# Multimedia to Enhance Blended Learning Experience in Constrained Low Bandwidth Environment

Nazir Ahmad Suhail[1], Jude T. Lubega[2], and Gilbert Maiga[2]

[1] School of Computer Science and IT, Kampla University,
P.O. Box 25454, Kampala, Uganda
nazir_suhail@yahoo.co.uk
[2] College of Computing and Information Sciences,
Makerere University, P.O. Box 7062, Kampala, Uganda
{jlubega,gmaiga}@cit.mak.ac.ug

**Abstract.** This paper identifies multimedia compatible with the challenges of constrained low bandwidth environment by using a Multi Level Systematic Approach (MLSA) through literature investigation, aimed to enhance blended learning experience in developing countries. At level I, a huge database for various media formats was identified. At level II, most commonly used visual media was selected based upon the usability characteristics. At Level III, we conducted a critical deep investigation of selected very commonly used media formats using different characteristics. The analysis of Level III investigation was done at Level IV. The study concluded that MP4, MP3 and JPEG or PNG are, respectively, the video, audio and graphic formats compatible with the challenges of constrained low bandwidth environment. This paper extends some sections of the previous work published by the same authors.

**Keywords:** Blended learning, multimedia, multilevel systematic approach, constrained low bandwidth environment.

## 1 Introduction

The widespread availability of new innovative learning technologies that offer flexible, cost effectiveness, and quality educational opportunities have changed the spectrum of higher education. Universities around the world are embracing e-learning to meet the demands of knowledge based society. Although e-learning provides access to learning content to anyone, anywhere, and anytime, the lessons learned proved that to facilitate successful learning, a single mode of instructional delivery may not provide sufficient choices and social contact [13]. These large scale moves of technology use led to blended learning, an effective approach to deliver the educational content. In blended learning approach, traditional in-class and e-learning sessions are integrated to attain the benefits of both learning forms [3].

Driven by technological advancements, flexibility, and lower cost, coupled with demand for higher education [5], the adoption of blended learning model is an ideal choice for the universities in developing countries which is pursued by many organizations in developed world [4]. However, universities in developing countries are

S.K.S. Cheung et al. (Eds.): ICHL 2012, LNCS 7411, pp. 362–372, 2012.

facing some typical key challenges such as Constrained Low Bandwidth Environment (CLBE) towards its adoption. Although several blended learning frameworks (e.g., [6], [7], [8], [9], [10], [11]) have been proposed, the issue of integrating technology into traditional face-to-face class room learning in CLBE has not been adequately addressed. However, the issue was addressed recently in "Optimization Technique for Implementation of Blended Learning in Constrained Low Bandwidth Environment" [1] that has Network Optimization and Multimedia (Video, Audio, and Graphics) Optimization as its main components. This research falls within the scope of [1].

The potential of multimedia to make positive impact in teaching and learning environment at higher education is well recognized by the researchers. Therefore blended learning process can be enhanced significantly through delivering the content using visual media (video, audio, and graphics) that is an effective teaching and learning approach [29]. However, such multimedia applications put high demand for large bandwidth which is limited in the context of developing countries where demand always exceeds the supply [27]. The adverse network conditions associated with the context of CLBE directly affect the efficient delivery of multimedia over the Internet [28]. Furthermore designing and developing of such instructional content is costly, especially for the organizations seeking to implement blended learning solutions in their systems in the context of emerging environments. Therefore, transmission of visual media (video, audio, and graphics) in constrained low bandwidth environment, a peculiar state associated with developing countries is a research challenge that requires investigation [2], due to lack of research in this area to address this critical issue.

On that basis, this paper identifies the multimedia compatible with CLBE, in an effort to design the content sensitive to the challenges of Least Developed Countries (LDCs) using an extensive Multi Level Systematic Approach (MLSA) through literature investigation. The study concluded that MPEG 4, MP3, and JPEG or PNG are the video, audio, and graphic files formats respectively, compatible with the challenges of CLBE.

## 2 Technological Terms

### 2.1 Constrained Low Bandwidth Environment

The Constrained Low Bandwidth Environment is characterized by low bandwidth together with other network related constraints such as misuse and mismanagement of bandwidth, viruses, spam, and Internet worms causing network congestion [12]. Low bandwidth refers to insufficient bandwidth to meet the user demand.

### 2.2 Multimedia

Multimedia refers to the representation of computer based information through video, audio, graphics and animation in addition to text [14]. However, this paper focuses on visual media (video, audio and graphic) file formats.

### 2.3 Blended Learning

The most commonly used definition of blended learning is thoughtfully integrating traditional classroom learning and online learning (e-learning) experiences to