to three video formats namely Instructor element, White paper element and Presentation element. Anastasios Doulamis and Nikolaos Doulamis [5] discussed about scalability of video content adaptation according to user environment. Wen-Huang Cheng, Chia-Wei Wang and Ja-Ling Wu [6] discussed about how to provide small size videos by emphasizing important aspects of scenes while retaining background context.

Most of the researchers discussed about e-learning videos related to distance education using desktop based methodology. Emphasis was given to transcoding existing video lectures to mobile video formats. Also, different video delivery techniques through mobile video streaming protocols like HTTP and RTSP have been proposed. Though some of the researchers tried to formulate guidelines for developing e-learning videos, implementation challenges specific to Indian environment were not addressed. Unlike other European and American countries, Indian students community uses different mobile phones with different software and hardware capabilities. There is a need to do research in formulating guidelines for mobile video content development and instructional design customized for Indian environment. The proposed approach and pilot experiment discusses about approach for mobile video content development right from scratch instead of adapting existing e-learning videos to mobile format.

IV. GUIDELINES FOR M-LEARNING VIDEO CONTENT DEVELOPMENT AND INSTRUCTION DESIGN

Instructional Design (also called Instructional Systems Design (ISD)) is the practice of creating “instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing” [7]. The instruction design used for desktop based e-Learning can not be used for m-learning as mobile learners use mobile devices which has smaller screen size. Instructional designers need to adopt a different approach when designing courseware that is going to be deployed and delivered via mobile devices. With the wide range of mobile phones available with varying device features and capabilities, there is a need to develop instructional design along with the content for small devices.

The following guidelines as shown in Table I may be followed for developing m-learning video contents and instructional design.

Table I
GUIDELINES FOR MOBILE VIDEO CONTENT & INSTRUCTION DESIGN

Index	Guideline
A	Understand the Learner
B	Limit Graphic Content
C	Short and Crisp Content
D	Multimedia Support
E	Interactive Design
F	Mobile Dimensions

A. Understand the Learner

An instructional designer needs to know end user requirements and the context in which they use their mobile devices for learning. It is only then that they will be able to cater to the requirements of the learners in the way that is effective. For example, if learners are sales executives and largely use their mobile devices to find about product information or sales process information, an instructional designer needs to have an idea about the circumstances so that courses can be tailored in a manner that makes it more purposeful and relevant for learners.

B. Limit Graphic Content

As the mobile devices have small screen compared to desktop computers, rendering graphical contents may increase processor load and drain battery power. Since most of the mobile phones especially in Indian students community do not support flash content, it is advisable not to develop the content in flash format to reach wider audience [8]. As most of the mobile devices have limited input/output capabilities like touch screen, quartz keypad and T-9 keypad, data entry may be limited [9]. Navigation to other mobile pages may be provided using hyperlinks or auto filling feature instead of providing entire text.

C. Short and Crisp Content

The video lectures used for desktop based learning are developed keeping in view desktop learner with an assumption of having larger bandwidth and screen. So, desktop based learner does not have much problem in viewing normal e-learning video lectures. Whereas in mobile learning, student would use a handheld mobile phone for accessing video lectures. It would not be convenient to view videos meant for desktop based e-learning for mobile environment. In case of m-learning, students can not pay attention for more than 10-15 minutes because of smaller screen size. Although some of the mobile phones support desktop based videos, the videos developed using complex video codecs consume significant

amount of processing power and drain mobile battery. Also, mobile learner has to pay for data transmission cost for accessing larger video files through mobile networks.

Keeping in view above mentioned limitations, mobile video content developers have to implement a different content development strategy for reaching maximum number of mobile learners. As large amount of data is not convenient to view on mobile devices, large text or data can be chunked in to smaller bits and rendered on to mobile screens. Also, appropriate font size may be chosen so that the text displayed is readable. For example, a course can be divided in to modules and further modules may be chunked in to sub topics based on instruction design as shown in Fig 1.

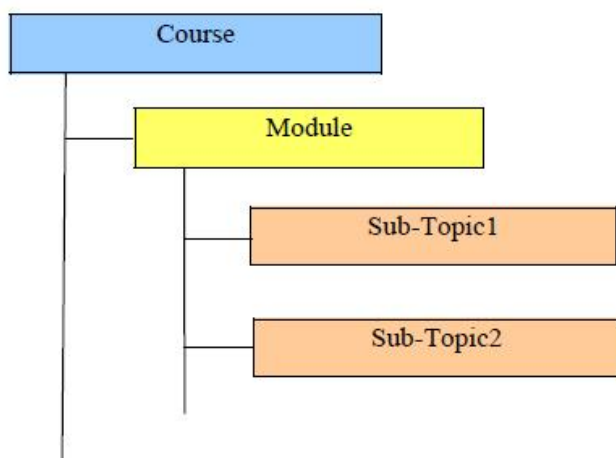


Figure 1. Course Structure

If the objective of the course is to explain a process or functioning of a product, it is best to use visuals with audio explanation as this works better for mobile devices. Multiple versions of the contents can be developed at various stages to meet end user requirements.

D. Multimedia Support

As most of the mobile devices have varying device capabilities and hardware features, it may be difficult to support all media formats. Though some of the Original Equipment Manufacturers(OEM) provide support for playing videos using proprietary codecs, there is no universal policy or implementation support for all audio/video codecs. As most of the OEMs support 3GP standard, video contents were developed using H.263 video and AMR audio codecs.

E. Interactive Design

Graphical User Interface (GUI) should be engaging and thus enabling learner interaction. E-learning and flash based interactivities such as roll over, buttons and so on which are not possible in m-learning may be avoided. However, one could include some interactivities that could help the learner

to recall the information that has been shared. Provision may be provided to add simple assessments that evaluate learner's understanding of the subject. Such an application feature not only provides interactivity but also engages learner in education.

F. Mobile Dimensions

An instructional designer needs to keep in mind the dimensions of the mobile devices for which courseware is targeted. For example, iPhones have different dimensions when compared to a Blackberry or i-Pad or Tablet PCs. The design has to be compatible to multiple devices. Also, instructional designer should keep in mind targetted end users and their devices.

V. PROPOSED APPROACH & EXPERIMENTAL RESULTS

In general, m-learning could be used for formal learning, informal learning or performance support. Although there are certain limitations associated with handheld devices in terms of processing speed, display and memory capabilities, instructional designers and mobile application developers need to adopt a different approach for successful implementation of m-learning project. The following Fig 2 shows different stages of proposed m-learning approach.

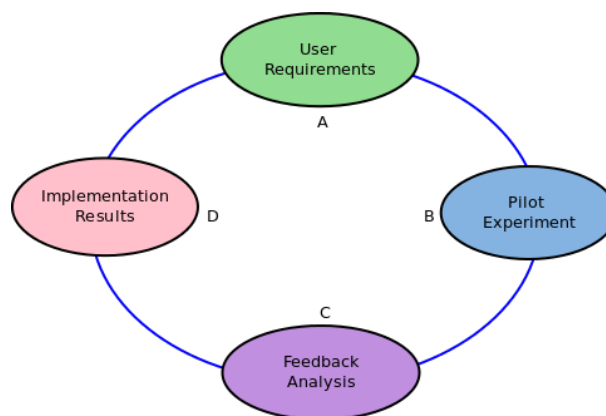


Figure 2. M-Learning Approach

A. User Requirements

Before starting any project, it is important to understand the details like for whom we are developing m-learning application, targetted content, what kind of devices would be used for m-learning, what would be the network connection, in what situations m-learning would be used, what are the pedagogical issues that may arise etc. Interactions took place with finishing school students from different geographical locations like C-DAC Hyderabad and TCE Madurai, who have completed their graduation and preparing for their job interviews. Students were informed about the purpose of m-learning pilot experiment and expected deliverables. Students were asked several questions for capturing and

understanding user requirements. As shown in Fig 3, 58% of the students preferred to have mobile video lectures, 17% preferred to have presentation slides, 14% preferred to have audio lectures and 12% preferred lecture notes.

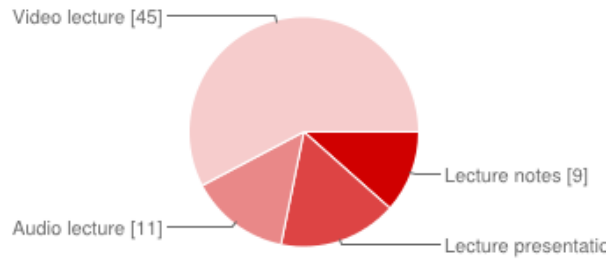


Figure 3. M-Learning Content

B. Pilot Experiment

After capturing user requirements, a pilot experiment was carried out using the sample mobile video content developed as part of our research activity in m-learning. Objectives of the pilot experiment was to 1. Identify suitable video encoding parameters for developing mobile video content and 2. Identify suitable video presentation style for m-learning. For experimentation purpose, C-Programming video contents were developed and packaged along with mobile client applications for Android and J2ME platforms. Students were asked to download and install these mobile applications appropriate to their mobile phones and participate in the pilot.

1) *Identification of Suitable Video Format*: First objective of the pilot experiment was to study, analyse and identify mobile video format suitable for m-learning. 60 finishing school students from C-DAC Hyderabad and TCE Madurai were involved for carrying out this pilot experiment using their own mobile phones. Students mobile phones were analysed with different combinations of audio and video encoders as shown in Table II.

Table II
MOBILE VIDEO CONTENT FORMATS AND CODECS

Sl No	Audio Codec	Video Codec	File Container
1	AAC	H.264	MP4
2	AAC	MPEG-4 SP	MP4
3	AMR	H.263	3GP

2) *Identify Suitable Video Presentation Style*: Second objective of the pilot experiment was to identify suitable video presentation style for m-learning. For that, “functions” concept under C-Programming was chosen and sample content in four identified styles namely 1.Green board 2.Presentation slides 3.White board and 4.Animated video as shown in Fig 4 were developed and tested. The four video presentation styles for the same concept were subjected to

students feedback for analysis and improvements. Students used their own mobile phones for viewing and later provided their feedback using online feedback form hosted on google docs.

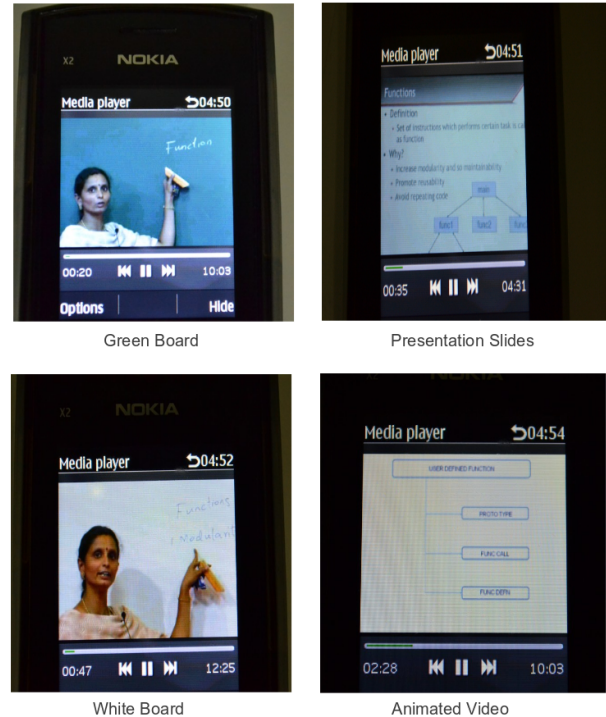


Figure 4. Different Presentation Styles

C. Feedback Analysis

It was observed that unlike students of European and American countries, most of the Indian students use basic and medium range mobile phones for their day to day activities which were not supporting required file format as shown in the Fig 5.

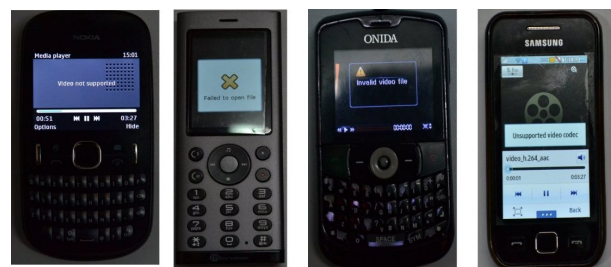


Figure 5. Nokia Asha 200, Micromax M2, Onida G720, Samsung Champ Duos C3312 not Supporting H.264 Video Formats

As device manufacturers support different audio, video codecs most of the students mobile phones did not support

H.264 video codec and AAC audio codec. Whereas H.263 video and AMR audio codecs were widely supported on students mobiles. Based on pilot experiment results and students feedback, it was decided to consider H.263 and AMR codecs for mobile video content development. Also, the feedback provided by end users helped us to identify suitable presentation style for m-learning. It was observed that most of the students favoured for Green board based video lectures for course delivery through mobile phones.

D. Implementation Results

Although mobile video content development guidelines were formulated, guidelines followed for developing content for one subject may not be useful for other subjects. For example, the content development approach used for C-Programming need not be same for Soft Skills. For C-Programming, focus should be on explaining fundamental concepts with illustrative examples. Similarly for Soft Skills focus may be on grammar, pronunciation, spelling, usage etc. Considering the above discussed guidelines, courseware was formulated using identified presentation style and mobile video formats. As shown in Fig 6, out of 60 students, 42 rated mobile video content as good, 16 rated as satisfactory and remaining 2 rated that developed contents can be improved.

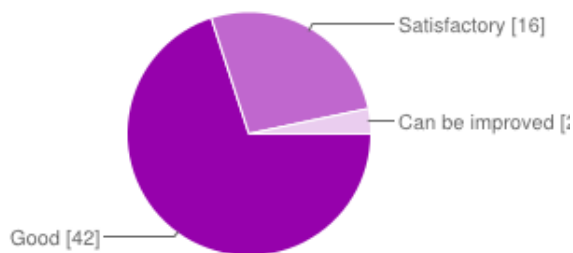


Figure 6. Audio Video Quality

VI. CONCLUSION

This paper discussed about m-learning technology, challenges and its relevance to Indian context. Approach for formulating mobile video content and instructional design guidelines were also discussed. Pilot experiments to identify suitable video encoding parameters and presentation style for m-learning were discussed by designing a courseware in C-Programming. As the formulated guidelines are more suitable for developing contents for computer programming languages, these guidelines may not be suitable for other courses like Soft Skills and Entrepreneurship.

Authors would like to carry forward the research work being undertaken to develop full fledged courses and applications catering to the needs of Indian mobile learners. In near future, the proposed approach would be widely implemented and a full fledged mobile content development activity for

Soft Skills and Entrepreneurship would be carried out to help finishing school students who have completed their graduation to learn using these contents and prepare for their job interviews. Also, there is a need to develop m-learning video content with local language support.

ACKNOWLEDGMENT

This work is being carried out as part of our research work on "Mobile Learning" and is supported by e-learning Division of Department of Electronics and Information Technology(DeitY) [10], Ministry of Communication and Information Technology, Government of India. We are grateful to Prof.Mercy Shalinie of Thiagarajar College of Engineering(TCE), Madurai, Tamilnadu for her guidance and support for carrying out this pilot experiment. Also, authors would like to thank Shri.G.V.Raghunathan, Retired Senior Director, DeitY, Govt of India who has been guiding us in doing this research work.

REFERENCES

- [1] TRAI press release no:191/2012, dated October 09, 2012 www.trai.gov.in
- [2] <http://en.wikipedia.org/wiki/MLearning>
- [3] Kumar Mandula, Srinivasa Rao Meda, Dhanendar Kumar Jain,"Research and Implementation of Mobile Video Streaming Application for Ubiquitous Learning", IEEE International Conference on Technology Enhanced Education(ICTEE),Kerala, India, 2012
- [4] Ganesh Narayana Murthy, Sridhar Iyer, "Study Element Based Adaptation of Lecture Videos to Mobile Devices", National Conference on Communications(NCC), 2010
- [5] Anastasios Doulamis, Nikolaos Doulamis,"Optimal Object-Based Scalability for Video Content Adaptation according to the Usage Environment", National Technical University of Athens, Greece, IEEE Workshop on Signal Processing Systems(SIPS), 2005
- [6] Wen-Huang Cheng, Chia-Wei Wang, Ja-Ling Wu, "Video Adaptation for Small Display Based on Content Recomposition", IEEE Transactions on Circuits and Systems For Video Technology, Vol.17, No.1 January, 2007
- [7] M.David Merrill, Leston Drake, Mark J.Lacy, Jean Pratt, ID2 Research Group, 1996, Reclaiming instructional design. Educational Technology, 36(5), 5-7. <http://mdavidmerrill.com/Papers/Reclaiming.PDF>
- [8] <https://sites.google.com/a/adlnet.gov/mobile-learning-guide/best-practices>
- [9] <http://www.astd.org/Publications/Newsletters/Learning-Circuits/Learning-Circuits-Archives/2008/07/Authoring-Best-Practices-for-M-Learning-Content-Development>
- [10] <http://deity.gov.in/>