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Effective E-Learning Adoption Policies in Developing Countries

A Case of Nepal with Conjoint-Based Discrete Choice Approach

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Abstract

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E-learning and technology assisted learning environment are buzzwords for the school environment in developed countries but they are in a very infant stage in the context of developing countries whose curriculum and teaching methodologies are based on the traditional approach. Besides, skilled teachers prefer working in schools situated in urban areas, which imposes more challenges to rural areas. These challenges are generally characterized by quantitative output-oriented short term planning of education, and the gap in the quality of education offered by schools in urban and rural areas. The situation has been more aggravated due to the use of different textbooks and materials by government-run and privately-owned schools. Thus, it is imperative to introduce an inclusive education policy to address the needs of socio-economically diverse population. In addition, there is the need of developing a sustainability model

for technology-assisted education policy to prepare for a qualitative knowledge base society.

Identifying the appropriate attributes for the e-learning environment, a conjoint based discrete choice modeling with stated preference data gathered from 6 regions of Nepal, this study finds out that parents and school children are price sensitive and willing to exploit the Internet as a supplementary learning tool to the existing system. Thus, the study prescribes a win-win scenario for the best policy formulation to address the digital gap between the urban-rural and rich-poor accessibility to education.

Keywords: e-learning adoption, discrete choice analysis, multinomial logit model, mixed logit model, education policies

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Chapter 1 Introduction

1.1. Overview

Education system, a driving force of economy, has been found one of the least prioritized sectors for improvement in the context of developing countries such as Nepal (Mathema, 2007). Researchers and policy makers have worked for implementing effective digital learning environment system for students and developing various kinds of systems such as virtual learning, open learning, e-learning, on-campus learning, off-campus, and on-site learning. Nevertheless, availability, accessibility and affordability have been major concerns for a country like Nepal. Traditional teaching and learning methods have been widespread in the school environment. Students are dependent on inadequate hard copy learning materials and limited text books. In many rural parts of the country, public schools lack trained and qualified teachers. Government strategies, policies and their implication are limited just to continue the way that have been practiced rather than upgrading the system and making conducive environment for enabling students willing to study new things in a creative way. On the other hand, very few private schools in urban areas are able to introduce technologically assisted learning environment to some extent.

When we talk about advanced and value added technologies and services, we often tend to forget about fundamental things such as preparing an enabling

environment for accepting and adopting technologies. The advent in advanced computing has made it possible to expand its usability to every sector ranging from education to economy. Developed and industrialized countries have integrated such advances into education and other sectors, leaving developing countries lagged behind farther, meaning that they have failed to catch up technological advances for their overall economic activities. Lately industrialized countries such as South Korea, Taiwan, Hong Kong and Singapore proved the technological integration into their educational system which has rewarded them to tie up with vibrant and dynamic economy (Page, 1994). The countries and the community which initiated technology inclusion in the educational system have become world's leading economies while those which followed traditional educational system have become the laggard (Butler & Sellbom, 2002) even though they have immense capacity.

Technology-enabled classrooms are widely practiced in developed countries to improve educational effectiveness (Hansen et al., 2012). Such classrooms prompt to change social behavior, habits, and interests as well.

Developing countries have started following the technology inclusion as a bid to achieve the UN Millennium Development Goals (MDGs)[1], one of which is to "achieve universal primary education" by 2015. Many social workers and companies which are working for better education have designed and

[1] http://www.un.org/millenniumgoals/

manufactured low-powered and low-cost computers to attract children to school, enable effective teaching by integrating them to improve conventional teaching environment with the support from communities, government and non-governmental organizations for advancing the education sector. The One Laptop Per Child (OLPC) project[2], the Raspberry-Pi[3] project and so on are some well-known projects which are especially targeted to school children, and widely deployed in developing countries for creating technology-driven educational environment in schools at low cost. In most cases, they have shown good results if schools are not connected to the Internet but, in some cases, where the school is connected to the Internet, results are mixed, meaning that students were found misusing the Internet rather than just using it for their educational purposes[4],[5],[6]. If the Internet is utilized in a proper way, it is obvious to get many advantages in a short period of time. However, Yadav et al. (2013) found that the increment in haphazard Internet usage pattern makes students become addictive and is the major cause of depression, anxiety and stress. The use of the Internet and mobile technologies by adolescents is important for the acquisition of lifelong learning, however, prolonged periods of the Internet use is associated with psychological

[2] http://laptop.org/en/

[3] http://www.raspberrypi.org/

[4] http://www.ctvnews.ca/health/ban-internet-in-kids-bedrooms-limit-social-media-use-pediatricians-1.1516532 accessed on Oct 12, 2013

[5] http://www.theguardian.com/society/2013/oct/21/warning-parents-children-internet-use accessed on Oct 12, 2013

[6] http://www.telegraph.co.uk/technology/internet-security/10393707/Fifth-of-primary-school-children-admit-meeting-cyber-strangers.html accessed on Oct 12, 2013

and sociological problems (Gunuc & Kayri, 2010), work difficulties (Li et al., 2010), and family relationship (Gunuc & Dogan, 2013).

The Internet and mobile technologies have brought tremendous opportunities in education, business, technology advancement and other daily life activities. Nevertheless, the Internet has brought positive and negative impacts on our lives. Positively considering the changes it has brought, it is no doubt that the Internet is a beautiful gift to the human being. However, we need to consider the negative impact as well, which began to be seen due to its inappropriate use, activities such as cyber bullying, child pornography, and school-dropouts (Jonsson et. Al, 2014). In absence of proper monitoring and guidance to children, they might have improper and heavy dependence on the Internet and lose creativity. In addition, usage behavior towards the advanced technology has also accounted by the familiarities with the technology, innovativeness, self-efficacy of the technology (Yang, 2012). Thus, there should be a proper analysis on the impact of the Internet with both pros and cons so that the government and other responsible organizations can take initiatives to formulate proper policies and adopt necessary measures for the optimal benefit in social life, business and so on to make the Internet as a supportive tool for the acquisition of knowledge and overall development sphere. According to Lenhart et al. (2010), 58% of children aged below 10 in developed countries get cellphone and 5% of children aged 12-13 use twitter and other social network service. Though the use of technology since their childhood increase their self-efficacy, in case of not well controlled or monitored

usage, their formal education might be affected due to its misuse. We have seen the Internet as a better way to bring lifelong learning environment and enhance education, but the Telegraph[7] reported that one-in-five children dropouts at the age of 16 in the UK despite the high use of the Internet and technology integration in the academic environment. Usually parents have less time to look after their children's activities and guide them properly; hence if proper policies are not introduced and implemented in time, then this situation will be vulnerable to their mental development (Covell & Becker, 2011). Likewise, rampant use of the Internet has reportedly increased violence due to the misuse of social networking sites and cyber-bullying. Therefore, timely and proper actions should be taken so as to avoid the adverse effect of the Internet.

In the case of school children's usage of the Internet and electronic gadgets, teachers in schools and parents at home are responsible to guide for their proper use. Most of the schools in developing countries cannot provide computers on one-to-one basis and have to get the students to share computers for the Internet use or educational materials. And if schools have sufficient infrastructure, parents need to pay very high tuition fee which may not be affordable to the low and medium income families. On the other hand, parents cannot monitor their children all the time even though they live together. In the case of developing countries, governments have failed to provide the technology-powered

[7] http://www.telegraph.co.uk/education/educationnews/9072482/OECD-fifth-of-British-teenagers-drop-out-of-school-at-16.html accessed on Oct 15 2013

classrooms to each school and monitor the access of the technology and its usage properly.

This study intends to suggest policy makers and stakeholders to consider the adoption of technologically assisted learning environment. While doing so, the study aims at contributing to enriching the methodological aspect with discrete choice approach to show the attributes that need to be considered for an effective deployment and adoption of e-learning in schools.

The study is organized as follows. Chapter two covers background and problem statement of this study as such how it mainly intends to show the importance of the digital learning environment over the traditional teaching methodologies and how the Internet can be used to upgrade the quality of education in developing countries. This chapter also comprises the scenario of ICT infrastructure that can be useful to promote e-learning and preparedness of human resource to deal the above stated problem in Nepal. The third chapter summarizes previous studies on technology adoption, e-learning and its effectiveness and framework developed in technology assisted learning environment and e-learning techniques. The fourth chapter is focused on methodological overview of this study, which concentrates on the behavioral aspect of stakeholders who directly receive or use the services. Chapter 5 reveals the estimation result of the surveyed data. The final chapter draws the interpretation of the result and policy implication from the result.

1.2. Research motivation and Objectives

E-learning has been considered as the new way to advance teaching techniques but it cannot replace regular classroom environment. It acts as a supplementary environment for classroom teaching learning activities. The school stands as the primary place for children to interact with the society, share knowledge, create basis for career development, and explore opportunities. The Internet in this digital age has further accelerated the pace and speed of learning environment in schools. The maturity of the Internet and rich Internet application technologies has made possible to create virtual school environment regardless of the physical proximity. Computer and Internet technologies, which brought tremendous opportunities and flexibility to enhance quality of education, are still out of reach from the school environment in the context of a developing country like Nepal. Many researchers (Fernández, Correa &Losada, 2011; Astrachan et al., 2011; Chen & Liu, 2013; Fazelian & Soraghi, 2010; Sharma & Chhabra, 2011; Mohammadi, Ghorbani & Hamidi, 2011) have focused on the performance analysis of the integration of technology, computer, and the Internet in school, but as far as our knowledge, there is hardly any research carried out based on learners' preference. In the case of the adoption of e-learning system, we can identify three major stakeholders from the consumers' side; namely, students, teachers, and parents, and from producers' side - content developer, policy maker and authorities like ministries and concerned departments. This study aims to

analyze the preference structure of e-learning adoption in schools which is based on the features of e-learning package offered by a particular school and further tries to interrelate preference structure with the consumer, service provider, policy maker and related public agencies working directly and indirectly in the education sector.

The objectives of this study are to suggest an appropriate policy framework for accelerating efficient education sector, and identify incentives to enrich e-learning content that can be utilized as a supplement to the existing system. It consists of the methodological framework using conjoint survey to identify and analyze consumers' preference structure, their taste variation and effects of socio-demography that dictates the preference structure. By the use of willingness-to-pay (WTP), the perceived value for each level of attributes are identified, which can be utilized to suggest for the realization of the sustainability model of e-learning adoption from the perspective of consumers, service providers and policy makers .

Many studies have been carried out to analyze the performance of students after the adoption of the Internet, using learning management system as a tool. The aptitude based learning system (Eck, 2006; Windham, 2005; Kvavik, 2005) helps "Net-Generation" students learn effectively but proper awareness should be taken into consideration to avoid problems of technology driven learning as identified by Hansen et. al. (2012) and problems of adoption (Uchida, 2004). By avoiding problems, wide variety of contents, system platform can be employed

by identifying the aptitude of individuals to help their career development. At this outset, this study attempts to analyze students' preference of learning structure in a computer-enabled environment, taking samples from different regions of Nepal.

The research questions of this study are:

(1) What are the preferences of potential e-learning adopters in high schools of Nepal with respect to the attributes of e-learning adoption?

(2) How do these preferences influence their choice of the e-learning system? The questions can be further extended to a sub-question as: what are the parameter values of the attributes given in the choice sets? By analyzing the choice patterns of respondents, the utility that every attribute level poses to the average consumers is derived. With this knowledge, it is possible, for instance, to rank levels and attributes according to the importance.

(3) Given this knowledge, what policy implications can be drawn based on potential adopters' preferences regarding e-learning adoption in Nepal? This question is set to provide deeper insights and make the findings of this work relevant to policy implications as mentioned in the question.

Chapter 2 Research Background

2.1. Prevailing Education system in Nepal

The traditional practices of education in Indian subcontinent started with the *guru* culture[8], in which teachers are considered as the main source of knowledge. The knowledge acquired by disciples is limited with the knowledge imparted by teachers. But in the modern context, this seems to be unrealistic. With the advent of the Internet, students can get knowledge from different sources. However, Nepal has failed to utilize the advantages of technology and facilitate to use other sources of knowledge. In the current context, the government has been implementing different phases of the periodic plan to improve the educational system and promoted the participation of the private sector in education. The involvement of the private sector has remarkably improved the quality of education and increased the outreach but is limited, to a greater extent, only in the urban areas across the country. Now, it is time to reorganize and reframe the educational policy to minimize the disparity of private-public and urban-rural schools. Thus, to minimize this disparity, the government has announced different skill oriented and technology integration programs to public schools along with the provision of the Internet services to the public schools throughout the country.

8 http://en.wikipedia.org/wiki/Guru

Every year the performance of school level education is evaluated through the School Leaving Certificate (SLC) examination[9], but some education experts have asked the government to revise the national evaluation system stating that SLC results cannot be the only trusted factor to evaluate students' performance. Moreover, the performance is degrading every year[10]. In figure 1, the budget for education has increased from 3.1% of GDP in 2003 to 4.7% in 2011. However, the performance as measured by SLC pass out percentage shown in figure 1 is decreasing. On the other hand, the government considered the 5 years of curriculum and textbooks renewal cycle[11] up to grade-12. Meanwhile UNESCO Bangkok (2008) maintains "the present curriculum took effect at the lower secondary level in 2001, the secondary level in 1998 and the upper secondary level in 1990". This clearly tells us about the curriculum recycling period in the education sector; however, the curriculum for private schools has been revised on every 4 year basis. UNESCO Bangkok (2008) further reports that government has planned to integrate grade 1 to grade 12 on the 12 year education cycle which was piloted in 2007 and aimed for the full implementation of the reform by 2010 but it has been delayed.

[9] School Leaving Certificate (SLC) examination is the main exam, which every student needs to pass in order to get the admission to higher education in colleges and the university.

[10] http://www.thehimalayantimes.com/fullNews.php?headline=SLC+syndrome%3AImpact+of+the+results&NewsID=248887

[11] http://www.unesco.org/education/wef/countryreports/nepal/rapport_3.html

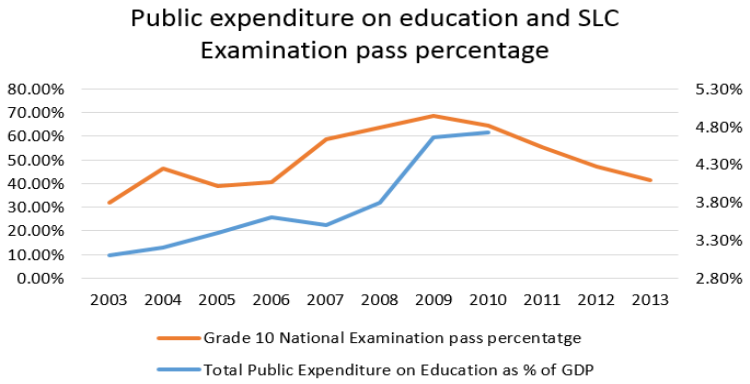

Figure 1public expenditure in education sector and SLC Exam result (Office of the controller of Examination-2014)

2.2. Current trend of technology induced education system

The government has the policy to promote technology induced education; however, the effective implication of the policy can be seen only in private schools located basically in urban areas. Generally it is not accessible to all. There are many community-led organizations [12] , [13] and non-government organizations[14],[15] which are supporting to enhance quality education. However, without proper education framework and policies, these efforts do not seem to be effective. To incorporate with the ICT development through the firm base,

[12] http://gorkhafoundation.org/?page_id=129
[13] http://www.nepalwireless.net/
[14] http://olenepal.org/
15 http://nren.net.np/

Ministry of Education (2013) has dissiminated the ICT in education master plan. Government of Nepal has allocated the budget to purchase the related facilities to all public schools across the country in fiscal year 2014/2015[16], but the provision of proper manpower and sustainability model of the project are major concerns. In many cases, the use of the computer and the Internet in schools are limited to skill based trainings rather than integrating it into regular classes. In addition, the frequency of usage is limited due to less computer-student ratio. In private schools, a course of computer science comprising basic programming knowledge like QBASIC, PHP, and HTML, and advanced computer software such as Photoshop, inDesign, and so on is made mandatory for secondary level classes. Basic computer application skills such as the Office package and the use of of the Internet, including basic web-browsing (mostly social network service) and email facilities, are taught to beginner level students. . Thus, the adoption of computer education in private schools can be seen much more progressive than in public schools.

2.3. Innovation in education and existing networks and services

Innovation in the education sector can be possible if open participation of external knowledge source is allowed to the system with an appropriate incentive

16 http://www.ekantipur.com/the-kathmandu-post/2014/01/08/editorial/technological-teaching/257950.html accessed on June 17 2014

model. However, we cannot see such incentives in the current education system and infrastructure. Community based and non-profit based models are being practiced with their own efforts with limited suitable support framework from the government, leaving alone to motivate themselves. In order to assure their secure and exerting participation, the government needs to incentivize their work to create innovation platform for attracting third party individuals and generating the digitally rich quality library. Promoting the third party involving in education, other than the government and the private sector, could be a winning solution to empower under-privileged communities. Since the major investment in education goes to regular staffing and administrative cost which does not necessarily help to improve the quality of education, remarkable changes in current investment in infrastructure and strategic policy need to be considered[17].

The urbanization rate and migration to urban areas have reportedly been high, leaving marginalized people in remote rural areas. This situation has further widened the information-knowledge gap, as well as the digital gap, creating huge social division between the urban-rural people and rich-poor people. Thus, it is necessary to create a common platform to innovate education services through the technology assisted learning environment and make inclusive education through incentivizing people to integrate technology. This helps in getting

[17] http://www.youtube.com/watch?v=yOs2HFTxXWY accessed on May 16, 2014

adequate reading materials and getting teaching staff as facilitators to learning environment even in the case that the qualified teaching faculties are not available.

Chapter 3 Literature Review

New technologies adopted by the members of the community are spread if supportive environment is enabled, according to the theory of diffusion, proposed by Rogers (2003). Some technological adoption takes faster pace to reach nearly saturation of the S-curve of the diffusion model, however, some technology or products diffuse slowly. ICT, as a general-purpose technology, has been seen with exponential rate of diffusion. Li and Shiu (2012) have identified the determinants of the diffusion of the Internet as: telecommunication policy, income, education, competition policy, English proficiency, and Internet cost. Kiiski and Pohjola (2002) have identified income, access costs, good governance, urbanization and education as the determinants of the adoption of the Internet. In the case of developing countries, there has been a vast digital divide in terms of the use of computer and the Internet.

A digital divide is defined as the gap between the segments of society which can or cannot access ICTs and take advantage of them. Anderson (2008) further divides the knowledge society into four levels – (a) a global system, (b) national or cultural system, (c) social organization, and (d) a smaller community. From this perspective, the school can be taken as a smaller community, from where the firm base of ICT education can be propagated to fill the gap of socio-economic status and, eventually, leading to its spread to the global level. A digital gap, which is more pronounced as the buzzword in replacement of knowledge gap in

the digital era, is also considered as the disparity of information dissemination and can be extended to the lack of infrastructure and ability to access such infrastructure as pricing and know-how to the proper use of ICT. Brandtzæg, Heim and Karahasanović (2011) classified the Internet users in response to digital divide as “non-users”, “sporadic users”, “instrumental users”, “entertainment users”, and “advanced users”; among which “non-users” and “sporadic-users” reflect large digital divide. Digital divide is also categorically defined from the perspective of ownership divide and the under-use of specific technology (Cruz-Jesus, Oliveira and Bacao, 2012; Pick & Nishida, 2014; Hilbert, 2011). Efficacy in mitigating digital divide cannot be achieved if either of these categories exits (Shank & Cotten, 2014).

On the other hand, the adoption of e-learning has been reported with such barriers as the lack of management support, IT problems, workloads and lack of time (Ali & Magalhaes, 2008). Al-alak and Alnawas (2011) identified perceived usefulness, perceived ease of use, computer knowledge, management support and intention to adopt as the barriers to the adoption of e-learning in a study made upon Jordanian lecturers. . From the developing countries perspective, apart from the above identified factors, socio-economic and psychological aspects, unreliability of the technology, and quality of the content (Butler & Sellbom, 2002), support system and perceived usefulness over the traditional or false cost benefit analysis are major factors of adoption .

The use of the Internet can provide the access of avenue for new opportunities to facilitate the continuation of life-long education by creating platform for innovation, new hobbies, and personal growth to re-define the career (Kari & Savolainen, 2007). The importance of e-learning and self-learning, and their usage have been growing rapidly with the advancement of telecommunications and information technologies since such technologies have become the platform for the creation of contents and the efficient use of new procedures to better guide the learners for selecting their suitable learning materials (Polydoropoulou & Lambrou, 2012).

ICT education, the computer and the Internet are the fundamental things. Digital materials carry similar significance as well. Given the context of the heavy dependence on hard copy printed educational materials in developing countries, e-learning seems a challenging task which involves the use of digital content and materials for the interactive learning environment. E-learning, on the other hand, is the fusion of electronic teaching learning materials and ICTs. E-learning system is categorized into the linear learning system[18] and the collaborative learning system[19]. The collaborative learning system is further divided into the Internet

[18] Linear learning system refers to the computer based learning or training system which is self-paced learning activities delivered on a computer system. CBTs provide learning stimulus beyond traditional learning methodology from textbook, manual, or classroom-based instruction. WIKIPEDIA 2014

[19] Collaborative learning is distinguishable from the traditional approach to instruction in which the instructor is the principal source of knowledge and skills. WIKIPEDIA 2014

based- and the network based-environment (Ibáñez et al, 2013). The main advantage of e-learning is that it increases the engagement -attendance and motivation of students which are requisite for learning (Mohammadi, Ghorbani & Hamidi, 2011).The guidebook for the policy makers authored by Bybee (1997) mentions the 5E Model as "Engagement, Exploration, Explanation, Elaboration and Evaluation", which is still valid to enrich different teaching methods and techniques together (Çepni & Şahin, 2012; Fazelian & Soraghi., 2010).

The independent learning in the e-learning system is guided by the personalized learning adaptation (Wang, 2014), and self-regulated learning environment (Pintrich, 1999; Wang, 2011). Pintrich (1999) pointed that the efficiency is highly correlated with the motivation in the self-regulated learning environment of the learners, and further elaborates as "*self-regulated learning can be facilitated by the adoption of mastery and relative ability goals and hindered by the adoption of extrinsic goals with the positive-efficacy and task value beliefs can promote self-regulated behavior"*.

E-learning has become an important trend in recent years. In addition to providing richer resources than the traditional classroom to facilitate learning, e-Learning also overcomes the limitations of time and space of traditional teaching. E-learning allows learners to learn independently, meaning that it enables learners for self-supervision and is absent from any enforcement mechanisms of traditional teaching (Wang, 2011).

Adoption of e-learning system is basically adopting virtual learning environment in which teachers act as a guide for the students which is also possible through the use of artificial intelligence to recommend students for further improvement. Balabanovic (1998) studied on the text recommendation system to deliver appropriate documents based on users learning experiences and preferences. Polydoropoulou and Lambrou (2012) studied the e-learning recommender system targeted in shipping industry to develop the effective learning advisor system. The recommender system can help learners to select the suitable educational material to address difficulties and empower shipping industry where alternate career changes require by rotating job during onboard. The advancement of digital technology has brought tremendous flexibility to deliver interactive audio-visual learning materials which are highly preferred over the printed plain text materials. When digital materials are available, they could be customized to one's own preference and could be made accessible to one's own convenience.

Chapter 4 Methodology

Discrete choice analysis is a qualitative (Train, 2003) analysis pronounced in the marketing research to predict between the alternatives available in the market (Hanemann, 1984; Kasuga, Zeng & Shishikura, 2008; Manandhar, 2012; McFadden & Train, 2000; Savage & Waldman, 2005). It deals with the data gathered from the stated preference or revealed data of certain product, services or system. This study elects to use the discrete choice modeling with a conjoint survey for capturing the stated preference data and revealing users' preference structure in selecting the suitable and available packages. Toward this end, it studies the adoption of e-learning in Nepal with hypothetically designed packages featuring different attributes of limited choice alternatives.

In the stated preference data gathering techniques, researchers often create a hypothetical situation (Polydoropoulou & Lambrou, 2012) which closely resembles the real scenario and decision makers are allowed to choose the best alternatives among the set of alternatives quantitatively characterized by "which one". Following the properties of the discrete choice analysis, the set of the alternatives in the choice set are subjected to be exhaustive so that the decision makers have to choose the appropriate alternatives among the sets. Since the alternatives are made available in finite number out of which the decision maker chooses only one alternative from particular choice set unlike the multiple choices in the common choice set scenarios. For example, in the choice set of the survey,

5 differently featuring alternatives are made available to the respondent out of which s/he is asked to rank the alternatives ranging from the best to the least preferred which has no subtle difference than main requirement for discrete choice analysis (Manandhar, 2012).

While choosing an alternative set, the decision maker tries to find maximum utility among the available alternative sets, comparing the perceived level of utility on each attribute or by compromising some level of attribute even though that level gives high utility to make high utility of profile but other level gives less in overall valuation. In this study, suppose the decision maker has high tendency to select a profile set with availability of the Internet along with Windows operating system at a lower price but if not available in the lower price, then the decision maker either sacrifices to pay a higher price to remain on Windows and the Internet or sacrifices either of level in which the decision maker perceives higher utility to get at a lower price. In some cases, demography and psychological behaviors may dictate the decision making process by devaluating the perceived utility to give the falsity, creating more heterogeneity. The utility maximization process follows with comparing characteristics and motivational factors on available features of packages such as whether it has the quality of Internet, ease of use of content and its extent of interactive, reliability of services and other factors like how teaching faculties are effective (Polydoropoulou & Lambrou, 2012). Thus, in either of ways, the decision maker tries to acquire maximum level of utility from the available sets of alternative profiles.

4.1. Random Utility Theory

In market research, the discrete choice analysis based on the random utility theory has been used extensively (Vij & Walker, 2014; Train, 2003; Hanemann, 1984; McFadden & Train, 2000). The studies have employed the discrete choice analysis model describing the relationship between the explanatory variables and the choice of the Internet adoption. This study follows the utility maximization behavior of the consumer. As in our knowledge, there are a few studies carried out in the adoption of the e-learning rather focusing on the performance analysis of the internet adoption, use of e-learning package or learning management system in school. This study takes the advantage of the previous literature of performance analysis and the literature of consumer behavior, utility maximization and discrete choice analysis in different categories but resistive on technology for relevancy.

Stated preference survey has been employed for analyzing consumer preference as employed by Savage & Waldman (2005) in the study of broadband internet access; Gómez et al. (2014) to design the subsidy program; Jones et al. (2013) in the study of effective incentives of technology adoption; and Hall et al. (2004) in the study of health care services. They have estimated utility by using random utility model, seeking respondents' preferences in terms of featured attributes such as functionality, advantages, service fee, and so on.

E-learning is not restricted by time and location, which can provide learning environment to learners and teachers effectively (Chen & Tseng, 2012). However, the supportive facilities to access the system such as the access of Internet with sufficient bandwidth, the availability of the computer and its accessories, and availability of electricity account its flexibility of use.

In economics literature, utility theory is defined as the ability which satisfies the needs or wants by consuming the goods (Varian, 2009). It is the representation of preference structure over the sets of available services or goods. However, the measurement of the satisfaction from the use of goods or services is an abstract thing which cannot be measured quantitatively; rather it is the perceived level of satisfaction compared to the available sets of the choices. Thus, many studies have been conducted to quantify the perceived utility achieved by the consumer, one of them is the Random Utility Theory (Louviere, 2004; Cascetta, 2009; Andersson & Ubøe, 2010; McFadden & Train, 2000). The model can be approximated using Mixed Logit with appropriate choice variables and mixing distribution in required degree of accuracy (McFadden & Train, 2000).

Discrete choice model is being used in marketing, technology forecasting analysis and so on, on the basis of the model (McFadden, 1973; Train, 2003), in which respondents are allowed to perform the choice experiments, to choose the best alternative among available alternatives in a set using comparative judgment of available choice sets. The comparison of choice set follows the law of comparative judgment, as "it is not only compared with the physical stimulus

intensities but also to the qualitative comparative judgment" (Thurstone, 1927). This comparative judgment to derive one's utility depends on attributes of alternatives and the characteristics of individuals, popularly known as socio-demography of individual. Thus, the selection of attributes and their levels play the major role in organizing a set of alternatives from which respondents find their greatest possible utility associated with each attribute of the alternatives.

Assuming the person i has n alternatives which are mutually exclusive and exhaustive with other alternatives, chooses the best alternative j from the set of n available alternatives by comparing all available attributes and their features on which s/he can maximize his/her perceived utility based on the utility theory, his/her utility by selecting the alternatives becomes

$$U_{nj} = V_{nj} + \varepsilon_{nj}$$

Where V_{ij} is the observable part of the utility which can be measured by the direct effect on the choice and is common to all agents but ε_{ij} is unobservable part, often called as the stochastic part of utility. Unlike the V_{ij}, ε_{ij} suffers from the different factors which cannot be accounted easily by the researcher and is not possible to include in the deterministic part of the utility function. However, the researcher tries to capture its existence to analyze its properties using appropriate distribution. The above equation can be further decomposed as

$$U_{ij} = V(x_{nj}, s_n) + \varepsilon_{nj}$$

Where x_{nj} is the vector composed of attributes of alternatives j to n^{th} consumer and s_n is vector of characteristic of n^{th} consumer. The deterministic part of utility function can be represented in linear (Kirby, 2011) and non-linear form (Koppelman, 1981; Mandel, 1994) but for simplicity of analysis, we assume it has a linear relationship though non-linear links stronger consumer behavior than linear model (Mandel, 1994).

$$U_{ij} = \beta'_{nj} x_{nj} + \alpha'_{nj} s_n + \varepsilon_{nj}$$

Where β'_{nj} is the coefficient of the particular choice attribute, also known as the consumer preference and α'_{nj} is the degree of influence on deterministic part of utility by attributes of choice set of individual. In the case of stochastic part, $\varepsilon = \{\varepsilon_{n1}, \varepsilon_{n2}, \dots, \varepsilon_{nJ}\}$ follows the joint distribution as our specification (since its characteristics depend critically on the researcher's representation of that choice situation), which helps individuals to decide probabilistically. Hence, the probability of choosing the choice set from the available alternatives is given by

$$P_{ni} = Prob(U_{ni} > U_{nj}, \forall_j \neq i) = Prob(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}, \forall_j \neq i)$$

$$P_{ni} = Prob(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}, \forall_j \neq i)$$

Since, the probability of each random term $\varepsilon_{nj} - \varepsilon_{ni}$ is below the observed quantity $V_{ni} - V_{nj}$ which follows that the probability of choosing alternative by the individual is chosen on joint distribution.

4.2. Multinomial Logit or Rank Ordered Logit Model

Multinomial Logit (MNL) popularly known as the ank-ordered Logit or Conditional Logit Model mostly used in the rank ordered stated preference conjoint survey with RUM. Rank-ordered Logit is an extension of the multinomial Logit which uses the rank between the available set or alternative set, whereas, Multinomial Logit uses the most preferred one in the available set (Beggs et al., 1981). The MNL Model assumes no correlation between the attributes and contains only individual characteristics of individuals; in other word, it has homogenous characteristics (Hausman & McFadden, 1984). It provides the closed form model without the need of multivariate integration which makes computation simple but suffers from the independence from irrelevant alternative property (McFadden, 1973; Hausman & McFadden, 1984; Train, 2003).

In discrete choice analysis, MNL is one of the widely used models and its functional form of the choice model (Hausman & McFadden, 1984) is given by

$$P(i|x, C, \beta) = e^{x_j\beta} / \sum_{j \in C} e^{x_j\beta}$$

Where $C = (1,2, \dots, J)$ is a finite set with alternatives i and j; x_j is the vector of explanatory variables describing attributes of alternatives in j and the characteristics of the decision makers comprising in K-vector of explanatory variables describing the attributes of alternatives in j and the characteristics of the

decision maker which affects the desirability of alternative j; and is the attributes of C. β is a K-vector of taste parameters; $P(i|x, C, \beta)$ is the choice probability that a randomly selected decision maker, when faced with choice set C with attributes x, will choose i.

Since the MNL model assumes independence of irrelevant alternatives property, which means if the individual prefers any alternative profile let us say A out of the given set $\{A, B, C\}$ and addition of choice profile D should not be changed to the original decision between previously available set. The model assumes the Gumbel or extreme value error type I distribution, which closely approximates the normal distribution and the error components are identically and independently distributed over the individual choice decision and alternatives (McFadden, 1973).

When a consumer is given to rank his/her preference to the set of alternatives, let the n consumer gives his response $r_n = \{r_{n1}, r_{n2}, \dots, r_{nJ}$ over the available J alternatives as $j = 1,2, \dots, J$ in descending order of preference and corresponding utilities following (So & Kuhfeld, 1995; Calfee, Winston & Stempski, 2001)

$$U(r_{n1}) > U(r_{n2}) > \cdots > U(r_{nJ})$$

in other word

$$Prob(r_n) = prob\left(U(r_{n1}) > U(r_{n2}) > \cdots > U(r_{nJ})\right) \; for \; j = 1,2, \dots J$$

Which can be transformed into closed form as

$$prob\left(U(r_{n1}) > U(r_{n2}) > \cdots > U(r_{nJ})\right) = \prod_{k=1}^{J-1} \frac{e^{\beta x(r_k)}}{\sum_{m=k}^{J} e^{\beta x(r_m)}}$$

And the likelihood function to be maximized is given by

$$LL(\beta) = \sum_{n=1}^{N} \ln\left(\prod_{k=1}^{J-1} \frac{e^{\beta x(r_k)}}{\sum_{m=k}^{J} e^{\beta x(r_m)}}\right)$$

$$= \sum_{n=1}^{N}\sum_{k=1}^{J-1} \beta x(r_k) - \sum_{n=1}^{N}\sum_{k=1}^{J-1} \ln\left(\sum_{m=k}^{J} e^{\beta x(r_m)}\right)$$

4.3. Mixed Logit Model

When there is the need of identification of taste of heterogeneity in choice estimation to avoid biased utility results, Mixed Logit Model is used. Train (1998) and Train (2003) emphasized the use of Mixed Logit which defines the functional form for its choice probabilities whose behavioral specification derived on choice probabilities takes the particular form. The distribution of each customer's tastes is derived, conditional on the customer's observed choices and the distribution of tastes in the population (Train & Revelt, 2000). To address the need of flexible Logit model for the random taste variation, unrestricted substituted patterns, correlation among unobserved factors in choice variation over the time and relaxation from IIA property, Mixed Logit fills the gap of dominating assumption

of homogeneity in the preference structure (Train, 2003). This model has been widely adopted in policy studies for the new product using stated preference method (Savage & Waldman, 2005; Manandhar, 2012; Lee et al., 2006; Train & Sonnier, 2005). The use of Mixed Logit model incorporates the random variation in coefficient of the attribute in utility function (Train & Sonnier, 2005) and can approximate any random utility model to any degree of accuracy through the appropriate specification of distribution of the coefficient of attributes unlike Probit model. It is not restricted to the normal distribution (Train, 2003). It provides the information on the distribution of estimated parameters as well as individual customer's conditional taste densities (Train & Revelt, 2000).

Let us assume that individual ($q = 1 \dots Q$) chooses an alternative amongst I presented alternatives in each of T choice scenario. The decision maker, q is placed in such a hypothetical situation in which he needs to select considering the optimally available set of alternatives in choice situation t and chooses the alternatives with the highest utility. The relative utility associated with each alternative i as evaluated by each individual q in a choice situation t is represented in a discrete choice model by a utility expression of the general form (Lee et al., 2006; McFadden & Train, 2000; Hensher, 2002).

$$U_{qit} = \beta_q x_{qit} + \varepsilon_{qit}$$

Where x_{qit} is the vector of explanatory variables that are observed by the researcher and includes the attributes of the alternatives, socio-economic

characteristic of the respondents and descriptors of the decision context and choice task itself in choice situation t (McFadden & Train, 2000; Hensher, 2002). As pointed by Train (2003) ε_{qit} is the stochastic part of the utility of an individual which cannot be observed by the observer and is assumed to be independent and identically distributed (iid) extreme value type I. However, the stochastic term can be decomposed into two parts as $\varepsilon_{qit} = \eta_{qit} + \sigma_{qit}$ on which η_{qit} covers the stochastic part and is independently, identically distributed over individuals and σ_{qit} covers the heteroskedastic over the consumer and correlated over the alternatives. For the simplicity of the analysis, as the stochastic term also covers the individual we can just drop the subscript t as

$$U_{qi} = \beta_q x_{qi} + \eta_{qi} + \sigma_{qi}$$

As the Mixed Logit model can approximate any choice model and assumes general distribution for η and an iid extreme value distribution for ε (McFadden & Train, 2000). Mixed Logit probabilities (Revelt & Train, 1998; Train, 2003) are the integrals of standard Logit probabilities over a density parameters and can be expressed as

$$P_{ni} = \int L_{ni}(\beta) f(\beta) d\beta$$

Where $L_{ni}(\beta)$ is the Logit probability evaluated at parameter β.

$$L_{ni}(\beta) = \frac{e^{\beta' x_{ni}}}{\sum_{j=1}^{J} e^{V_{nj}(\beta)}}$$

And $f(\beta)$ is the density function. $e^{V_{nj}(\beta)}$ is the observed portion of the utility which depends on the parameter β. As we have already assumed that the utility function is linear for simplicity, the probability takes the form of

$$P_{ni} = \int \left(\frac{e^{\beta' x_{ni}}}{\sum_{j=1}^{J} e^{V_{nj}(\beta)}} \right) (\beta) d\beta$$

Mixed Logit comes with general distributions (Train, 1998) and repeated choices (Revelt & Train, 1998). Since this model is derived from the utility model, we also follow the previous utility equation for our study.

4.4. Willingness to Pay

In the stated preference data on the choice based conjoint analysis, the attributes and their levels are presented in such a way to realize nearly a real scenario though the survey is conducted in the hypothetical situation. In the stated preference situation, consumers select their products in a hypothetical situation with different features and price ranges, but there might arise the problem that they may not know the all functional values of the product, rather they are aware of the price that they can afford or not. Willingness to pay (WTP) is an important welfare analysis in the market analysis and there are mainly two primary approaches to estimate the WTP for differentiated goods: hedonics function is used if the number of the product is large (Rosen, 1974), and discrete choice models if the number of the product is small (McFadden, 1973). WTP is the

measure of consumers' willingness to purchase a certain product but, in most of the cases, consumers do not know the certainty to buy and their intension to buy and are willing to pay certain item, which is the decision of consumer's probability to purchase (Schlereth, Eckert & Skiera, 2012). Thus it is the estimation of price sensitiveness to the attributes of consumers that exhibits the probability of choosing the product and sensitiveness to the change of product which affects their perceived values of utilities. There are various views regarding WTP. Schlereth, Eckert and Skiera (2012) argue that it is the price range which is associated with the probability to purchase if the price of the goods falls on the WTP interval. The probability to purchase on the lower limit of WTP interval is higher than the higher limit of the interval but it is also affected by the socio-demographic characteristics of consumers. Consumer heterogeneity will be the important distinguishing feature in identifying their purchasing decisions from the discrete good (Wong, 2010).

In the discrete choice analysis, the willingness to pay is expressed as the ratio of coefficient of attributes to the coefficient of the price attribute which is mathematically expressed as

$$WTP = \frac{\beta_{ia}}{\beta_{ip}},$$

Where, β_{ia} is the coefficient of any attribute on which the consumer selects the choice set i from a set and β_{ip} is the coefficient of the pricing attributes.

Chapter 5 Empirical Results and Discussion

5.1. Designing the Choice cards for the discrete choice experiments

Stated preference method in discrete choice experiments is one of the most frequently used methods for evaluating the market demand and relative importance of aspects of decision making process (Johnson, et al., 2013). Experimental design is the process of generating specific combinations of attributes and levels that respondents evaluate their relative utility over each other in a choice question (Johnson et al., 2013). Our target is to evaluate the utility of the entire e-learning package offered by the institution where the multiple factors affect the decision makers to decide whether or not to go for that specific package. In the context of developing countries, availability of such scenarios to choose from the number of institutions at accessible distance which offer those multi-attributed and comparable packages, but they may not be available in the reality but our target is to fulfill the demand of the respondent on a single institution to maximize the social welfare. Thus, we have identified the basic but key factors for e-learning packages and those attributes with some relevant levels available in the specific locality for instance, in Nepal, is included. In order to make the consistency for the academic research, this paper follows some of the attributes taken by the previous researchers. In the e-learning package, content is one of the most important attributes which was studied by Wang (2014) and focused on the

elementary school mathematics, where the contents are presented in interactive flash animation and pictures with little text. Kasuga, Zeng & Shishikura (2008) studied the adoption of the digital TV, in which content was presented as the availability of digital channel, and considered as the one of the important attributes for the penetration of digital TV along with the effect of network externality. Here, our level of attributes are featured with the offline and online based content, either developed by Internet based company, offline repository or offline software package. For the sake of analysis, this study considers OLE Nepal as the baseline level for the content attribute.

Since we are not only focused on the online and offline content, the technological advancement has boomed the Internet very fast along with the Internet rich application and educational materials are also available on the Internet even though providers (whoever produces the material, blogs, article) are not featured for the regular courses, can also be used as the learning materials. The digital content is not limited to the one's production and we believe that wide varieties of contents can be obtained from the Internet such as YouTube channels[20], non-commercial[21], commercial[22], open courseware[23] which could be used as supplementary learning material in the school environment.

[20] YouTube channels http://vidstatsx.com/youtube-top-100-most-subscribed-education-channels
[21] Khan Academy, TED Talk, etc.
[22] Skill Soft, Cisco, Allen Interactions, Lynda, Tata Interactive System, Designing Digitally, Cenage Learning, etc.
[23] MIT Open courseware, Standford Opencourseware etc.

The debate on the open source software versus proprietary one has been in climax and some governments have made policies regarding the adoption of the open source system and software for education. Few government agencies have already decided to adopt the open-source system in education, for example, the Pennsylvania government rolled out the Linux based system in the school environment[24]. Similarly, the Brazilian Government[25],[26], the UK Government[27], the Macedonian Government[28]and so on have independently decided to switch to open source to minimize the cost of the system[29] . In addition, multilateral agencies like European Union are encouraging to foster the use of Open-Source system in education sector[30],[31]. A case study shows that students' computing knowledge has been improved in the Linux environment[32]. The beauty of Linux is that it can run on the single board computers, popularly known as microcomputers, such as Raspberry PI, XO[33].They are affordable with good

[24] http://www.linux.com/news/featured-blogs/200-libby-clark/761499-pennsylvania-high-school-rolls-out-1700-linux-laptops-to-students accessed in April 26, 2014
[25] http://news.bbc.co.uk/2/hi/4602325.stm accessed on April 26, 2014
[26] http://www.userful.com/products/case-studies/brazil-case-study accessed on April 26, 2014
[27] http://www.techradar.com/news/software/operating-systems/linux-in-education-a-genuine-alternative-915319 accessed in April 26, 2014
[28] http://www.ubuntu.com/news/macedonia-school-computers accessed in April 26, 2014
[29] http://opensource.com/education/13/7/linux-westcliff-high-school accessed on April 26, 2014
[30] https://joinup.ec.europa.eu/community/osor/news/polish-high-school-linux-pcs-faster-and-cheaper accessed in April 26, 2014
[31] https://joinup.ec.europa.eu/community/osor/news/education-ministry-romania-endorses-ubuntu accessed in April 26, 2014
[32] https://joinup.ec.europa.eu/elibrary/case/british-school-switches-students-computers-linux-reducing-costs-and-improving-computin accessed in April 26, 2014
[33] http://iqjar.com/jar/an-overview-and-comparison-of-todays-single-board-micro-computers/ accessed in April 26, 2014

performance and suitable to use in school environment (Sadler & Eisenbach, 1984; Hawkins et al., 1982).

As the government is concerned with cost of deployment, efficiency and effective impact in education, shifting to open source system would be the winning solution. Rajanen (2011) analyzed the cost benefit analysis of the open source and commercial software development and found considerable risk of failure when inherent cost of usability becomes apparent, concrete and measureable. However, the opponents of the open-source projects argue about flexibility, interoperability, and intuitive interface for compilation and dissemination (Beheshti, Jambhekar & Deloney, 2010) with the proprietary system which is well developed from the viewpoint of long term impact despite higher initial cost. Thus, the study considers both operating environments and includes one more attribute - mobile (Tablet/smart phone) platform, one of the rapidly used systems, as an access to e-learning content (Hwang & Chang, 2011).

One of the pertinent factors for the decision makers and directly associated with the welfare variation associated with the selection of the choice option is price which is considered by various policy and market researches (Site & Salucci, 2013).

The attributes need to have effectiveness that can describe the suitable values, outcomes and interventions along with the technological aspect (Johnson et al., 2013). Certain classes of experimental designs, including orthogonal designs,

have desirable property of independent variation by requiring that correlations among attributes all be zero. Note that the number of feasible choice questions is lower than the full factorial of all possible combinations of attribute levels. The full factorial includes pairing attribute levels with themselves (Johnson et al., 2013). Ideally the experiment aims to find the how much the first offered package is important than the other package offered in a row. The design consists of carefully selected attributes with different levels. It is important that making different levels for the same attributes for the respondents should have less correlation. Thus, the special attention has been given to the experiment design so that the respondents can clearly identify their utility through choice profiles presented to them. Summing up, the conjoint design has been performed using the orthogonal design offered by the SPSS statistical package[34] and some irrelevant choice profiles were removed to make more realistic case for the conjoint analysis. The identified attributes and their levels are shown in table 1.

In the final survey, 6 choice sets, each of which, contains 5 profiles and the respondents are requested to rank their perceived preferences as 1 for the best option, following 5 for the worst one.

Attributes	Levels	Definition
	MiDas eClass	

[34] http://pic.dhe.ibm.com/infocenter/spssstat/v20r0m0/index.jsp?topic=%2Fcom.ibm.spss.statistics.help%2Fidh_orth.htm

Content Provider	CDC (Govt.)	Midas eClass=1, CDC (Govt)=0 if Midas is used; OLE Nepal=base
	OLE Nepal	
Facilitator	Nepal Wireless	Nepal Wireless=1, NGO/INGO=0, Government =0 if Nepal wireless is used; Self/Community=Base
	Government	
	NGO/INGO	
	Self/Community	
Access	1	Internet=1; No Internet=0
	0	
Operating System	Linux Environment	Linux environment=1, Mobile OS=0 if Linux OS env. Is used; Windows environment= base
	Mobile OS Environment	
	Windows Environment	
Price	200/400/600/900	Monthly service
Maintenance Facility	Available	Available=1, available upon request=0 if maintenance service is available in premises; not available =base
	Available upon request	
	Not available	

Table 1Summary of attributes and their definition

The pilot survey was conducted in two schools (public and private school) in Dolakha district, central part of Nepal. Some of the variables and questions were irrelevant and confusing, thus the final survey questionnaire was prepared

to overcome the problems seen in the pilot survey. The final survey was conducted in other representative regions of the country.

5.2. Descriptive Statistics

This study is focused on identifying the perception of which system students want to adopt; however, as we discussed earlier, the sample of the study shows the existing digital divide in the country as shown in Table 3

Respondents	Age Ranging from 14 years to 31 years their education level ranges from literate to undergraduate and the highest degree earned in family literate to PhD
Survey period	Pilot survey was conducted in 2014-01-02 to 08 and final survey was conducted in 02-10 to 03-20 (on 03-26 final data was received)
Sample size	298 Valid Samples

Table 2Summary of respondents

Since the conjoint survey is one of the rarely conducted surveys in the field of education in Nepal, respondents were thought to be less familiar with such a survey design. Therefore, special orientations were given to the respondents prior to their filling the survey responses. In the pilot survey, 42 sample responses were valid out of 51 received responses which helped to rectify the problems for the final survey. While conducting the survey, special attention was given to

minimize invalid responses. In total, 298 valid data were received out of 378 responses. The invalid responses were due to not duly filled out responses (either filled with most preferred in all choice sets or repeated choice numbers for the same set or incomplete answers), and/or if some descriptive questions were left or some cross checking questionnaires were not filled out correctly[35]. The full result of descriptive statistics is presented in appendix, in which 86% of the respondents have been found with the experience of computer usage. The question on computer experience is replicated differently and considered as one of the points to check the data validity; while transferring questionnaire, if somebody filled as he did not use computer but had computer proficiency was considered as the invalid data and the whole response was rejected. Here, the most noticeable point is the equal participation of male and female respondents despite making the survey random. This will contribute to suggesting gender-friendly policy implication for the access of education.

According to the NTA MIS Report 2014-02[36] statistics, the country has 87.2% telephony penetration while the Internet access rate is only about 30.99% (77.92% of Internet subscribers are using Internet from mobile devices) but if we account the Internet and telephony access according to the age group, the penetration rate in youth age group would be higher. We can derive the relation

[35] In part II, experience of computer was asked to the respondent and later in part III another question was asked to specify computer proficiency: the data was made invalid if the respondent answered "No" to computer experience and later if he answered "he has some proficiency"
[36] MIS Report of NTA http://nta.gov.np/en/2012-06-01-11-33-01/mis-archives/mis-reports/nta-mis-84/download

of relative access to school, telephony, Internet and computer literacy from the data, but the most noticeable point is that the people with Internet experience may not have computer experience or vice versa. According to the Central Bureau of Statistics Nepal (CBS Nepal)[37], only 7.28% of families in rural areas and 23.66% families in urban area have computers in 2011.

As the study is focused on the willingness to adopt e-learning packages according to the needs, we have only included the variables and questionnaire that can prove respondents awareness to the adoption of the Internet and its integration to the learning environment. In the socio-demographic information part, it was found that 39% of people do not want to pay more than NPR 400[38] per month while 35% cannot pay for this system in future. This signifies that the government needs to take it seriously for the adoption of the system in public and private schools so as to make equal access. The point to note here is that private schools can offer computer education but their monthly tuition fee, computer education, and fee for other facilities are reportedly higher than the average Nepali's purchasing parity for education[39]. This leads to the increment in socio-economic gap between the people and, ultimately, widens the digital gap based on the affordability of monthly tuition fee.

	Type of content preferred by respondent

[37] http://cbs.gov.np/
[38] Exchange Rate of 1 USD =101.099 NPR as of February 2014
[39] http://www.rukminifoundation.org/2012/01/06/not-so-free-education/ accessed on 15 June 2014

		Native language and interactive	Language doesn't matter but interactive	English and interactive	Total
Computer Skill (Self Disclosed)	No idea	35.00	2.78	6.59	13.76%
	Basic	16.25	30.56	21.98	21.48%
	Medium	36.25	58.33	60.99	54.03%
	Advance	12.50	8.33	10.44	10.74%
	Total	26.85%	12.08%	61.07%	
Family Income	< 20000	46.25	25.00	28.57	29.87%
	20000-30000	16.25	16.67	23.08	20.47%
	30000-40000	15.00	22.22	19.78	18.79%
	40000-50000	6.25	8.33	6.59	6.71%
	50000-60000	7.50	16.67	10.44	10.40%
	60000<	8.75	11.11	11.54	10.74%
	Total	26.85%	12.42%	61.07%	
English Proficiency (Self Disclosed)	None	2.50	11.11	0	2.01%
	Little	26.25	16.67	11.54	16.11%
	Normal	36.25	44.44	41.76	40.60%
	Fluent	35.00	27.78	46.70	41.28%
	Total	26.85%	12.08%	61.07%	
Content Experience	Yes	11.25	33.33	26.92	23.49%
	No	88.75	66.67	73.08	76.51%
	Total	26.85%	12.08%	61.07%	
Gender	Male	50.00	50.00	54.40	52.68%
	Female	50.00	50.00	45.60	47.32%
	Total	26.85%	12.08%	61.07%	

Table 3Types of contents preferred by respondents according to demography

*self-disclosed method is employed in the survey when the proper measure of certain achievement is not possible (Liu et al., 1997)

Among 298 valid respondents, 7% respondents have education higher than the undergraduate level and 90% of them have finished up to grade 12 excluding literates (this study only focuses the adoption of e-learning up to grade 12). 53% of respondents have answered that they use the Internet in their schools, it doesn't necessarily mean that they have the Internet in their schools, there is the possibility of using GPRS/EDGE/3G services for surfing the Internet during school hours.

In the cross-tabulation analysis of the descriptive statistics, 54% of respondents have been found with medium computer skills and they do prefer interactive digital content. Digital content producers in the native language might not be available for what they need for a particular subject but it is possible that similar materials can be available in English over the Internet; therefore, those who have already had experience of computer seem to be indifferent with the language of delivery. The flavor of interactive learning could help learners to learn effectively, irrespective of the medium of instruction (either English or Nepali) on particular topics. And it is obvious that those who are familiar with the English language have higher tendency to choose English as the medium of instruction. In this survey, the ratio of female participation nearly corresponds to the World Bank's statistics, which states that the ratio of young literate females to males aged 15-24 is 86.81%[40].

[40] http://data.worldbank.org/country/nepal

	Affordability of respondents for e-learning system in schools						
		0	Up to 200	200 to 400	400 to 600	Above 600	Total
Family Income	<20000	33.96	65.71	29.76	18.64	21.43	32.89%
	20000-30000	13.21	11.43	32.14	20.34	28.57	20.47%
	30000-40000	21.70	11.43	14.29	25.42	14.29	18.79%
	40000-50000	6.60	0	5.95	11.86	7.14	6.71%
	50000-60000	12.26	8.57	7.14	10.17	21.43	10.40%
	60000<	12.26	2.86	10.71	13.56	7.14	10.74%
		35.57%	11.74 %	28.19 %	19.80 %	4.70%	
English Capacity	None	1.89	0	2.38	3.39	0	2.01%
	Little	23.58	11.43	11.90	11.86	14.29	16.11%
	Normal	35.85	65.71	45.24	28.81	35.71	40.60%
	Fluent	38.68	22.86	40.48	55.93	50.00	41.28%
	Total	35.57%	11.74 %	28.19 %	19.80 %	4.70%	
	No idea	22.64	11.43	11.90	5.08	0	13.76%

Computer Skill	Basic Medium Advanc e	16.04 50.94 10.38	20.00 62.86 5.71	26.19 48.81 13.10	23.73 59.32 11.86	28.57 64.29 7.14	21.48% 54.03% 10.74%
	Total	35.57%	11.74 %	28.19 %	19.80 %	4.70%	
Family Education	Literate Primary High School Undergr aduate Graduat e Doctora l	6.60 17.92 35.85 12.26 20.75 6.60	0.00 8.57 60.00 17.14 14.29 0	4.76 7.14 32.14 25.00 30.95 0	3.39 10.17 27.12 32.20 22.03 5.08	0 28.57 28.57 35.71 7.14 0	4.36% 12.75% 35.57% 21.48% 22.48% 3.36%
	Total	35.57%	11.74 %	28.19 %	19.80 %	4.70%	
Gender	Male Female	47.17 52.83	54.29 45.71	59.52 40.48	54.24 45.76	42.86 57.14	52.68% 47.32%
	Total	35.57%	11.74 %	28.19 %	19.80 %	4.70%	

Table 4Cross tabulation of willing to pay for e-learning in future system in schools by demography

The cross tabulation of descriptive statistics shows that very few (4.7%) respondents can pay more than NPR 600 separately for the e-learning system. This signifies that the business model could be accommodated with this service fee up to NPR 600 which is approximately equal to $6 per month. However, majority of respondents who do not want to pay for e-learning system in future would not find significant outcome from the experience. In this situation the government should intervene for the subsidy model by providing incentive to the stakeholders. Breaking their strength and response to service fee for their hypothetical situation of the service package, majority of the people who have good command over English, computer skill and education degree would think that it is worthy to pay for computer education and e-learning package. However, higher income family responded to pay less in future for the package of their preference.

5.3. Empirical Results

In the previous chapter, the general methodological framework for this study has been presented. This section follows the model specified above according to the random utility model.

$$U_{nj} = \beta_{Midas} Midas + \beta_{NW} NepalWireless + \beta_{Gvt} Government +$$
$$\beta_{Internet} Internet + \beta_{Mobile} MobileOS + \beta_{Linux} LinuxOS +$$
$$\beta_{Available} Available + \beta_{Price} Price + \varepsilon_{nj}$$

In the above utility equation, the digital content provider attribute $Midas$ is a dummy variable; $NepalWireless$ and $Government$ are the attributes for the infrastructure provider and are responsible to provide computer equipment, Internet connection and accessories which are needed to access e-learning contents. The availability of connectivity attribute $Internet$ is also a dummy variable which means the availability of the Internet packaged in computer assisted learning system. In recent developments with regard to the adoption of e-learning and integration of technology in schools, the platform has become the major issue in terms of cost and maintenance; thus, dummy variable $Mobile\ OS$ and $Linux\ OS$ are featured with the platform from which adoptees access the system and $Windows\ OS$ is the baseline because of its widespread share by default. The variable, $Support\ availability$, denotes the technical support for the overall system in order to use the system without any disturbance.

The above equation has only taken account of the attributes that are identified as the major factors to adopt e-learning system. Along with these seen factors, socio-demographic information of adoptees are also responsible for the perceived utility during the decision making process. Thus, it is necessary to analyze the effect of socio-demography on the decision making process. The

following model presents the random utility model interacting with the socio-demographic variables of an individual.

$$U_{nj} = (\beta_{Midas} + \beta_{MEskill} English_{skill} + \beta_{MCskill} Computer_{Skill}) Midas + (\beta_{CDCGov} + \beta_{CDCGovedu} Education) CDCGovernment + \beta_{NW} NepalWireless + \beta_{Gvt} Government + (\beta_{NGO} + \beta_{NGO} Education) NGO + (\beta_{Internet} + \beta_{InternetintexpSch} IntExpinSchool) Internet + (\beta_{Mobile} + \beta_{Mobilecompexp} CompExp + \beta_{MobileEskill}) MobileOS + \beta_{Linux} LinuxOS + (\beta_{Available} + \beta_{Availablecurrentpaying} CurrentPaying + \beta_{AvailableFincome} FamIncome) Available + (\beta_{Availablereq} + \beta_{AvailablereqCSkill} Comper_{skill} + \beta_{AvailablereqESkill}) AvailableReq + (\beta_{Price} + \beta_{PriceintexpSch} IntExpinSchool) Price + \varepsilon_{nj}$$

The above equation is the combined effect of socio-demographic interaction on utility. Where $English_{skill}$, $Computer_{Skill}$, $Education$, $IntExpinSchool$, $CurrentPaying$, $FamIncome$ represent $English\ skill$, $computer\ skill$, $internet\ experience\ in\ school$ by respondents who are $currently\ paying$ for computer education either offered by the school or from a private institution, and $family\ income$ of respondent respectively.

5.3.1. Estimation using Rank Order Logit Model

The survey data consist of 298 valid rank ordered choice responses in which the rank consists of 1 to 5, representing the most preferred to the least preferred

choice profile from a choice set. Six choice sets were provided on a single survey questionnaire resulting 1788 observations for the analysis. Since, the data contains rank ordered stated preference, we used rank order Logit model for empirical investigation for which NLOGIT/LIMDEP software is used to analyze the rank order estimation.

Variable	Coefficient(Standard Error)	T-Value	Willingness to pay
Midas eClass	0.0782(0.0413)*	1.896	65.55247
CDC(Gvt)	-0.0564(0.0429)	-1.316	insignificant
Nepal Wireless	0.1858(0.0484)***	3.842	155.6425
NGO/INGO	0.0192(0.043)	0.448	insignificant
Government	-0.1182(0.0564)*	-2.095	-99.0679
Internet	0.4957(0.0346)***	14.334	415.307
Mobile System	0.0748(0.0406)*	1.843	62.70531
Linux System	-0.1547(0.043)***	-3.599	-129.582
Available	0.183(0.0399)***	4.586	153.2972
Available on Request	-0.0294(0.0483)	-0.61	insignificant
Price	-0.0012(0.0001)***	-18.49	

Table 5Estimation result using Rank Order Model

Note: * 10% level of Significance, ** 5% level of significance, ***1% level of Significance, Log likelihood function -8201.995

The table 5 shows the estimation result using rank-ordered Logit model, in which current scenario and their expectation for the further services are clearly seen that government involvement in the adoption of technology is not satisfactory in terms of content delivery and support to infrastructure. As consumers' behavior is driven by their past experiences, many periodic development plan had not been accomplished successfully as planned and significant effect is accounted to negatively paid services.

In the *content* attribute, respondents prefer $Midas\ e-class$ which has the flexibility to use without Internet, and are indifferent toward the content developed by the incumbent (CDC) with the base variable $OLE\ Nepal$. The CDC is responsible to distribute curriculum based reading materials to schools across the country. However, regions which are geographically diverse and lack the road access have suffered from getting the delivery of reading materials in time. Because of this, the third party involvement in the sector of content development and distribution is required to address the existing gap.

Concerning the infrastructure which is necessary for the adoption of e-learning system, respondents are seen preferring$Nepal\ Wireless$, a community based company; paying negatively to the $Government$ support and indifferent to the $NGO/INGO$ support. This signifies that the stakeholders should think about transferring ownership to the community for these kinds of projects. The need of

regular support to the system could be guaranteed through community ownership in infrastructure and services. According to the estimation result, the community based model in education sector would be the next model as other well-practiced community model in such fields as forestry (SDC Cooperation, 2011), healthcare (Sepehri & Pettigrew, 1996) and hydropower[41], which have reflected its effectiveness and show the need in education as well.

The Internet is becoming the part of daily life. Though the penetration of Internet in Nepal is is rather low, awareness about the Internet among the people is high because of the significant increase of other communication services and people's level of education. In the estimation result, the Internet service in school premises is seen preferred for the purpose of e-learning and other activities.

The operating system in computing system is one of the important factors. It is the fact that the computer with the Linux operating system is almost negligible compared to the Windows operating system. Though the Linux operating system has its own benefits over Windows, most of the respondents have preferred Linux operating system to Windows. However, mobile platform is seen highly preferred in terms of the operating system platform.

On the other hand, timely or in premises service availability, maintenance facility and training are highly preferred to on request service.

[41] http://www.worldbank.org/en/news/feature/2014/02/05/renewable-energy-powers-rural-nepal-into-the-future accessed on May 20, 2014

Concerning the monthly fee for e-learning package and computer education, respondents prefer less, which indicates that they prefer reliable Internet service, mobile platform, Midas–eClass, community based infrastructure facilitator, and in premise support.

In the result, willingness-to-pay (WTP) for each attribute against the monthly fee gives the clear information about respondents' preference on the mentioned levels of corresponding attributes. From the result, it is inferred that respondents are ready to pay higher monthly fee on desktop based digital application over the Internet based one; their willingness to pay for Nepal Wireless is high amongst other level of attributes. Internet, Mobile, in-premise support service availability are also highest paid attributes in corresponding attributes level.

In conclusion, WTP gives the clear insight for perceived utility from attributes and its level in a choice scenario. This tries to quantify the utility in terms of price and it is possible to make the combination of service package which has positive and high willingness to pay for the service. From the above tabulated result, consumers do not find any incentive (consumer welfare) if e-learning package consisted of Midas e-Class as the digital content, Nepal Wireless as infrastructure facilitator, reliable Internet through mobile platform and in-premise support service offered more than NPR 852.48.

5.3.2. Estimation using Rank Order Logit Model with interaction of socio-demographic variables

The estimation with rank order Logit with the interaction of socio-demographic variables has more intuition. The table 6 shows the estimation results from the interaction with socio-demographic variables. And the estimation result after the interaction with socio-demographic variables has slightly changed. However, the overall result is more or less same as in table 5. In the estimation without the interaction of socio-demographic variables, Midas eClass is significant but later becomes insignificant; CDC is seen significant with positive sign which is not so in the estimation result without interaction; mobile operating platform becomes indifferent over the Windows platform; the case with Linux remains the same.

Variable	Coefficient (Standard Error)	T-Value
Midas eClass	0.06026(0.1396)	0.432
CDC(Gvt)	0.2253(0.11626)*	1.938
Nepal Wireless	0.1785(0.04855)***	3.678
NGO/INGO	-0.22692(0.1251)*	-1.814
Government	-0.12130(0.0566)*	-2.142
Internet	0.8817(0.1839)***	4.793
Mobile System	0.00684(0.20568)	0.033

Linux System	-0.1587(0.04311)***	-3.682
Available	0.51269(0.13582)***	3.775
Available on Request	0.04951(0.23762)	0.208
Price	-0.0007(0.00018)***	-4.024
Computer Experience		
Midas eClass	-0.09537(0.03868)**	-2.466
Mobile Operating System	-0.16882 (0.09766)*	-1.729
Available on Request	-0.37631(0.12699)**	-2.963
Internet Experience in School		
Internet	0.23607(0.06382)***	3.699
Price	-0.00032(0.00012)**	-2.693
Education of Respondent		
CDC (government)	-0.11565(0.04468)**	-2.588
NGO/INGO	0.10115(0.04888)**	2.069
English Capacity		
Midas eClass	0.08512(0.04151)**	2.05
Mobile Operating System	0.08183(0.04270)*	1.916
Available on Request	0.10920(0.04638)**	2.354

Table 6Estimation result: Rank order Logit interaction with the socio-demographic variable

Note: * 10% level of Significance, ** 5% level of significance, ***1% level of

Significance, Log likelihood function -8145.4

From the estimation result presented in table 6, those who have experience with computer are seen willing to pay negatively if they are compelled to use the system offered in the mobile platform, which means they can differentiate functionality, ease of use, efficiency of desktop and mobile platform. On the other hand, those who use the Internet service in the school are positive for the Internet service but they prefer less monthly fee. Those who are getting computer education from the school are willing to pay monthly fee if the in-house support facility is available which signifies that they have the previous usage experience of what would happen if not in-house support facility were not provided. People having good English skill prefer mobile platform, Midas eClass and support on request.

5.3.3. Estimation Using Mixed Logit Model

Mixed Logit model often called as the Random Parameter Logit model is considered as the most promising in discrete choice model (Hensher, 2002). Although other choice models such as multinomial probit, generalized extreme value models exist, they have practical barriers to the empirical usefulness of the estimated parameter (Hensher, 2002). The estimation of Mixed Logit is made using LIMDEP/NLOGIT software, and the estimation result is shown in table 7.

Variable	Mean(b) of B	Variance (W) of B

	Coefficient (Standard Error)	T-Value	Variance(Standard Error)	T-Value
Midas eClass	0.0759(0.0151)***	5.029	0.0672(0.0101)***	6.626
CDC(Gvt)	-0.0783(0.0189)***	-4.135	0.0797(0.0123)***	6.495
Nepal Wireless	0.1832(0.0187)***	9.775	0.2463(0.0116)***	21.158
NGO/ INGO	0.0159(0.0166)	0.956	0.2988(0.0128)***	23.344
Governme nt	-0.1432(0.0251)***	-5.697	0.0572(0.0178)***	3.22
Internet	0.5749(0.0152)***	37.862	0.7087(0.0118)***	59.979
Mobile System	0.1143(0.0164)***	6.976	0.427(0.0108)***	39.517
Linux System	-0.1557(0.0159)***	-9.824	0.0299(0.0122)**	2.442
Available	0.1879(0.0157)***	11.996	0.0295(0.0114)**	2.583
Available on Request	-0.0138(0.0211)	-0.653	0.0232(0.0129)*	1.808
Price	-0.0013(0.00003)***	-51.969		

Table 7Estimation result using Mixed Logit

Note: * 10% level of Significance, ** 5% level of significance, ***1% level of Significance, Log likelihood function -8170.107

In the estimation, all the attributes are assumed as they are distributed normally. The estimation result using Mixed Logit and Rank-ordered Logit has no difference in terms of their sign of estimation. However, the level of significance of some attributes has changed. The attribute "CDC(Gvt)" is not significant in multinomial Logit estimation, but it is significant with the Mixed Logit estimation. This implies that multinomial Logit is suffered from the Independence from Irrelevant Alternatives (IIA) property but relaxation of attributes avoids resulted significance of attributes in Mixed Logit.

The striking result using Mixed Logit estimation is that due to the presence of heterogeneity in preference, the digital content is less valued than the infrastructure which is the key for the policy implication. This suggests that infrastructure is more important than having digital content due to the fact that having computer education in school is more important than imparting multimedia driven knowledge. Because the multimedia oriented teaching environment is effective only after having sound knowledge to operate computer and its accessories. In addition, Internet facility in schools is highly valued by the respondents, which infers that having computer infrastructure and Internet facility they can find suitable course idea, and knowledge through the Internet. Similarly, the respondents have also valued pricing for e-learning system, which is one of

the important factors to drive the affordability of education. Thus, the presence of heterogeneity in the preference of respondents and their most valued attributes should be addressed by the stake holders to make high adoption rate of e-learning system.

Variable	Estimation from Mixed Logit		Estimation from Multinomial Logit	
	Coefficient (Standard Error)	T-Value	Coefficient (Standard Error)	T-Value
Midas eClass	0.0759(0.0151)***	5.029	0.0782(0.0413)*	1.896
CDC(Gvt)	-0.0783(0.0189)***	-4.135	-0.0564(0.0429)	-1.316
Nepal Wireless	0.1832(0.0187)***	9.775	0.1858(0.0484)***	3.842
NGO/INGO	0.0159(0.0166)	0.956	0.0192(0.043)	0.448
Government	-0.1432(0.0251)***	-5.697	-0.1182(0.0564)*	-2.095
Internet	0.5749(0.0152)***	37.862	0.4957(0.0346)***	14.334
Mobile System	0.1143(0.0164)***	6.976	0.0748(0.0406)*	1.843
Linux System	-0.1557(0.0159)***	-9.824	-0.1547(0.043)***	-3.599
Available	0.1879(0.0157)***	11.996	0.183(0.0399)***	4.586
Available on Request	-0.0138(0.0211)	-0.653	-0.0294(0.0483)	-0.61

Price	-0.0013(0.00003)***	-51.969	-0.0012(0.0001)***	-18.49

Table 8Comparison of estimation result

Note: * 10% level of Significance, ** 5% level of significance, ***1% level of Significance

The level of significance of attributes in beta value and its' corresponding variance are different, which implies the presence of heterogeneity in taste; similarly, some attributes which are not significant in beta value are significant in variance, which means there is significant heterogeneity in the respondents' preference. The variance in attributes such as Nepal Wireless, Internet, and Mobile operating platform are relatively large compared to their mean value. All attributes and levels which are significant have variance over the respondents. The presence of heterogeneity among respondents shows that people have diverse views on the provided services It seems a remarkable number of the respondents do not know practically how e-learning works and how it is important. Moreover, the presence of heterogeneity can be interpreted as the presence of the digital divide/knowledge divide across the country.

From both estimation results, we have found the key attributes and respondents' behavior in preference structure. Based on the comparison of those two estimation results, the preference of Linux system is negative with respect to

Windows system. This could be because of the surveyed sample, which consists of mostly high school children, who might not have prior knowledge on cross platform comparison such as Linux system and Windows system. Their ignorance to open source system, its cost effectiveness, and computing efficiency might have led them to take Linux as a non-preferable choice.

Chapter 6 Key Findings and Policy Implications

From the result of the analysis, important implications can be drawn: as community driven infrastructure provider is the most preferred attribute presented in the choice scenario, community-based e-learning system would be imperative to establish in Nepal. The Nepalese IT Policy Directive 2000[42] has made such provisions as computer education in the secondary school level, establishment of tele-centers across the country, only 1% duty to levy against the import of computer and its related parts. However, they have not been realized effectively and sufficiently. What the IT Policy lacks is extensive and varied perspectives to attract the private sector and community based projects, which means the policy should incorporate the essence of leveraging community-based efforts for nurturing IT infrastructure and developing robust knowledge society by providing access of technology to remote areas of Nepal. The policy could elaborate the need to a wider extent, but the scope has been limited in establishing a few hundreds of tele-centers across the country. One of the reasons for which could be the lack of preparedness and strategic plan on part of the use of the system by the community for whom it is targeted. Regardless of considering the proper

[42] Information Technology Policy 2000, http://www.nta.gov.np/en/component/joomdoc/Policies/IT%20Policy%202057%202000.pdf/download accessed on May 20, 2014

manpower to handle IT system in rural areas, the community driven projects have been found aware of the issue of ownership by the users, while government projects turned deaf ear to such a critical success factor, resulting to the failure of most of the tele-centers in a short period of time.

Community projects may not be the best model for sustainable ICT development throughout the country since it is limited to a specific region and has only origin specific communal responsibility. Now it is the government that has to take initiatives to interlink all community projects and facilitate building such projects in areas where such initiatives have not taken place so far. Culminating the experiences gained from the community projects and the lessons learned from the failure model of tele-center projects, the government should establish a separate agency to look after the integration of technology in the education sector, resulting in helping strengthen the system and bearing more responsibilities over the projects across the country.

In most of the district headquarters, private schools have offered computer education with hardly affordable monthly fees to general students. Some community projects such as Nepal Wireless are successful model in ICT sector which has not only provided the computer and Internet infrastructure to schools but also successfully implemented the e-commerce initiatives, virtual banking and so on in the rural area to attract people to use and learn computer education. Thus, there is the need of such infrastructure providers that can cope with the

community requirement and motivate them to involve in value added service and Internet link urban areas and rural areas according to their needs and interest.

Computer literacy in Nepal is at an infant stage. The Census report 2012 estimates only 7.8% of households have a personal computer. In another report by the World Bank 2009, the Internet affordability is only $8 per month[43], in the NTA MIS report 2014, Internet penetration rate is 33%; which is quite unsatisfying progress of the Internet demand as the increase in the increase of mobile penetration but the government should make special focus on strengthening the use of Internet applications and their adoption in the education sector. In the estimation results, mobile operating system is the most preferred one over other operating systems. It is obvious that flexibility to use mobile devices in terms of size, features, and mobility are of course better for the e-learning system as identified by Hwang & Chang (2011). Windows operating system is taken as the base operating system in analysis and is found better preferred than Linux operating system. However, mobile operating system has its own limitations with storage size, computing efficiency and application than other desktop systems. In case of Linux operating system, the support is hardly available due to network externalities. However, like mobile platform, Linux operating platform can be operated in a low power availability scenario and also can be used in micro-computers which minimizes the ownership divide in digital divide category. As compared to CAPEX and OPEX, Linux operating platform

[43] http://wdi.worldbank.org/table/5.12#

is more feasible than other personal computers if micro-computers are used for accessing the digital content. Even though the respondents prefer mobile operating system, because of the operating efficiency, desktop penetration is more important in school environment, which make students to learn in an efficient way, than mobile operating platform.

In the emerging as well as developed economies, the use of the open source system has been highly encouraged and their governments and development agencies like European Union, World Bank and so on are encouraging the use of open source system in education. In case of the developing economies like Nepal, Open source system such as Linux system is unlikely to be suitable in the short run because of the lack of the preparedness of the concerned technical manpower and support. Though there are some organizations which work for the open source projects and are promoting the use of open source system like FOSS Nepal[44] and OLE Nepal[45] are not effective mainly due to network externalities of the operating system caused by the de-facto use of proprietary system and the support available for open source system to the consumer. But comparing to the proprietary system, open source system has many advantages in terms of the cost of the hardware, computing efficiency relative to the one time and running cost, and also the cognitive knowledge gained by the users. However, the estimation reveals that respondents have higher willingness-to-pay for mobile operating

[44] FoSS Nepal is the non-profit organization who advocates to use of opensource system like Linux

[45] OLE Nepal is non-profit organization which develops learning application for education

system and lower for Linux operating system with respect to Windows operating system. Most of the applications are being developed to be compatible with the mobile platform which includes smartphones based on some proprietary system and open source. However, our study does not focus on the mobile operating system; rather focuses on mobile platform and desktop applications. In the desktop case, if open source is adopted its hardware could be replaced with microcomputers which is considered as one of the cheapest solutions for the school environment in terms of one time installation and running cost (since it uses very low power roughly less than 10watts in extreme case other than the monitor which is same for either case). Thus, the government should take advantage of the open source system by developing open source friendly technical manpower and infrastructure to deploy large scale computers to schools.

Coming back to the preference of the Internet in school, respondents are ready to pay high amount for the computer education offered comparing to other attributes we have analyzed in this study. With the rapid spread of Internet technologies and the social media, it is quite noteworthy that the awareness of the Internet has reached the school children and parents. The interesting figure from the statistics of 2011 national census[46] is that 64.63% of population owns mobile phone; however only 61.83% of households have toilet in their homes which clearly identifies that the Nepalese are more aware to the use of technology rather spending on the other basic but necessary infrastructure. The use of the Internet

[46] CBS 2011 highlight http://cbs.gov.np/wp-content/uploads/2012/11/Major-Finding.pdf

and integrated it to the school environment as the regular source of teaching and learning can change the perception of being heavily dependent on the hard copy textbook and also can identify learners and teachers to learn and teach with the booming idea that is related to the curriculum they use for the regular course. As the world is being polarized with the use of technology and digital gap, the positive aspect of perception to the Internet could be utilized to diffuse educational content or use as to train the teachers and students remotely in a very short time. Thus, the government and other related stakeholders should take advantage over it so that the new service or business innovation could be started to boost or create the knowledge society and ultimately to uplift the national economy.

The digital content is one of the important attributes of this study in which three different scenarios were taken as mentioned in the previous chapter. Since the Internet penetration is very low together with the insufficient bandwidth, less reliability, latency of connection of Internet being used in rural areas, the prevailing Internet infrastructure is just sufficient for text-browsing and some other basic features but not for the streaming facility. From the estimation result, it is revealed that the respondents pay positively NPR 65 over the online based digital content but are indifferent with the state-owned digital curriculum development. As revealed by the descriptive statistics, 61% of the respondents have chosen English and interactive reading materials for the upcoming material if offered. Here, it can be inferred that the third party participation in digital

content development could be better in terms of content delivery effectively. There have been many cases of government inefficiency in delivering the curriculum based hard copy printed book even the agency is obliged to do. However, the private schools that are not using the government recommended textbooks up to grade 8 are delivered on time regardless of the geographical difficulties. Thus, it is recommended that the open participation of content delivery to education sector could bring the innovation and participation of wide range of the stakeholders through the private sector could make the digital content resourceful in terms of the wide heterogeneity scenario. Therefore, the government should be open and encourage private sector to develop the digital contents based on the curriculum considering the cultural and language diversity.

In conclusion, computer literacy, use of technology in the education and public service sector, and integration of Internet are not sufficient to catch up with the prospected development strategy. In order to achieve the goal of the development plan and transform Nepal from the least-developing economy to the emerging economy, government needs to focus by making strategic plan to adopt the computer integrated, e-learning assisted classroom infrastructure so that the students' skills and knowledge could be saleable in the global job market upon their graduation. Currently the country's GDP is heavily based on remittance (25% of GDP is contributed by remittance)[47] whose share comes largely from unskilled labor. The situation could be changed with the proper and efficient use/integration

[47] http://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS

of technology in classroom to make children adoptive for technology or limiting them with the hard copy material. It also creates and opens the opportunity of innovative platform for the next generation to make the service oriented economy rather than the remittance supported economy.

This study is only focused on the technology aspects of the preference structure for the adoption of e-learning from consumers' perspective. Since the surveyed sample comprises a large number of students, we can rather say that this study focuses from the students' perspective. However, in the adoption of e-learning, the major role for decision to adopt the system goes with teachers, and parents. Still it is also true that students' perspective is also important to consider for the adoption of e-learning to provide better entertaining environment rather than forcing them to study which they might not prefer. Meanwhile, the surveyed samples were taken from the representative regions which are not divided into the urban-rural setting. The study does not account for infrastructure and available resources in those areas to show the disparity between urban and rural areas although there exists a huge digital divide. It is expected that such "divides" can be portrayed from the presence of heterogeneity in the estimation result.

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Appendix

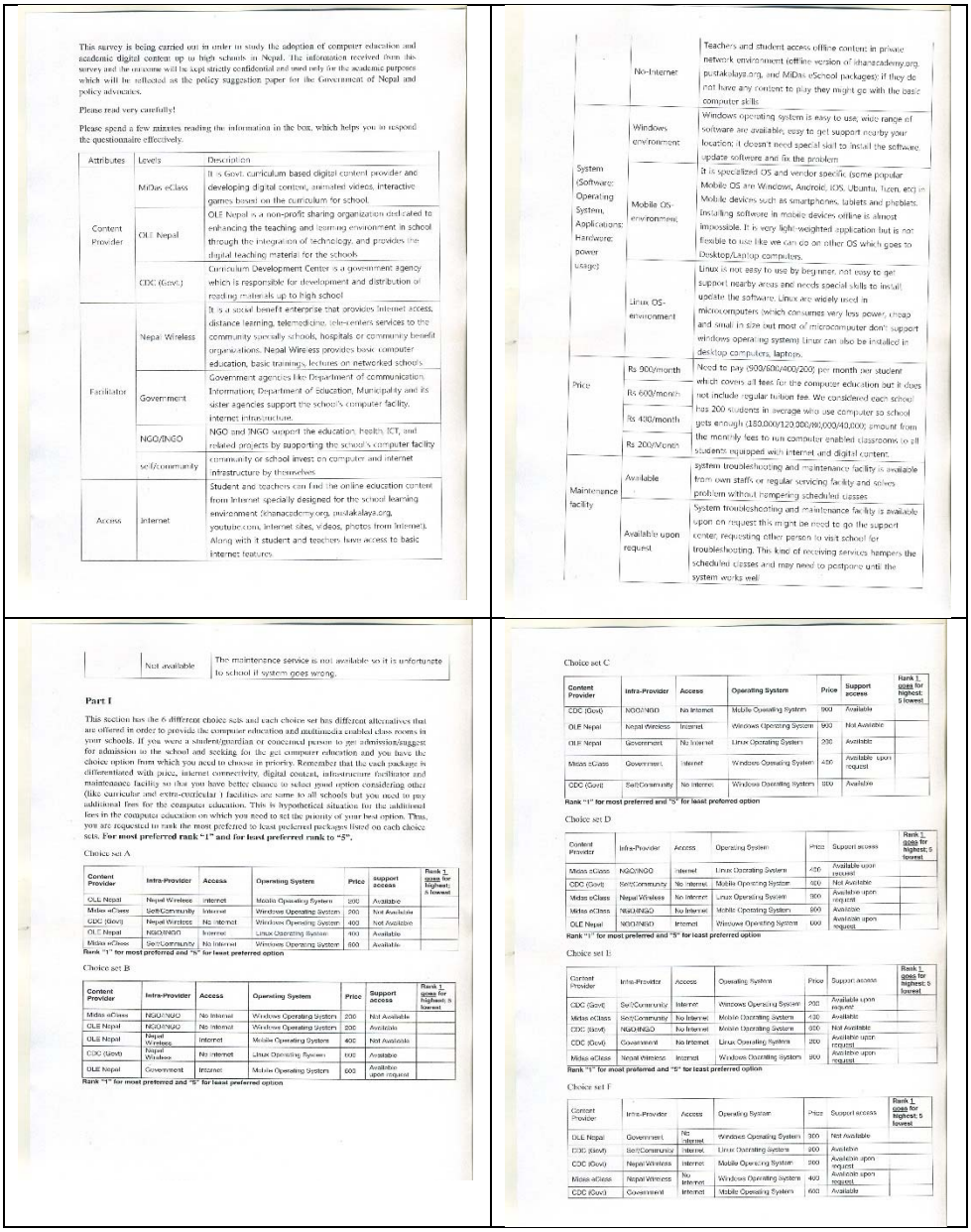
Sample orthogonal Profile

Card List

	Card ID	Content Provider	Infra-Provider	Access	Operating System	Price	support acess
1	1	OLE Nepal	Nepal Wireless	Internet	Mobile Operating System	200	Available
2	2	OLE Nepal	NGO/INGO	Internet	Windows Operating System	600	Available upon request
3	3	Midas eClass	Self/Community	Internet	Windows Operating System	200	Not Available
4	4	OLE Nepal	Self/Community	No Internet	Mobile Operating System	400	Available
5	5	OLE Nepal	NGO/INGO	No Internet	Windows Operating System	200	Available
6	6	CDC (Govt)	Government	Internet	Windows Operating System	400	Not Available
7[a]	7	Midas eClass	NGO/INGO	Internet	Windows Operating System	900	Available
8	8	Midas eClass	Self/Community	No Internet	Mobile Operating System	400	Available
9	9	Midas eClass	Government	No Internet	Windows Operating System	900	Available

Questionnaire

*The Questionnaire used for the survey is the exact literal translation of the following



This survey is being carried out in order to study the adoption of computer education and academic digital content up to high schools in Nepal. The information received from this survey and the outcome will be kept strictly confidential and used only for the academic purposes which will be reflected as the policy suggestion paper for the Government of Nepal and policy advocates.

Please read very carefully!

Please spend a few minutes reading the information in the box, which helps you in respond the questionnaire effectively.

Attributes	Levels	Description
Content Provider	MiDas eClass	It is Govt. curriculum based digital content provider and developing digital content, animated videos, interactive games based on the curriculum for school.
	OLE Nepal	OLE Nepal is a non-profit sharing organization dedicated to enhancing the teaching and learning environment in school through the integration of technology, and provides the digital teaching material for the schools.
	CDC (Govt.)	Curriculum Development Center is a government agency which is responsible for development and distribution of reading materials up to high school
Facilitator	Nepal Wireless	It is a social benefit enterprise that provides Internet access, distance learning, telemedicine, tele-centers services to the community specially schools, hospitals or community benefit organizations. Nepal Wireless provides basic computer education, basic trainings, lectures on networked school's
	Government	Government agencies like Department of communication, Information, Department of Education, Municipality and its sister agencies support the school's computer facility, internet infrastructure.
	NGO/INGO	NGO and INGO support the education, health, ICT, and related projects by supporting the school's computer facility
	self/community	community or school invest on computer and internet infrastructure by themselves
Access	Internet	Student and teachers can find the online education content from Internet specially designed for the school learning environment (khanacademy.org, pustakalaya.org, youtube.com, internet sites, videos, photos from Internet). Along with it student and teachers have access to basic internet features.
	No-Internet	Teachers and student access offline content in private network environment (offline version of khanacademy.org, pustakalaya.org, and MiDas eSchool packages); if they do not have any content to play they might go with the basic computer skills
System (Software: Operating System, Applications: Hardware: power usage)	Windows environment	Windows operating system is easy to use, wide range of software are available, easy to get support nearby your location; it doesn't need special skill to install the software, update software and fix the problem
	Mobile OS-environment	It is specialized OS and vendor specific (some popular Mobile OS are Windows, Ancroid, iOS, Ubuntu, Tizen, ect) in Mobile devices such as smartphones, tablets and phablets. Installing software in mobile devices offline is almost impossible. It is very light-weighted application but is not flexible to use like we can do on other OS which goes to Desktop/Laptop computers.
	Linux OS-environment	Linux is not easy to use by beginner, not easy to get support nearby areas and needs special skills to install, update the software. Linux are widely used in microcomputers (which consumes very less power, cheap and small in size out most of microcomputer don't support windows operating system). Linux can also be installed in desktop computers, laptops.
Price	Rs 900/month	Need to pay (900/600/400/200) per month per student which covers all fees for the computer education but it does not include regular tuition fee. We considered each school has 200 students in average who use computer so school gets enough (180,000/120,000/80,000/40,000) amount from the monthly fees to run computer enabled classrooms, to all students equipped with internet and digital content.
	Rs 600/month	
	Rs 400/month	
	Rs 200/Month	
Maintenance facility	Available	system troubleshooting and maintenance facility is available from own staffs or regular servicing facility and solves problem without hampering scheduled classes
	Available upon request	System troubleshooting and maintenance facility is available upon on request this might be need to go the support center, requesting other person to visit school for troubleshooting. This kind of receiving services hampers the scheduled classes and may need to postpone until the system works well
	Not available	The maintenance service is not available so it is unfortunate to school if system goes wrong.

Part I

This section has the 6 different choice sets and each choice set has different alternatives that are offered in order to provide the computer education and multimedia enabled class rooms in your schools. If you were a student/guardian or concerned person to get admission/suggest for admission in the school and seeking for the get computer education and you have the choice option from which you need to choose in priority. Remember that the each package is differentiated with price, internet connectivity, digital content, infrastructure facilitator and maintenance facility so that you have better chance to select good option considering other (like curricular and extra-curricular) facilities are same to all schools but you need to pay additional fees for the computer education. This is hypothetical situation for the additional fees in the computer education on which you need to set the priority of your best option. Thus, you are requested to rank the most preferred to least preferred packages listed on each choice sets. **For most preferred rank "1" and for least preferred rank to "5".**

Choice set A

Content Provider	Infra-Provider	Access	Operating System	Price	Support access	Rank 1 goes for highest; 5 lowest
OLE Nepal	Nepal Wireless	Internet	Mobile Operating System	200	Available	
Midas eClass	Self/Community	Internet	Windows Operating System	200	Not Available	
CDC (Govt)	Nepal Wireless	No Internet	Windows Operating System	400	Not Available	
OLE Nepal	NGO/INGO	Internet	Linux Operating System	400	Available	
Midas eClass	Self/Community	No Internet	Windows Operating System	600	Available	

Rank "1" for most preferred and "5" for least preferred option

Choice set B

Content Provider	Infra-Provider	Access	Operating System	Price	Support access	Rank 1 goes for highest; 5 lowest
Midas eClass	NGO/INGO	No Internet	Windows Operating System	200	Not Available	
OLE Nepal	NGO/INGO	No Internet	Windows Operating System	200	Available	
OLE Nepal	Nepal Wireless	Internet	Mobile Operating System	400	Not Available	
CDC (Govt)	Nepal Wireless	No Internet	Linux Operating System	600	Available	
OLE Nepal	Government	Internet	Mobile Operating System	600	Available upon request	

Rank "1" for most preferred and "5" for least preferred option

Choice set C

Content Provider	Infra-Provider	Access	Operating System	Price	Support access	Rank 1 goes for highest; 5 lowest
CDC (Govt)	NGO/INGO	No Internet	Mobile Operating System	900	Available	
OLE Nepal	Nepal Wireless	Internet	Windows Operating System	900	Not Available	
OLE Nepal	Government	No Internet	Linux Operating System	200	Available	
Midas eClass	Government	Internet	Windows Operating System	400	Available upon request	
CDC (Govt)	Self/Community	No Internet	Windows Operating System	800	Available	

Rank "1" for most preferred and "5" for least preferred option

Choice set D

Content Provider	Infra-Provider	Access	Operating System	Price	Support access	Rank 1 goes for highest; 5 lowest
Midas eClass	NGO/INGO	Internet	Linux Operating System	400	Available upon request	
CDC (Govt)	Self/Community	No Internet	Mobile Operating System	900	Not Available	
Midas eClass	Nepal Wireless	No Internet	Linux Operating System	900	Available upon request	
Midas eClass	NGO/INGO	No Internet	Mobile Operating System	900	Available	
OLE Nepal	NGO/INGO	Internet	Windows Operating System	900	Available upon request	

Rank "1" for most preferred and "5" for least preferred option

Choice set E

Content Provider	Infra-Provider	Access	Operating System	Price	Support access	Rank 1 goes for highest; 5 lowest
CDC (Govt)	Self/Community	Internet	Windows Operating System	200	Available upon request	
Midas eClass	Self/Community	No Internet	Mobile Operating System	400	Available	
CDC (Govt)	NGO/INGO	No Internet	Mobile Operating System	900	Not Available	
CDC (Govt)	Government	No Internet	Linux Operating System	200	Available upon request	
Midas eClass	Nepal Wireless	Internet	Windows Operating System	900	Available upon request	

Rank "1" for most preferred and "5" for least preferred option

Choice set F

Content Provider	Infra-Provider	Access	Operating System	Price	Support access	Rank 1 goes for highest; 5 lowest
OLE Nepal	Government	No Internet	Windows Operating System	900	Not Available	
CDC (Govt)	Self/Community	Internet	Linux Operating System	900	Available	
CDC (Govt)	Nepal Wireless	Internet	Mobile Operating System	900	Available upon request	
Midas eClass	Nepal Wireless	No Internet	Windows Operating System	400	Available upon request	
CDC (Govt)	Government	Internet	Mobile Operating System	600	Available	

Rank "1" for most preferred and "5" for least preferred option

Part II

Please mark (✓) for appropriate option

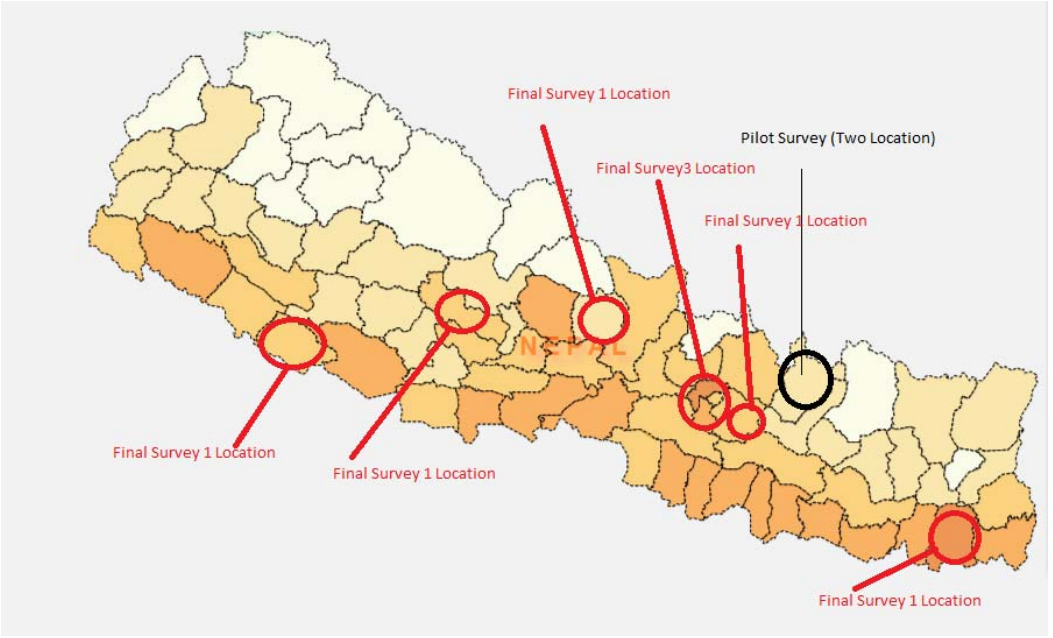
1. Have you ever used computer?
   a. Yes ☐ b. No ☐ (If you did not use computer previously please go to 10)
2. How have you utilized computers in your school?
   a. Basic computer skills ☐ b. along with multimedia ☐ c. Advance use (e-learning packages, Internet, programming etc.) ☐
3. Did you use Internet?
   a. Yes ☐ b. No ☐ (If yes, answer question 4)
4. How do you use Internet?
   a. Learning new things along with social networking (Facebook/twitter etc.) ☐
   b. Entertainment along with social networking (Facebook/twitter etc.) ☐
   c. Social networking only (Facebook/twitter etc.) ☐
5. Have you ever used e-Learning Packages like Midas eClass, ePustakalaya, Khan Academy etc.?
   a. Yes ☐ (If your answer is yes please answer Question 6)
   b. No ☐
6. What kind of content do you prefer?
   a. Native language and interactive ☐
   b. Language doesn't matter but interactive ☐
   c. English and interactive ☐
7. How long have you had access to computer and those e-learning packages?
   a. Every day ☐ tentative duration per week.....hour
   b. Not every day ☐ tentative duration per week .....hours
   c. Once a week ☐ tentative duration per week.....hour(s)
   d. Sometimes ☐ tentative duration per month.....hour(s)
8. What do you think after taking computer education/multimedia enabled class in your school?
   a. Computer skill improved but academic performance became weak ☐
   b. Became smarter than previous year ☐
   c. Became crazy to social networking ☐
9. Are you paying any fees for computer education?
   a. Yes ☐ amount Rs ...../month
   b. No ☐
10. Are you planning to switch your school where computer education is offered?
    a. Yes ☐ can pay Rs ...../month as computer education fee.
    b. No ☐ cannot afford.

Part III

Please mark (✓) for appropriate option

1. Gender: Male ☐ Female ☐
2. Age: ☐ years
3. Education: ☐ Literate ☐ Primary ☐ Higher school ☐ Undergraduate ☐ Graduate
4. Your computer skills: ☐ No idea ☐ Basic ☐ Medium ☐ Advance user
5. You English ability ☐ None ☐ little ☐ Normal ☐ Fluent
6. Highest degree earned in your family: ☐ Literate ☐ Primary ☐ Higher school ☐ Undergraduate ☐ Graduate ☐ Doctoral
7. Family income per month: Less than Rs. 20,000 ☐ 20,000-30,000 ☐ 30,000-40,000 ☐ more than 40,000 ☐

Survey Location



Descriptive Statistics

	Frequency	Percent
computer Experience		
Yes	257	86.24%
Never Used	41	13.76%
Experience of internet in school		
Yes	158	53.02%
No	140	46.98%
Reasons to use Internet		
No Experience	42	14.09%
Learning and Social network	225	75.50%
Entertainment along with social networking	19	6.38%
Social networking only	12	4.03%
Content Experience		
yes	70	23.49%
No	228	76.51%
Type of preferred content		
Native language and interactive	80	26.85%
Language doesn't matter but interactive	36	12.08%
English and interactive	182	61.07%
Computer usage Frequency		
No	76	25.50%
Every day	51	17.11%
Not every day but more than a day in a week	58	19.46%
Once a week	67	22.48%
Sometimes	46	15.44%
Tentative used duration of computer in a month		
not et al	76	25.50%
less than 10 hours	89	29.87%
10-20 hours	54	18.12%
20-30 hours	46	15.44%
more than 30 hours	33	11.07%
Effect of internet (self-evaluation)		
Do not have experience in internet	41	13.76%
Only computer skill improved	39	13.09%
Became smarter than previous year	177	59.40%
Became crazy to social networking	41	13.76%

Can pay for computer in future		
no et al	106	35.57%
less than 200	0	11.74%
200-400	0	20.13%
400-600	0	8.05%
more than 600	0	24.50%
	Frequency	Percent
Gender		
Male	157	52.68%
Female	141	47.32%
Age of participants		
Up to 17	245	82.21%
more than 17	53	17.79%
Education of Participants		
Literate	11	3.69%
Primary	178	59.73%
High School	86	28.86%
Undergraduate	23	7.72%
Computer Skill of participants		
No idea	41	13.76%
basic	64	21.48%
Medium	161	54.03%
Advance	32	10.74%
English skill of participants (self-evaluation)		
None	6	2.01%
Little	48	16.11%
Normal	121	40.60%
Fluent	123	41.28%
Highest degree earned in family		
Literate	13	4.36%
Primary	38	12.75%
High School	106	35.57%
Undergraduate	64	21.48%
Graduate	67	22.48%
Doctoral	10	3.36%
Family income		
less than 20000	98	32.89%
20000 to 30000	61	20.47%

30000 to 40000	56	18.79%
40000 to 50000	20	6.71%
50000 to 60000	31	10.40%
more than 60000	27	9.06%

Cross Tabulation of Descriptive statistics

		Type of content preferred by respondent			
		Native language and interactive	Language doesn't matter but interactive	English and interactive	Total
Computer Skill (Self Disclosed)	No idea	28	1	12	13.76%
	basic	13	11	40	21.48%
	Medium	29	21	111	54.03%
	Advance	10	3	19	10.74%
	Total	26.85%	12.08%	61.07%	
Family Income	less than 20000	37	10	52	29.87%
	20000 to 30000	13	6	42	20.47%
	30000 to 40000	12	8	36	18.79%
	40000 to 50000	5	3	12	6.71%
	50000 to 60000	6	6	19	10.40%
	more than 60000	7	4	21	10.74%
	Total	26.85%	12.42%	61.07%	
English Proficiency (Self Disclosed)	None	2	4	0	2.01%
	Little	21	6	21	16.11%
	Normal	29	16	76	40.60%
	Fluent	28	10	85	41.28%
	Total	26.85%	12.08%	61.07%	
Content Experience	yes	9	12	49	23.49%
	No	71	24	133	76.51%
	Total	26.85%	12.08%	61.07%	
gender	Male	40	18	99	52.68%
	Female	40	18	83	47.32%
	Total	26.85%	12.08%	61.07%	

	Can pay in future for e-learning system in school						
		0	Up to 200	200 to 400	400 to 600	Above 600	total
Family Income	less than 20000	36	23	25	11	3	32.89%
	20000 to 30000	14	4	27	12	4	20.47%
	30000 to 40000	23	4	12	15	2	18.79%
	40000 to 50000	7	0	5	7	1	6.71%
	50000 to 60000	13	3	6	6	3	10.40%
	more than 60000	13	1	9	8	1	10.74%
		35.57%	11.74%	28.19%	19.80%	4.70%	
English Capacity	None	2	0	2	2	0	2.01%
	Little	25	4	10	7	2	16.11%
	Normal	38	23	38	17	5	40.60%
	Fluent	41	8	34	33	7	41.28%
	Total	35.57%	11.74%	28.19%	19.80%	4.70%	
Computer Skill	No idea	24	4	10	3	0	13.76%
	basic	17	7	22	14	4	21.48%
	Medium	54	22	41	35	9	54.03%
	Advance	11	2	11	7	1	10.74%
	Total	35.57%	11.74%	28.19%	19.80%	4.70%	
Family Education	Literate	7	0	4	2	0	4.36%
	Primary	19	3	6	6	4	12.75%
	High School	38	21	27	16	4	35.57%
	Undergraduate	13	6	21	19	5	21.48%
	Graduate	22	5	26	13	1	22.48%
	Doctoral	7	0	0	3	0	3.36%
	Total	35.57%	11.74%	28.19%	19.80%	4.70%	
Gender	Male	50	19	50	32	6	52.68%
	Female	56	16	34	27	8	47.32%
	Total	35.57%	11.74%	28.19%	19.80%	4.70%	

Estimation Result

Rank Ordered Logit without Interaction term

```
+--------------------------------------------+
| Discrete choice and multinomial logit models|
+--------------------------------------------+
Normal exit from iterations. Exit status=0.
+--------------------------------------------+
| Discrete choice (multinomial logit) model  |
| Maximum Likelihood Estimates               |
| Model estimated: May 25, 2014 at 04:00:06PM.|
| Dependent variable            Choice       |
| Weighting variable            None         |
| Number of observations        1788         |
| Iterations completed          5            |
| Log likelihood function       -8201.995    |
| Number of parameters          11           |
| Info. Criterion: AIC =        9.18680      |
|   Finite Sample: AIC =        9.18688      |
| Info. Criterion: BIC =        9.22056      |
| Info. Criterion:HQIC =        9.19927      |
| Model estimated using RANK data for LHS.   |
| Number of obs.=  1788, skipped   0 bad obs. |
+--------------------------------------------+
+--------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).     |
|      Constants only => P(i,j) uses ASCs    |
|        only. N(j)/N if fixed choice set.   |
|        N(j) = total sample frequency for j |
|        N    = total sample frequency.      |
|      These 2 models are simple MNL models. |
|      R-sqrd = 1 - LogL(model)/logL(other)  |
|      RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd)   |
|        nJ   = sum over i, choice set sizes |
+--------------------------------------------+
```

Variable	Coefficient(Standard Error)	T-Value	Willingness to pay
Midas eClass	.07823818 (.04125848)	1.896	65.55247
CDC(Gvt)	-.05644654(.04288524)	-1.316	insignificant
Nepal Wireless	.18576239(.04835260)	3.842	155.6425
NGO/INGO	.01924731(.04297955)	0.448	insignificant

Government	-.11823950 (.05644275)	-2.095	-99.0679
Internet	.49567717(.03457986)	14.334	415.307
Mobile System	.07484004(.04059728)	1.843	62.70531
Linux System	-.15465834(.04297204)	-3.599	-129.582
Available	.18296325(.03989741)	4.586	153.2972
Available on Request	-.02943949(.04826248)	-0.61	insignificant
Price	-.00119352(.645494D-4)	-18.49	

Rank Ordered Logit with Interaction term

```
+---------------------------------------------+
| Discrete choice and multinomial logit models|
+---------------------------------------------+
Normal exit from iterations. Exit status=0.
+---------------------------------------------+
| Discrete choice (multinomial logit) model   |
| Maximum Likelihood Estimates                |
| Model estimated: May 14, 2014 at 04:15:01PM.|
| Dependent variable              Choice      |
| Weighting variable               None       |
| Number of observations           1788       |
| Iterations completed             5          |
| Log likelihood function       -8145.400     |
| Number of parameters             26         |
| Info. Criterion: AIC =         9.14027      |
|   Finite Sample: AIC =         9.14071      |
| Info. Criterion: BIC =         9.22008      |
| Info. Criterion:HQIC =         9.16974      |
| Model estimated using RANK data for LHS.    |
| Number of obs.=  1788, skipped   0 bad obs. |
+---------------------------------------------+
+---------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).      |
|       Constants only => P(i,j) uses ASCs    |
|         only. N(j)/N if fixed choice set.   |
|         N(j) = total sample frequency for j |
|         N    = total sample frequency.      |
|       These 2 models are simple MNL models. |
|       R-sqrd = 1 - LogL(model)/logL(other)  |
```

| RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd) |
| nJ = sum over i, choice set sizes |
+----------+

Variable	Coefficient(Standard Error)	T-Value	Willingness to pay
Midas eClass	0.06026632(0.1396323)	0.432	insignificant
CDC(Gvt)	0.22532341(0.11626869)	1.938	304.08
Nepal Wireless	0.17856943(0.04855313)	3.678	240.98
NGO/INGO	-0.22692379(0.12509771)	-1.814	-306.24
Government	-0.12130733(0.0566437)	-2.142	-163.71
Internet	0.8817954(0.1839862)	4.793	1190.01
Mobile System	0.00684066(0.20568116)	0.033	insignificant
Linux System	-0.15878004(0.04311941)	-3.682	-214.28
Available	0.51269795(0.13582361)	3.775	691.90
Available on Request	0.04950996(0.23762635)	0.208	insignificant
Price	-0.000741(0.00018415)	-4.024	NA
Computer Experience			
Internet	-0.37227914(0.09695307)	-3.84	-502.40
Mobile Operating System	-0.16882023(0.09765972)	-1.729	-227.83
Available	-0.40975734(0.10039735)	-4.081	-552.98
Available on Request	-0.37630813(0.12698586)	-2.963	-507.84
Internet Experience in School			
Internet	0.23607303(0.06382283)	3.699	318.59
Price	-0.00031865(0.00011833)	-2.693	-0.43
Currently Paying			
Available	0.00024411(0.00014208)	1.718	0.33
Education of Respondent			
CDC (government)	-0.11565512(0.04468278)	-2.588	-156.08
NGO/INGO	0.10115168(0.04888366)	2.069	136.51
Internet	-0.12270612(0.04352241)	-2.819	-165.60
Computer Skill of Respondent			
Midas eClass	-0.09537177(0.03867918)	-2.466	-128.71
English Capacity			
Midas eClass	0.08511604(0.04151529)	2.05	114.87
Mobile Operating System	0.08182996(0.04270413)	1.916	110.43

Available on Request	0.10919768(0.04638621)	2.354	147.36
Family Income			
Available	.287848D-05(.971439D-06)	2.963	0.0039

Mixed Logit

```
+--------------------------------------------+
| Discrete choice and multinomial logit models|
+--------------------------------------------+
Normal exit from iterations. Exit status=0.
+--------------------------------------------+
| Start values obtained using MNL model      |
| Maximum Likelihood Estimates               |
| Model estimated: May 27, 2014 at 01:53:48PM.|
| Dependent variable              Choice     |
| Weighting variable              None       |
| Number of observations          1788       |
| Iterations completed            15         |
| Log likelihood function         -8201.995  |
| Number of parameters            11         |
| Info. Criterion: AIC =          9.18680    |
|   Finite Sample: AIC =          9.18688    |
| Info. Criterion: BIC =          9.22056    |
| Info. Criterion:HQIC =          9.19927    |
| Model estimated using RANK data for LHS.   |
| Number of obs.=  1788, skipped   0 bad obs.|
+--------------------------------------------+

+--------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).     |
|       Constants only => P(i,j) uses ASCs   |
|         only. N(j)/N if fixed choice set.  |
|         N(j) = total sample frequency for j|
|         N    = total sample frequency.     |
|       These 2 models are simple MNL models.|
|       R-sqrd = 1 - LogL(model)/logL(other) |
|       RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd)  |
|         nJ   = sum over i, choice set sizes|
+--------------------------------------------+
```

Variable	Coefficient(Standard Error)	T-Value
Midas eClass	0.0782(0.0413)	1.896
CDC(Gvt)	-0.0564(0.0429)	-1.316
Nepal Wireless	0.1858(0.0484)	3.842
NGO/INGO	0.0192(0.043)	0.448
Government	-0.1182(0.0564)	-2.095
Internet	0.4957(0.0346)	14.334
Mobile System	0.0748(0.0406)	1.843
Linux System	-0.1547(0.043)	-3.599
Available	0.183(0.0399)	4.586
Available on Request	-0.0294(0.0483)	-0.61
Price	-0.0012(0.0001)	-18.49

Normal exit from iterations. Exit status=0.

```
+--------------------------------------------+
| Random Parameters Logit Model              |
| Maximum Likelihood Estimates               |
| Model estimated: May 27, 2014 at 01:55:40PM.|
| Dependent variable              X12        |
| Weighting variable              None       |
| Number of observations          1788       |
| Iterations completed            31         |
| Log likelihood function         -8170.107  |
| Number of parameters            21         |
| Info. Criterion: AIC =          9.16231    |
|   Finite Sample: AIC =          9.16260    |
| Info. Criterion: BIC =          9.22678    |
| Info. Criterion:HQIC =          9.18612    |
| Random parameters model fit with ranks data; |
| fit with constants only to obtain pseudoR2. |
+--------------------------------------------+
+--------------------------------------------+
| Notes No coefficients=> P(i,j)=1/J(i).     |
|       Constants only => P(i,j) uses ASCs   |
|         only. N(j)/N if fixed choice set.  |
|         N(j) = total sample frequency for j |
|         N    = total sample frequency.     |
|       These 2 models are simple MNL models. |
|       R-sqrd = 1 - LogL(model)/logL(other)  |
|       RsqAdj=1-[nJ/(nJ-nparm)]*(1-R-sqrd)   |
```

| nJ = sum over i, choice set sizes |
+---+

+---+
| Random Parameters Logit Model |
| Replications for simulated probs. = 100 |
| Number of obs.= 1788, skipped 0 bad obs. |
+---+
+--------+-------------+---------------+--------+--------+
|Variable| Coefficient | Standard Error |b/St.Er.|P[|Z|>z]|
+--------+-------------+---------------+--------+--------+

Variable	Coefficient(Standard Error)	T-Value	Variance(Standard Error)	T-Value
Midas eClass	0.0759(0.0151)	1.896	0.0672(0.0101)	6.626
CDC(Gvt)	-0.0783(0.0189)	-1.316	0.0797(0.0123)	6.495
Nepal Wireless	0.1832(0.0187)	3.842	0.2463(0.0116)	21.158
NGO/INGO	0.0159(0.0166)	0.448	0.2988(0.0128)	23.344
Government	-0.1432(0.0251)	-2.095	0.0572(0.0178)	3.22
Internet	0.5749(0.0152)	14.334	0.7087(0.0118)	59.979
Mobile System	0.1143(0.0164)	1.843	0.427(0.0108)	39.517
Linux System	-0.1557(0.0159)	-3.599	0.0299(0.0122)	2.442
Available	0.1879(0.0157)	4.586	0.0295(0.0114)	2.583
Available on Request	-0.0138(0.0211)	-0.61	0.0232(0.0129)	1.808
Price	-0.0013039	-51.969		

초록

Effective E-Learning Adoption Policies in Developing Countries: A Case of Nepal with Conjoint-Based Discrete Choice Approach

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e-러닝과 테크놀로지 기반 교육 환경은 선진국의 교육 환경에서는 유행어이나 커리큘럼과 교육방법이 전통적인 접근법에 기반해 있는 개발도상국의 상황에서는 매우 초보적인 단계이다. 게다가 테크놀로지를 아는 교사들이 도심 지역에 집중되어 있어서 지방과 같은 외곽 지역에 많은 도전 할 과제를 던져 주고 있다. 일반적으로, 양적인 성과에 집중된 단기적 교육 계획과 사립학교 뿐 아니라 공립학교에서 도심과 지방의 교육의 질적 차이는 개발도상국에서 정보 격차를 줄이는 데 더욱 혼란스러운 상황을 만들어놓았다. 따라서, 사회경제적으로 다양한 인구 집단의 필요를 채워주는 포괄적인 교육 정책의 도입이 필요하다. 추가적으로 정보기반 사회의 건설을 지원하는 테크놀로지 기반 교육 정책의 지속 가능한 모델을 개발할 필요가 있다.

이 연구는 네팔의 6 개 지역에서 얻어진 선호도 데이터를 바탕으로 하는 컨조인트 기반 이산선택모형을 사용하여 학부모와 학생들이 가격에 민감하고 인터넷을 현재의 교육 시스템에 추가하여 부가적인 교육 툴로써

이용하기 원한다는 것을 밝힌다. 그러므로, 이 연구는 도심과 지방, 부유층과 저소득층 사이의 교육에 대한 접근성의 정보 격차를 해소하는 최상의 정책 개발을 위한 윈-윈 시나리오를 제시하고 있다.

키워드 : e-러닝 수용, 이산선택 분석, 다중로짓모델, 혼합로짓모델, 교육 정책, 정보 격차