Second Life for Illiterates: A 3D Virtual World Platform for Adult Basic Education

Tassawar Iqbal
Institute of Software Technology and Interactive Systems
Vienna University of Technology, Austria
COMSATS Institute of Information Technology
Abbottabad, Pakistan
iqbal@ifs.tuwien.ac.at

Klaus Hammermüller
talkademy, an open learning (OLE) language school, Vienna, Austria
Klaus.h@mac.com

A Min Tjoa
Institute of Software Technology and Interactive Systems
Vienna University of Technology, Austria
amin@ifs.tuwien.ac.at

ABSTRACT
Illiteracy is still a dilemma, around more than 700 million adults in the world are unable to read and write. In the present modern society, technology is used to provide the techno-literacy solutions to help out the illiterates. Unfortunately, these solutions rarely consider the traditional learning theories and exploit two-dimensional (2D) platforms. Furthermore these techno-literacy solutions focus on desktop applications such as movies, recorded lectures on CDs and web-based application like 2D text-based instructional programs and games. These 2D applications are lacking the features such as self-presence, social-presence, situated-learning, embodied environment and learning by doing suggested in the traditional learning theories. There is a need to bridge the gap between technology-based solutions and traditional learning theories and to exploit emergent three-dimensional (3D) technologies to provide these lacking features. In this paper, we explore how the benefits of 3D emergent technologies like Second Life (SL) are exploited in coherence with traditional theories for Adult Basic Education (ABE). We present an immersive learning platform based on Multiple Intelligences (MI) Theory. We design and discuss an adaptive learning scenario for ABE in the SL. Finally we scrutinize the proposed platform to get an overview of the strengths and weaknesses in the intended area of application.

Categories and Subject Descriptors
K.3.1 [Computer Uses in Education]: Computer Assisted Instructions (CAI); H.5.1 [Multimedia Information Systems]: Artificial, augmented, and virtual realities.

General Terms
Design, Human Factors.

Keywords
Adult Basic Education (ABE), Second Life (SL), Techno-literacy, 3D Virtual World (VW), Adaptive Interfaces.

iiWAS2010, 8-10 November, 2010, Paris, France.

1. INTRODUCTION
The movement against adult illiteracy is not new, rather it has a deep foundation of more than 55 years [37]. Research studies were conducted to facilitate adult illiterates. These studies can be divided into three categories. The first category deals with classical approaches for teaching and learning on cognitive and psychological grounds. These studies focus on two main teaching approaches, pedagogy and andragogy [9], [23] and moreover explain learning theories, such as Kolb's Experimental Learning [17], Lave's Situated Learning [19] and Gardner's Multiple Intelligences (MI) [14]. The second category of research studies uses technology, in order to support illiterates in accessing information using multimodal interfaces. It includes supporting applications, such as job information systems, basic health systems, city navigation systems, government portals and agriculture information systems [2], [7], [22], [28], [29], [36], [38]. The last group serves to improve literacy using technology-based solutions for illiterates. Online resources such as [13], [26] are available that provide a literacy platform to adult illiterates and guidelines to instructors. The work in this last category rarely keeps in view traditional theories devised for adult literacy [12], [19] as well as focuses on two-dimensional (2D) platforms. However these 2D platforms are unable to provide features, such as self-presence, social-presence, situated-learning, embodied environment, learning by doing and many others suggested in traditional theories and research studies [12], [16], [19], [20].

In this paper, we identify features that are important for adult literacy environments and map them to the traits of three-dimensional (3D) virtual world (VW). We explore the question of whether and how the benefits of emergent technologies like 3D VWs are exploited in coherence with traditional theories for Adult Basic Education (ABE). These findings guide us to present an immersive learning platform based on MI Theory. Second Life (SL), a 3D VW is qualified to implement this platform.

In the next section related work is provided. Section 3 defines the target users of the proposed environment and Section 4 explains the motivation of target users. How 3D-platforms serve illiterates is answered in Section 5. Selection of SL as learning environment and architecture of the proposed platform is explained in Section 6 and 7 respectively. In Section 8 a learning scenario for Adult Basic Education is presented. Section 9 evaluates the proposed platform using past studies. The last section concludes the paper.

2. RELATED WORK
Related work is divided into three categories. The first category includes traditional efforts and learning theories for adult illiterates. The second category is about technology-based

supportive solutions for adult illiterates. The last category describes technology-based literacy solutions for adult illiterates.

2.1 Traditional Efforts for illiterates

For adult illiterates, research studies were conducted to improve the literacy practices. These studies present models and approaches for literacy, such as, social dimensions of literacy, autonomous and ideological models of literacy, pedagogy and andragogy [9], [23] and learning theories, such as Kolb's Experimental Learning theory [17], Lave's Situated Learning Theory [19] that explain learning on physiological and cognitive grounds. These models and theories provide guidelines to augment the critical phenomenon of learning. In 1983, Gardner presented MI Theory [14]. It describes seven different intelligences, 1) linguistics, 2) mathematical logic, 3) visual-spatial, 4) musical, 5) body kinesthetic, 6) interpersonal and 7) intrapersonal that a human possesses and utilizes to learn. Each individual has different developed intelligences out of seven as a consequence their ways of learning things vary.

Eberle & Robinson [11] uncover problems being faced by illiterates in society. This study highlights the problems adults face in daily life, their motivation towards literacy acquisition and finally concludes with recommendations for better literacy acquisition. The author also emphasizes the need of informal learning environments for ABE.

2.2 Technology-based Supportive Solutions for illiterates

Technology-based supportive solutions highlight day to day needs of illiterates and facilitate their interaction with technology using text-free, multimodal (with Audio-Visual support) and tangible user interfaces. Rajput et al. [30] present an alternative information web called World Wide Telecom Web (WWTW) as a network of VoiceSites for delivering information services to visually impaired, illiterate or semiliterate users.

2.3 Technology-based Literacy Solutions for illiterates

Technology-based literacy applications, on the other hand are small in number. Dobriceanu and Nicola [10] present an intelligent Literacy Tool (iLIT) that is based on a customized embedded system with special software. It uses tablet PC as input device, a memory stick for storage purpose and a TV-set for display instead of monitors for low-income illiterate communities. Similarly, mobile-based solutions to improve literacy in third world countries are discussed in [15]. 2D Online resources [13], [26] are also available for adults, ranging from General Education Development (GED) to workplace education; however these resources are customized for functional illiterates, in contrast to the absolute illiterates.

3. TARGET USERS

Adult illiterates are target users of our proposed environment. Those who are unable to read and write are referred as illiterates [4], [27], [40]. Another group, who can recognize the letters of the alphabet and have small vocabulary of words but unable to comprehend the sentences is referred as *functional* Illiterate [40]. *S*o we can refer the former group as *Absolute Illiterate*. These are two basic categories of illiterates in society. To concretize our target user group, studies such as [5], [11], [15], [32], [39] help us to further divide illiterates into four groups as shown in Table 1. Where Group A, Group B and Group D require serious attention, especially Group A and Group B are more vulnerable. Group C, however, already knows how to walk, just the terrain is changed.

Table 1. Categories of target users

Groups of Illiterates	Definition	Want to learn/ Don't want to learn
A	Those, who are reluctant to go to formal environments for learning	Don't want to learn
B	Those, who do not find opportunity of education	Want to learn
C	Those, who move across countries	Want to learn
D	Those, who unable to get education due to family background	Don't want to learn

4. WHAT MOTIVATES THE ILLITERATES?

Motivation is core to every action performed by the human being. It is an enticing force bind with external or internal rewards and hence categorized as extrinsic and intrinsic motivation respectively.

Eberle & Robinson [11] highlight the needs of illiterates, such as illiterates desire to learn reading and writing but avoid exposing themselves to others. They wish to get rid of dependency. Literacy make them able to read and write to better serve their roles as parent, as employee, as employer, as buyer, as seller, as husband, as wife and as active citizen of society. Furthermore literacy also makes them able to read street/sign boards while travelling, telephone numbers and names, health information circulars and medicines' names, utility bills and different official correspondence. These needs seem to be very simple and ordinary but are very important and worthy for target community. Askov and Eunice [3] state, these immediate needs determine their interest and participation in literacy programs. However it is important to remember that, literacy does not mean to award degree to someone rather it has strong potential to help someone in solving problems in daily life [11].

These studies concretize that beyond the physiological needs, there are many other needs and motivational stimuli for illiterate to attract them towards literacy programs [35].

5. CAN 3D-PLATFORMS SERVE ILLITERATES?

Millar [24] emphasizes the need of computer assisted instruction in adult literacy programs and conducted a research study to examine its pros and cons. In this study data was collected from instructors through questionnaires and later on validated by conducting an experiment to determine efficacy of computer assisted instructions. The author hypothesized twelve advantages and eight disadvantages in this study. Out of these twelve advantages only six were achieved whereas four disadvantages were overcome, as shown in Table 2. Furthermore, text-based learning and communication applications are no longer acceptable in the present era of visual literacy [1]. Potential features, such as,

self-presence, social-presence, collaboration, one-to-one and one-to-many interaction, learning control, embodied environment, learning by doing are achievable through 3D VW and web 2.0. So, these platforms have potential not only to achieve advantages claimed in past studies [24] but also realize potential features and opportunities for learners as shown in Table 2. While it is challenging to exploit VW for adult illiterates, however Rankin, Gold and Gooch [31] state that "this is not to say that 3D games with their powerful graphical interface have become the panacea to learning rather thoughtful design and application of computer games determine effective digital learning environment".

6. SECOND LIFE FOR ILLITERATES

SL [34] is an open access 3D Multi-User Virtual Environment (MUVE). It was first made available for public access in 2003 by Linden Research Inc. In last three years, this 3D MUVE widely being used by education institutions for advanced education [25]. Educational institutions exploited the features of SL and presented learning scenarios for distance and blended learning [25]. We explore the SL as a learning platform for Adult Basic Education. We followed Robbins's taxonomy [33] for SL to identify traits of this 3D VW. The taxonomy of SL highlights affordance of this VW. We map Robbins's Taxonomy for SL to potential features of learning environment. How all the potential features of learning environment discussed in the Section 5 are achievable by exploiting SL's traits, is shown in Table 3.

7. PLATFORM ARCHITECTURE

In this section, we present a platform for adult basic education. The platform's architecture is divided into three components as shown in Figure 1. These components are described in the following sections.

7.1 Interface – based on MI Theory

The proposed architecture exploits SL and the interface it offers has strong coherence with MI Theory [14] as shown in Figure 1. According to this theory, people learn and understand in society through seven intelligences 1) linguistics, 2) mathematical logic, 3) visual-spatial, 4) musical, 5) body kinesthetic, 6) interpersonal and 7) intrapersonal and these all are considered equally important for learning. How learners with different learning styles and learning needs exploit the Gardner's intelligences is discussed in the following definitions:

Linguistics – uses spoken and written words. For learners who possess auditory skills, think in words, and prefer language to understand and express concepts.

Mathematical-logic – uses logic, reasoning ability, problem solving and numbers. Learners who think conceptually, like experiments and puzzle solving are better taught through this style.

Visual-spatial – uses pictures, 2D and 3D metaphors. Learners who think in term of pictures and physical space possess visual-spatial intelligence.

Musical – uses rhythms, melodies, tones and sounds. For learners who love music and sensitive to listening.

Body-kinesthetic – uses body movements, role playing and physical activities. Those learners who like movement, physical activities and learning by doing are target users of this learning style.

Table 2. Potential Features of Learning Environment

Second Life with Robbins's Taxonomy

Number of Users: ***"Multi-User"***	Object Ownership: ***"Private Ownership"***
Dominant Content Form: ***"Image Dominant"***	User Identity: ***"Custom"***
Type of Network: ***"WAN"***	Environment Access: ***"Public"***
Persistence of Environment: ***"Persistent, Non-persistent"***	User's Relationship with other users: ***"Collaborative"***
Stigmergy: ***"Stigmergy"***	User's Relationship with the Environment: ***"Collaborative"***
Communication channels: ***"text-chat, voice-chat"***	

Advantages Claimed		**Disadvantages Claimed**		**Potential Features**
1.Reading achievement gain **		1.Shyness +		1.Authoring (2D)
2.Positive attitude **		2.Change in computer technology +		2.Adult-oriented (2D)
3.Increased self-esteem **		3.Technical difficulties +		3.Audio component (2D)
4.Gain in computer skills +		4.High cost **		4.Sense of self-presence (3D)
5.Cost effectiveness +		5.Training requirement **		5.Social presence (3D)
6.Privacy +	+	6.Incompatibility with learner centered adult education **	+	6.Collaboration (2D)
7.Prestige +		7.Integration problems with curriculum **		7.One-to-one and one-to-many interaction (2D)
8.Individualization **		8.Change in teacher's and student's role +		8.Embodied environment (3D)
9.Learning Control **				9.Learning by doing (3D)
10.Fast feedback **				10. Problem centered learning (2D)
11.Flexibility and **				11. Independence (2D)
12.Records management +				12. Situated learning (3D)

(+) Represents advantages achieved and disadvantages overcame
(**) Represents advantages not achieved and disadvantages still problematic
(2D) supported by 2D web-based platforms
(3D) supported by 3D web-based platforms

Interpersonal – uses interaction and group discussion. Learners who have ability to communicate with other people and love to learn through discussion possess interpersonal learning style.

Intrapersonal – Learner who prefer to live alone and feel shyness are taught through intrapersonal style.

Each individual possesses differently developed intelligences and hence varies his/her way of learning. Learners with different intelligences may approach the platform and interact with it. In contrast to traditional learning environments and 2D platforms that rely on verbal and mathematical intelligences only, the proposed 3D platform offers range of channels to augment interface and invites learners with different intelligence for learning experiences.

The MI Theory is considered while designing the learning scenarios in the proposed solution. The learning scenario uses SL, a 3D VW that provides an immersive environment. Each and every metaphor used as Learning Object (LO) or used for the support of the learning scenario is 3D in nature and provides the visual-spatial support in learning. LOs are presented as written alphabetic characters with audio support that aid linguistic intelligence. Provision of text and voice chats augment interpersonal learning and provide opportunity to develop relationships. Learners' avatar through their motions, actions and sense of self-presence emulate the body-kinesthetic. Intrapersonal concerns are addressed using adaptive support through recording learner's usage data. Learning scenarios offer background music while learning that helps the learner with musical-rhythmic intelligence.

7.2 Second Life – 3D Virtual World

We exploit a 3D VW for ABE; it presents different learning scenarios. These learning scenarios for target learners are categorized into 1) Linguistic Scenarios, 2) Numeracy Scenarios and 3) Game Scenarios. In the first category, scenarios are designed for linguistic learning such as, alphabets, words and sentences. In the second category, scenarios are presented to learn numbers and basic mathematical skills, such as, addition, subtraction etc. The last category consists of game-based learning activities for both linguistic and numeracy. It also serves for implicit evaluation of learners. All three learning scenarios designed in SL are adaptive in nature and offer learning contents according to learners' background and domain knowledge.

7.3 Web-Service-based Adaptive Module

Adaptive module keeps track of learners' activities in the provided scenarios. For the adaptation and personalization support, the proposed environment uses two types of information related to the learner, 1) User's data – that constitutes personal profile of the learner (e.g. name, gender, background, domain knowledge) and 2) Usage data – that includes the action and activities performed by the learner during learning (learning object learned, data about implicit evaluation). The former information is acquired once from the learner before joining the learning environment and the later type of information recorded by the system during his/her learning experiences.

During the learning and evaluation phase in the SL environment, information against all the activities (performed by the learners) is acquired and forwarded to the Learner's Model Manager (LMM). It stores the learner's usage information into the learner's model to provide personalization accordingly. The Linden Scripting Language (LSL) is used that acquires the learner's usage data from the SL's client and forwards it to the LMM that stores it into the learner's model. By using the LSL, one can track the user's actions for instance navigation, touches, time-spent, position, evaluation and interaction with the LOs in learning environment. This usage data then posted to LMM using HTTP.

The second module Content Repository (CR) is a database which consists of lesson plans and all the contents of lessons. It is important to mention that it includes text-based lesson contents, for instance alphabetic characters and relevant metaphor's name only. LMM request the contents exploiting the learner's model and content repository sends these contents as an output to the third module Background-Manager/Content Presenter (BMCP). The third module BMCP consists of three types of databases 1) learners' avatars – database of different characters represent learners in the SL learning environment, 2) 3D-Contents – it includes all metaphors that instantiate a learning environment in SL for learners and 3) learners' inventory – it stores the information about the learners' avatars and different metaphors assigned to these avatars. BMCP uses LSL to update and retrieve the information from these databases and to finally instantiate the personalized learning environment for the learners.

8. A 3D LEARNING SCENARIO FOR ABE

For Adult Basic Education, Learning Scenarios are designed to educate the target users in the areas of linguistics and numeracy. In linguistic, target users are able to learn alphabets, words and sentences in different languages. However as a first step we considered English language for learning in the proposed solution. Numeracy learning scenario includes learning of numbers and basic mathematical operations, such as, addition, subtraction etc. For the evaluation of the learners, a game-based scenario is designed that serves for the implicit evaluation of learners. All these scenarios are designed considering the MI theory, so that learners with different intelligences feel comfortable while learning.

This paper focuses upon the linguistic learning and game-based evaluation scenarios. Linguistic learning scenario contains 3D LOs as alphabetic character and metaphor relevant to that alphabetic character, for instance metaphor of "Apple" for alphabetic character "A". These metaphors are selected on the basis of domain knowledge and background of the learners because adult learners want to learn only those things they need to know [23]. Furthermore Curtis [6] stresses that the ability to comprehend and acquire new vocabulary is influenced by the domain knowledge. Thus in proposed adaptive environment metaphors may vary for different learners against same alphabetic character considering the learner's domain knowledge and background. Whenever an avatar (in SL) of a learner (in Real Life) passes nearby a LO (alphabetic character and its metaphor), it speaks aloud. For example, when an avatar passes nearby a LO "A", this LO generates voice of "A" and then of relevant metaphor "Apple" for a learner. A certain range is specified around each LO called effective circle, upon entering into it that LO first vibrates to get the attention of a learner's avatar and loudly pronounces that alphabetic character (like "A" produce voice of "A") and its metaphor (produce voice of "Apple"). Until an avatar resides in this effective circle of a particular LO, that LO speaks aloud again and again with specific gaps to avoid mixing

Table 3. Mapping Robbins's Taxonomy to Potential Features of Learning Environments

Robbins's Second Life Taxonomy/ Derived Traits **	**(+) Advantages & Potential features provided/ (#)Disadvantages overcame**	**Remarks**
Multi-user	Collaboration^{+}, 1-to-1 & 1-to-m interaction^{+}	
Image dominant / Immersive	sense of self-presence^{+}, social presence^{+}, Embodied Environment^{+}, Learning by doing^{+}, situated Learning^{+}	
Online environment	Training requirements$^{\#}$, incompatibility with learner centered adult education approach$^{\#}$, flexibility^{+}, 1-to-1 & 1-to-m interaction^{+}, authoring^{+} → curriculum integration problems$^{\#}$	Because of an online nature, 1) technology expert are able to train the teacher as mentor, remotely. 2) teacher-centered approach is now switching to learner-centered style of learning. 3) authoring is possible that overcomes curriculum integration problem
Public Access	Shyness$^{\#}$, (Immersive-nature, collaborative) → self-esteem^{+}	Immersive nature and collaboration provides self-esteem
Customized Scenarios **	Learning Control^{+}, Adult-Oriented^{+}, Problem- centered Learning^{+}	
Voice-chat	Supports Absolute illiterates, Audio Component^{+}	
Text-chat	Supports Functional Illiterates	
(User Identity, Stigmergy, Object-Ownership)→Adaptivity **	Reading achievement gain^{+}, individualization^{+}, Fast Feedback^{+}	User Identity, Stigmerg & Object-Ownership take part in Adaptivity

and to enhance clarity. Once the learner has learned that LO, he/she needs to click on it. This mouse click action is reported to learner model through LMM to keep track of knowledge of a learner. Learner in the learning scenario can move by using four arrow keys on the keyboard and can click the LOs using simple mouse left-click. He/she needs not to deal with complex operations like mouse movement, drag and drop and menu selection.

The proposed environment offers a game-based scenario as an evaluation phase after the learning phase. In chronological order alphabetic characters are divided in six evaluation phases followed by learning phases. Consider the first evaluation phase following the first learning phase; it consists of Game-based scenario for implicit evaluation of learners because evaluating adult learners is not a recommended practice [11]. The inspiration of this game-based evaluation scenario is based on "Alphabet Scavenger Hunt" [21]. The game-based evaluation scenario consists of a room with a door used for entry and exit of avatars of learners. This room has several metaphors that are relevant to the alphabetic character that a learner has learned in the last learning phase. In addition to learned metaphors, the room has collection of some other metaphors to give the sense of selection to the learners. When a learner enters into the room, he/she listens a sound of one of the alphabetic characters that he/she has learned in last phase. The learner is asked to find relevant metaphor to this alphabetic character. After finding this metaphor in the room the learner needs to click on the metaphor. This mouse click action is reported to the learner model to update the learner's knowledge. This same process is repeated for all LOs, a learner learned in the last learning phase. After successfully finishing the evaluation phase the learner's avatar will again find itself in the next learning phase and this mechanism is repeated until visit of the learner in the linguistic learning scenario finishes however a learner can logout at anytime and resume the learning session. In case of logout, environment saves the learner present state and in next session provides him/her with same contents, LOs and metaphors.

All the actions performed by the learner during learning for example mouse-clicks, navigation, interaction with LOs and evaluation data is acquired using LSL and forwarded using LMM to learner's Model that is used for personalization of learning environment for the learner with the help of CR and BMCP.

9. SCRUTINIZING THE PROPOSED PLATFORM

The platform we proposed for the ABE has potential to augment the mechanism of learning and its worth can be proved by the accepted principles and theories [18], [23]. The theory of Andragogy states that adults are self-motivated and come up with past experience, they want problem oriented, independent learning style and short-outcomes and want to know the reason why they need to learn. We, in the proposed learning environment consider all the needs of adult learners and facilitated them accordingly as shown in the Table 3. Furthermore adaptive support in the proposed learning environment considers their past experience, background and domain knowledge. Similarly Edgar Dale, a known educationist developed the Cone of learning and explained different styles of learning [8]. The Cone of Learning illustrates that best we can remember is 90% of what we say and do as shown in the Figure 2. Dale stresses the importance of active style of learning by "saying" and "doing" things practically. Following the same pattern, our proposed environment offers linguistic,

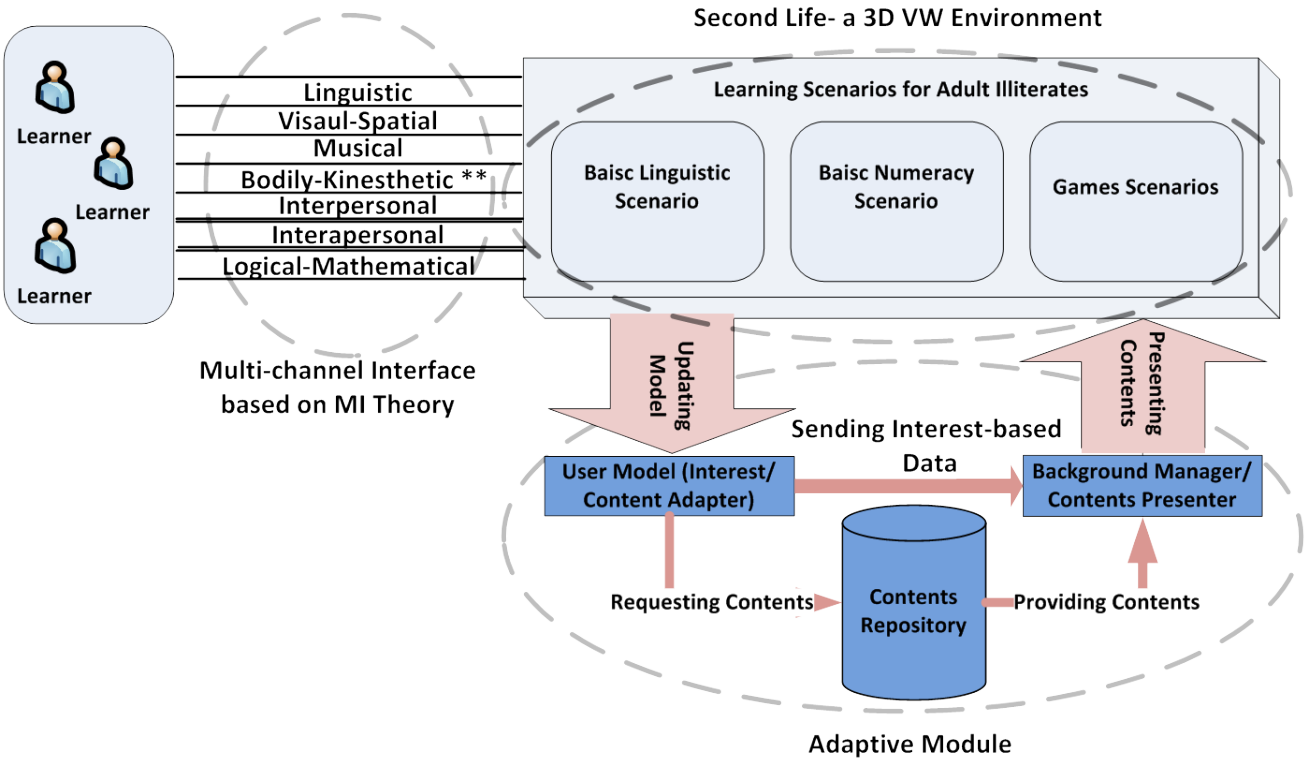

Figure 1. Platform Architecture

verbal, audio, video, musical, immersive, interpersonal and body-kinesthetic support for learning and for similar reason it presents practical realization of theory of MI.

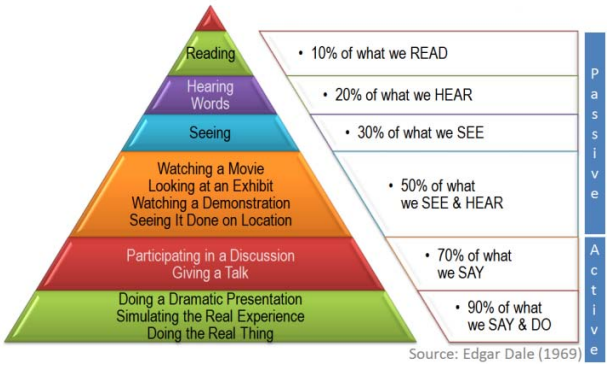

Figure 2. Dale's Cone of Learning [8]

10. CONCLUSION

In this paper, we presented an adaptive learning platform for adult basic education. This platform is accompanied with SL and MI Theory to bridge the gap between technology and learning approaches. This learning platform presents learning material to target users, such that it engages most or all of the intelligence on the continuum of seven intelligences. This allows ample range of adult illiterates to participate in informal learning environment and augments their learning experiences.

We plan to further enhance the platform in context of personalization and learning scenarios. In 3D multiuser virtual environment, adaptation of contents is critical such that a 3D space presents contents for a person according to his/her profile may not match with the profile of other user(s). This problem can be addressed by providing best common adaptation that optimizes the match based on group of users' models. We will explore how this and many other personalization issues in 3D multiuser virtual environment can be addressed to provide interactive control to the learners in the learning platform. We will further study the events that happened and activities performed by the learners in 3D space to concretize the usage data for personalization. Finally we will enhance our proposed platform and extend this prototype version towards final implementation.

11. ACKNOWLEDGMENT

The presented work is partially supported by HEC (Higher Education Commission) of Pakistan, ASEA UNINET (ASEAN EU Academic University Network), the Vienna University of Technology, the Austrian Exchange Service, and the Lifelong learning programme of the European Union.

12. REFERENCES

[1] Aanstoos, J. 2003. Visual literacy: An Overview. *32nd Applied Imagery Pattern Recognition Workshop (AIPR'03)*, pp.189.

[2] Akan, K. D., Farrell, S. P., Zerull, L.M., Mahone, I.H. & Guerlain, S. 2006. eScreening: Developing an Electronic Screening Tool for Rural Primary Care, *Proceeding of*

System and Information Engineering Design Symposium, pp.212-215.

[3] Askov, Eunice, N. 1989. Adult Literacy, Computer Technology, and the Hearing Impaired, Proceedings of the Literacy and the Hearing Impaired conference, pp. 151-192.

[4] Compact Oxford English Dictionary, http://www.askoxford.com/concise_oed/illiterate?view=uk. Last Accessed November 11, 2009.

[5] Craats, I. Van de. 2007. OBSTACLES ON HIGHWAY L2, *In Proceedings of the second annual forum The Literacy Institute at Virginia Commonwealth University, Richmond*, pp. 149-163.

[6] Curtis, M. E., 2006. The Role of Vocabulary Instruction in Adult Basic Education, in: Comings, J., Garner, B., Smith, C., *Review of Adult Learning and Literacy*, Volume 6, Routledge, USA, pp. 43-69.

[7] D. Wirastuti., Luckin, R., Ray, E. Sherrif, R., Walker, K., Underwood, J., Dunckley, L. 2008. Development of a knowledge management system integrated with local communication channels and knowledge management initiatives for Kenyan rural farming, *5th Int'l Conf. on Wireless, Mobile and Ubiquitous Technologies in Education (WMUTE2008), Beijing-China*, pp.23-26.

[8] Dale, E. 1969. Audio-Visual Methods in Teaching, 3rd Edition, New York, Holt, Rinehart, and Winston.

[9] Dighe, A. 2004. *Pedagogical Approaches to Literacy Acquisition and Effective Programme Design*, Background paper for Education for All Global Monitoring Report.

[10] Dobriceanu, O. D., Nicola, H. 2006. Low Cost Literacy e-Learning Tool, *International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM '06)*, pp.1483-1488.

[11] Eberle, A., Robinson, S. 1980. *The adult illiterate speaks out: personal perspectives on learning to read and write*, Washington, D.C. National Institute of Education, U.S. Dept. of Education.

[12] Edmunds, C., Lowe, K., Murray, M., & Seymour, A. 2002. *The Ultimate Educator: Achieving Maximum Adult Learning through Training and Instruction*, National Victim Assistance Academy (Advance Topic Series). Washington, DC: US Department of Justice, Office of Victims of Crime. http://www.ojp.usdoj.gov/ovc/assist/educator/welcome.html Last Accessed November 11, 2009.

[13] e-Learning for Adults. http://www.elfora.net/. Last Accessed November 11, 2009.

[14] Gardner, H. 1983. Frames of mind: A theory of multiple intelligences, New York, Basic Books.

[15] Kam, M., Agarwal, A., Kumar, A., Lal, S., Mathur, A., Tewari, A., Canny, J. 2008. Designing E-Learning Games for Rural Children in India: A Format for Balancing Learning with Fun, *Proceedings of the 7th ACM conference on Designing interactive system*, pp.58-67.

[16] KOH, J., YOUNG-GUL, K., BUTLER, B. & BOCK, G-W. 2007. Encouraging Participation in Virtual Communities, Communications of the ACM, Vol. 50, No. 2, p. 69-73.

[17] Kolb, David A. 1984. Experiential Learning: Experience as the Source of Learning and Development, Prentice-Hall, Inc., Englewood Cliffs, N.J.

[18] Krudenier, J. 2002. Research-Based Principles for Adult Basic Education Reading Instruction, National Institute for Literacy, Washington, DC.

[19] Lave, J., & Wenger, E. 1990. Situated Learning: Legitimate Peripheral Participation, Cambridge, UK, Cambridge University Press.

[20] Learning Theories.com, Knowledge Base and Webliography. Last Accessed November 11, 2009.

[21] Literacy Games for Adults, NWT Literacy council. http://www.nald.ca/library/learning/howtokit/games/games.pdf, Last Accessed November 11, 2009.

[22] Mehdi, I., Sagar, A., Toyama, K. 2006. Text-Free User Interface for Illiterate and Semi-Literate Users, *International Conference on Information and Communication Technologies and Development* (ICTED' 06), pp.72-82.

[23] Merriam, S. B. 2001. Andragogy and Self-Directed Learning.. *In The New Update on Adult Learning Theory*. New Directions for Adult and Continuing Education no. 89, edited by S. B. Merriam, pp. 3-13. San Francisco: Jossey-Bass.

[24] Millar, D. 1996. *Executive Summary of the Use of Educational Software in Adult Literacy Programs: A Comparison of Integrated Learning Systems and Stand-Alone Software*, Ottawa, National Literacy Secretariat.

[25] Molka-Danielsen, E. J., Deutschmann, M. 2009. *Learning and Teaching in the Virtual World of Second Life*, Tapir Academic Press.

[26] Online Degree World, Education for Everyone. http://www.onlinedegreeworld.com/blog/2009/100-best-websites-for-free-adult-education/, Last Accessed November 11, 2009.

[27] Online Encyclopedia, http://www.encyclopedia.com/doc/1O999-illiterate.html. Last Accessed November 11, 2009.

[28] Patel, N., Agarwal, S., Rajput, N., Nanavati, A., Dave, P., S. Parikh, T. 2009. A comparative study of speech and dialed input voice interfaces in rural India, *Proceeding of the 27th International Conference on Human Factors in Computing Systems*, pp. 51-54.

[29] Plauche, M., Nallasamy, U., Pal, J., Wooters, C., Ramachandran, D. 2006. Speech Recognition for Illiterate Access to Information and Technology, *International Conference on Information and Communication Technologies and Development, UC Berkeley* (ICTD' 06), pp. 83-92.

[30] Rajput, N., Agarwal, S., Kumar, A., Anil Nanavati, A. 2008. An Alternative Information Web for Visually Impaired Users in Developing Countries, *Proceeding of the 10th International ACM SIGACCESS Conference on Computer and Accessibility*, pp. 289-290.

[31] Rankin, Y. A., Gold, R., Gooch, B. 2006. Evaluating Interactive Gaming as a Language Learning Tool, *Proceedings for ACM SIGGRAPH Conference.*

[32] Richmond, M., Robinson, C. & Sachs-Israel, M. 2008. *The global literacy challenge: A profile of youth and adult literacy at the midpoint of the United Nations Literacy Decade 2003-2012:* UNESCO.

[33] Robbins, S. 2007. A futurist's view of Second Life Education: A Developing Taxonomy of Digital Spaces, *In Proceeding of Second Life Education Workshop*, pp. 27-33.

[34] Second Life, a 3D Virtual World, http://secondlife.com/. Last Accessed November 11, 2009.

[35] Sibiya, S., and Rooyen, L. V. 2005. Illiterates in South Africa: Who are They and what Motivates them to Participate in literacy Campaigns? *International Review of Education*, 51(5–6): 479–497.

[36] Taoufik, I., Kabaili, H., Ketttani D. 2007. Designing an e-government portal accessible to illiterate citizens, *Proceedings of the 1st international conference on Theory and practice of electronic governance*, pp. 327-336.

[37] UNESCO Education Sector. 2004. *Position Paper: The Plurality of Literacy and its Implications for Policies and Programmes.* Paris: UNESCO.

[38] Walsh, P., Meade, J. 2003. Speech Enabled E-Learning for Adult Literacy Tutoring, *Proceeding of the 3rd IEEE International Conference on Advanced Learning Technologies*, (ICALT' 03), Vol. 1, pp.17.

[39] William, S., McMinn, J. 2009. Knowing Culture in Second Life: International literacy and technological know how in virtual world, *International conference on Multimedia and Information and communication Technologies in Education, Lisbon, Portugal*, pp. 616-621.

[40] World Reference English Dictionary, http://www.wordreference.com/definition/illiterate. Last Accessed November 11, 2009.