# A Framework for Evaluation of E- learning Applications in Developing Countries

**Aarati Prakash Khare[1] and Jyoti Kumar[2]**

[1,2]IDDC, IIT, Delhi
E-mail: [1]aaratipkhare@gmail.com, [2]jyoti@iddc.iitd.ac.in

**Abstract**—*E-learning as a mode of knowledge and skill dissemination is gaining popularity. With more usages of e-learning in diverse contexts, the need to evaluate the effectiveness of an e-learning application has risen both from point of view of ease of use of E–Learning, and also from the learner's efficiency measurement. While evaluation of e-learning systems will require expertise in system design, interaction design process, and user centered design methods, understanding of learning behavior etc., a framework of evaluation is required for standardization of evaluations.*
*This paper proposes a method to test the e-learning effectiveness from the lenses of usability and learning efficiency. The author has proposed a framework of evaluation which is based on extended Kirk Patrick model. The extended model includes 1) Learners' Attitude, 2) Social, Cultural background 3) economy and environment in Indian context.*

## 1. INTRODUCTION

E learning in the developing countries fast evolving from traditional to digital. The digital mode of learning can be synchronous, asynchronous, and blended learning. While synchronous learning is online where all the students are engaged in learning simultaneously, asynchronous learning gives freedom to individuals to choose the time and place of learning. The benefit of the latter is that the student may still use courses available on net yet can have the training at their own place and time though not connected to the group. Blended learning is the traditional way of learning partially supported by web enhanced instructions.

Diverse factors may impact the learning process using digital technology in developing countries, like less exposure to technology, poor methods of pedagogy, infrastructure, income, non-vernacular language, cultural, social and personal(2). However, there is a huge potential in the developing countries for e-learning, as the demand of quality education is high for a large section of society and governments arestruggling to provide the education due to shortage of teachers. Also, the demand of E-Learning in the professional fields like animation is growing (1). In order to ensure the effectiveness of the E-learning systems it is required to have evaluation processes in place. Currently not much literature is available on E-learning evaluation methods.

Further, the e-learning process is not constrained by scheduled time and place of learning, like traditional methods. Several options of using the online learning material exist including blended learning. The method of use of digital content provided in e-learning packages, online or offline may depend upon factors like economy, technology, learners pace and time, learner's ability, efficiency etc. Hence, the evaluation of e-learning has to be in the context of the user and the usage scenario.

Also, there has been high dropout rates reported in e-learning environment in developing countries in comparison to the traditional classroom base learning (3). The authors posit that the reason behind the higher dropout rates in e-learning mode may be either due to external challenges like infrastructure, economy, language etc. or may be merely due to the poor design of the e-learning package. In order to ascertain this a proper evaluation of e-learning methods will be required.

## 2. MODELS OF LEARNING AND CHALLENGES IN DESIGN OF E-LEARNING SYSTEMS

E-learning is a wide set of applications and processes which use all available electronic media to deliver vocational education and training. The term covers computer-based learning, web-based learning, and the use of mobile technologies; it includes virtual classrooms and digital collaboration and uses. Online, e-learning m-learning, traditional learning and blended learning are different approaches to learning underlying same principles of learning by the human beings but using different media and methods. Theories of effective learning, which have been explored in instructional design and educational psychology has been implemented by different agencies and researchers.

Efficient design of educational content becomes one of the main challenges in E-learning success. Instructional design aims at creating experiences which make the learning process efficient, effective, and appealing (4). The process of designing E-learning instructions consists broadly of determining the entry level knowledge of learner and his needs; defining the end goal of instruction and creating "interventions" to assist in the learning development of the

learner. The E-learning process is informed by pedagogically (process of teaching) and andragogically (adult learning) tested theories of learning and may take place in any settings and environment. The outcome of this instruction may be directly observable and scientifically measured or completely hidden and assumed. There are many instructional design models, but many are based on the ADDIE's model with the five phases: 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. As a field, instructional design is historically and traditionally rooted in cognitive and behavioral psychology, though recently Constructivism i.e. learning by doing (learning theory) has influenced thinking in the field probably will be the best suited theory for e-learning. (5), (6), (7), (8).

A considerable amount of training materials for the military was developed during WW2, based on the principles of instruction, learning theories, and behavioral aspects. Tests for assessing a learner's abilities were used in the training programs as a prerequisite for the candidates. After the success of military training, psychologists began to view training as a system, and developed various analyses, design, and evaluation procedures; based on cognitive and physiological aspects (9).

In 1946, Dale outlined a hierarchy of instructional methods and their effectiveness. According to him the people generally remember through learning activities 90% when they are exposed to a learning session through simulation, design, perform or do the real thing in comparison to any other source of instruction and information (10).

According to B. F. Skinner's 1954 article "The Science of Learning and the Art of Teaching", according to Skinner instructional materials that are effective, called programmed instructional materials, should include small steps, (broken into smaller assignments) frequent questions about the experience and the outcome which has been retained so far, immediate feedback about the content, and allow self-pacing according to the learner's ability. The Popularization of Behavioral Objectives – Robert F. Mager promoted the use of learning objectives with his1962 article "Preparing Objectives for Programmed Instruction". In the article, he describes how to write objectives, including desired behavior at the entry level, learning conditions, and assessment (9).

In 1956, a committee led by Benjamin Bloom published an influential taxonomy of what he termed the three domains of learning: Cognitive (what one knows or thinks), Psychomotor (what one does, physically) and Affective (what one feels, or what attitudes one has) which starts from the lowest level of cognitive domain that is knowledge and gradually taking 6 steps of learning goes up to the evaluation level. These taxonomies still influence the design of instruction (10), (11).

Robert Glaser first used the term "criterion-referenced measures" in 1962. In contrast to norm-referenced tests in which an individual's performance is compared to group performance or sample drawn from the population, a criterion-referenced test is designed to test an individual's behavior in relation to an objective standard or what was taught as standard task. It can be used to assess the learners' entry level behavior, and to what extent learners have developed mastery through an instructional program. In interactive courses it will be useful to assess the learning outcomes (9). In 1965, Robert Gagne described five domains of learning outcomes and nine steps or events of instruction in "The conditions of Learning", which is still in use as the foundations of instructional design practices (9). Genes work in learning hierarchies and hierarchical analysis led to an important notion in instruction – to ensure that learners acquire prerequisite skills that are smaller units before attempting to master the higher or more complex units. This is still in practice in any kind of training program (12).

As such there are no separate models of e-learning, rather models of learning in the electronic environment. That is to say, e-learning means using technology/ infrastructure to achieve better learning outcomes, or a more effective assessment of these outcomes with the help of instructors or trainers, or a more cost-efficient way of bringing the learning environment to the learners irrespective of culture and distance. It is all the more important, when implementing e-learning approaches, or the stages to be considered as pedagogical alignment? Or one has to be clear about the underlying assumptions. A model of e-learning would need to demonstrate on certain pedagogic principles and the added value of the technology.

Biggs has suggested the task of good pedagogical design is an ensured outcome of that there has to be a balance between all these aspects the curriculum we teach, the teaching methods we use, the learning environment we choose, and the assessment procedures we adopt. Biggs uses the term 'constructive alignment' to indicate that in his view the guiding assumptions about learning should be based on constructivist theory. The relevant point is that the alignment process cannot proceed without first examining the underlying assumptions about learning, and then adapting teaching methods that align with those assumptions. Biggs adopted a constructivist approach to ground the design decisions: there must be guidance on how to judge whether the learning and teaching processes adopted will really achieve the intended learning outcomes (13). For good pedagogical design, there is simply no escaping the need to adopt a theory of learning means even though it is the latest platform and learning environment, but the traditional learning theories and its models will be the base of e-learning system design (11).

## 3. EDUCATIONAL THEORIES AND E-LEARNINGAND VOCATIONAL EDUCATION & TRAINING

There are specific traditions in educational theory that derive from different perspectives about the nature of learning itself.

From different traditions in educational psychology three broad clusters or perspectives, which make fundamentally different assumptions about what is crucial for understanding learning, has been suggested (11).

These can be classified as:

1. The associations/empiricist perspective (learning as an activity)
2. The cognitive perspective (learning as achieving understanding)
3. The situative perspective (learning as social practice)

Learning is the process of connecting the elementary mental or behavioral units, through sequences of activity, it requires the prior knowledge which is experience based and skills gained over the period. This view encompasses the research traditions of associationism, behaviorism and connectionism (neural networks). Associationist theory requires subject matter to be analyzed as specific associations, expressed as behavioral objectives. This kind of analysis was developed by Gagnė (12) into an elaborate system of instructional task analysis of discriminations, classifications and response sequences. Learning tasks are arranged in sequences based on their relative complexity, according to a task analysis, with simpler tasks as pre-requisites for more complex tasks. Analysis of complex tasks into Gagnė's learning hierarchies – the decomposition hypothesis – involves the assumption that smaller units need to be mastered as a prerequisite for more complex units this theory is applicable while designing the task level when it's getting complex step by step.

 Robert Gagnė provided a basis for analyzing concepts and procedures of subject matter curricula in terms of information structures, and gave a new dimension to pedagogy. Within this broad perspective, particular sub-areas of cognitive research can be highlighted as particularly influential, e.g.: Schema theory an information processing theory that explains how knowledge is interpreted, stored and retrieved for processing and utilization of  internal knowledge structure, which includes of problem solving and reasoning, levels of processing in memory, general competencies for thinking, mental models, and metacognitive processes. The underlying theme for learning is to model the processes of interpreting and constructing meaning, and a particular emphasis was placed on the instantiation of models of knowledge acquisition in the form of computer programs. A mapping of theoretical accounts of learning onto pedagogical frameworks for design principles has been derived from the three broad, distinct fundamental theoretical perspectives: associationist (learning as an activity), cognitive (learning) as achieving understanding) and situative (learning as social practice).

As constructivism is eventually recognized as a philosophy about curriculum design, especially a practical aspect of learning rather than a learning theory, Vocational Education and Training (VET) and schools will gradually reform their curriculum and learning structures. For the VET sector to effect e-learning changes, 'policy must be advanced which supports likely future scenarios, including pervasive, virtual delivery of learning materials' (14). The VET sector will continue to be a leader in providing a balance of professional development for teachers in the use of ICT, and in developing quality new content for online delivery. The Framework will have an increasing influence on organizational behavior, policy and business and community sectors, enlightening them on the benefits of e-learning. Future projects under the framework will be less focused on products and more on engaging people to adopt a learner centered approach.

Educational Theory has also had an impact on using ICT, as content creators search for a theoretical basis to justify their designs, and as technology is seen increasingly as an enabler of learning. The popularization of cognitivism as the dominant 'post-modern/post-behaviorist' learning theory and the recognition of the importance of the social context for learning is changing curricula and teaching practice. Significant trends in connecting pedagogy and educational technology are emerging worldwide as learners; trainers and teachers evaluate the capacity of e-learning. They want to improve learning for different types of skills and competencies, especially for certain distant learning programs or there is a scarcity (15). In the sector of ICT effort is being directed at determining the factors that create effective electronic learning environments on any platforms (16), and the broader factors that create successful e-learning programs (17). Cognitivism and constructivism in learning focus on achieving higher-level or post 16 learning (18) in engendering independent, self-reliant learners who can employ a range of strategies to construct their own knowledge n competencies. Cognitivism is based on a cognitive model of the human mind and the premise of a limited working memory, and the importance of relating new knowledge to existing knowledge structures within the brain. Collaborative activities, (on virtual classrooms) sites where students can use e-mail, forums, bulletin boards and share and edit documents online arise as alternatives to the more rigid Learner Management Systems (19), it was argued that collaboration with students renews the teacher/learner relationship, while maintaining immediacy and minimizing the need for technical expertise.

Blended learning allows for a range of teaching and learning practices to be combined into a customized learning experience for each individual learner. The term blended learning is a  combination of e-learning and other training methods-this concept of blended learning will be used more effectively in future - proactive blending, which means taking into consideration the strengths and weaknesses of technology-mediated learning (20)

A number of sources have recently cited the growing trend to blended learning that is, incorporating the use of ICT into the instructional process to support rather than replace face to face delivery. In blended learning is described as a combination of traditional and technology based education 'a method of

educating at a distance that uses technology (high-tech, such as television and the Internet or low-tech, such as voice mail or conference calls) combined with traditional (or, stand-up) education or training' (21). It is likely that this is not actually a measurable trend away from online delivery and towards a blended mode, but more of the recognition that this mode is commonplace, meets the needs of larger numbers of students and teachers, and seems to be a key component of the more successful uses of ICT which covers the places where technology is still in an infant stage and some places where it is in advance stage. Some writers (22) have described blended learning as the strategic use of learning delivery platforms, possible platforms trends in technology and amalgamation of all including the traditional way of education. These channels are a physical classroom, a virtual classroom, print, email, message boards, the telephone, coaching and mentoring systems, EPSS, software simulations, online collaboration, self-paced e-learning, and knowledge management channels and increasingly, mobile or wireless channels. Blended learning has been successful because it commonly emerges as a delivery technique from a process of planning and analysis that has been described as 'bulletproof' (23). There is also an evidence to show that it is a learning design implicit in many successful models. In an analysis of a two-year empirical study (24), concludes that blended learning methods 'enhances employee productivity over single-delivery options'. Advocates of blended learning maintain its success is due to its combining successful elements of traditional and technology-enhanced delivery (25) and this is leading to a heightened awareness of its value especially in the developing countries.

Though there are learning theories which have looked into learning as a process within and without the learner, in context of e-learning we need to extract the concepts discussed in these theories that will be useful in understanding and evaluating the learning process. From, this perspective, Kirkpatrick model of evaluation has been taken by the authors for further discussion.
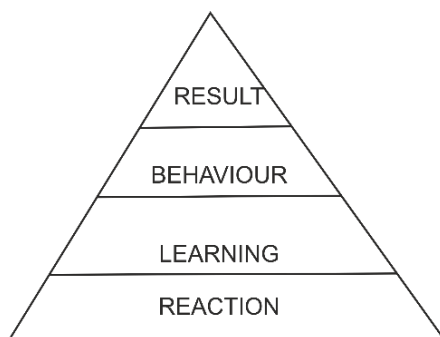


**Fig. 1: Kirkpatrik Model for Learning Evaluation**

While learning theories guide the design of the e-learning systems, models to evaluate the learning success has also been reported. One of such models of evaluation has been developed byDonald Kirkpatrick(26)is a model which is popular and has been used since late 1950s by thetraining community. This model focuses on four levels of outcomes measured as a result from a learning program. theevaluation has been proposed to be done at four levels, namely, Level 1- Reaction, Level 2- Learning, Level 3- Behavior, Level 4- Results.

Kirkpatrick suggested that the first level of the model called'reaction' should be measured after the completion of the learning program. The level one should measure the attitude or reactions towards components of learning like instructor, topic, presentation style, schedule, audio-visuals etc. The level one can be further broken down on the sub components such as characteristics of instructor and the presentation etc. The second level talks of evaluation of learners' positive attitude which is responsible for learning at the second level leading to a behavior change. Level 1 can be measured through the questionnaire checking the weakness and strength of the program. This can be checked with an8 pointer scale. Few advantages of level 1 – participants experience, engagement throughout the training, missing aspects, overall reaction as well as about the specific event.

Detail evaluation of level 1 that is reaction can provide formative evaluation information of the entire learning event; which will be helpful in improvement of future programs.

Level 2- learning evaluation determined the goal as what the participants have learned during the event as this program has been designed with specific objectives focusing on measuring knowledge, skills gained and change in attitude. Knowledge can be measured through instructor constructed achievement tests. These are criterion referenced tests based on Robert Glaser criterion measurement. In this the expert should have a pool of items to measure the content. Skill can be measured through performance test that is post-test. This is in comparison with pre-test measurement of skill and knowledge done at the entry level. This level evaluation helps the trainer to promote their program, helps in interpretation of the level three result as behavior change. This is a part of formative evaluation.

Level 3 behavior change in work place is at times long term and short term. This is on the job behavior this level evaluation involves specifically measuring of knowledge transfer, skills and attitude applied at the work place. This OJB on the job behavior basically effected by work place factors as well as training factors. Behavior change is based on extrinsic rewards as good grades, perks, praise, pay increase etc. and by intrinsic reinforcement of learned knowledge, skills or attitudes.

Level 4- results as the fourth level is taken at an organizational level. As ROI return on training investment increased in sales higher productivity, improved quality of work life, higher work morale, satisfaction.

## 4. DEVELOPMENT OF A FRAMEWORK FOR EVALUATION

Proposed framework for evaluation of an e-learning program,designed and created on basis of the models and theories described in the section 2need to be built in a way such that different stakeholders of system can find it useful and it is in congruence of the learning model used.

As discussed in section 2, Dale outlined the hierarchy in instructions suggesting that learning by doing helps retain 90% of the instructions, Benjamin bloom's taxonomy focused on the cognitive, affective and motor aspects of a user,Robert Glaser's emphasis on entry level and master level behaviours being separate, Gagne's recommendation for hierarchical structure of information, Biggs suggestion on balance between curriculum, teaching methods, learning environment and assessment procedures. The authors perceive an opportunity to accommodate these different models of learning in the e-learning context, especially in the context of the vocational training in developing countries.

In section 3, relationship between the VET sector and E-Learning as well as blended learning and impact of ICT has been discussed. Authors posit that incorporating ICT into existing learning environment instead of replacing face to face learning creating a blended learning environment, will make self- reliant learners who can construct their own knowledge and competencies in due course.
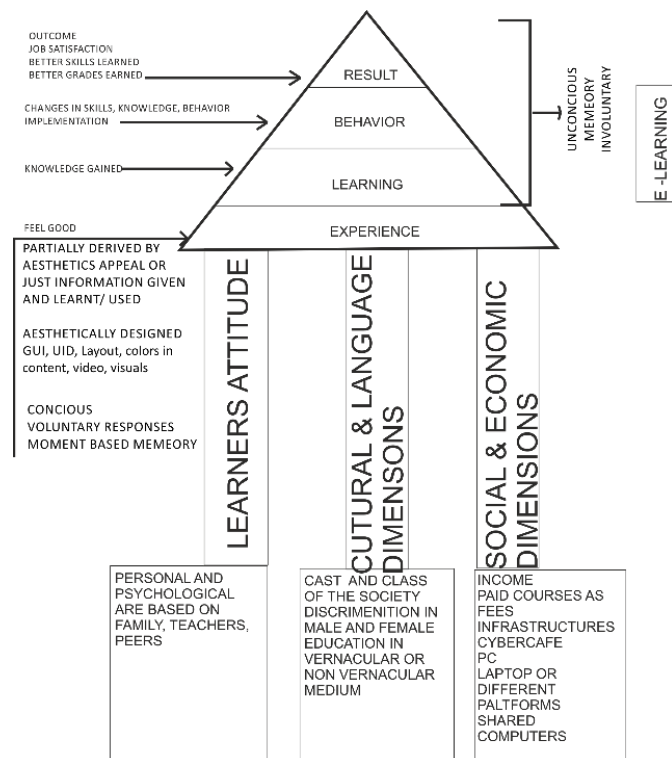


**Fig. 2: proposed framework based on Kirkpatrick's model**

It is proposed here that in order to accommodate the influences of the culture, learner's predispositions and socio-economic influences the Kirk Patrick Model of learners evaluation be extended with additional three pillars at the base to accommodate additional factors due to specific needs of the developing countries.

In developing countries education is affected by a no. of factors very unique to the nature of developing societies. Authors posit that these need to be accommodated in the evaluation of e-learning packages. Kirk Patrick model of evaluation for developing countries for the e learning program is selected by the author for extension as there is a need to accommodate and amalgamate factors like personal, social, cultural and economic on which this pyramid of evaluation model stands high. Which will have a strong impact on deciding the success of the program.

In Kirkpatrick's model, the first level is reaction which is measurable as 'Experience' or 'Satisfaction' of the leaner. The aspect of 'experience' can be treated both at the level of short term and long term impact as this is broken further as first impression of the site, ongoing experience of learning and long term reaction after the training or course is over. As compare to traditional method, where face to face learning happens, the instructor, topic, audio visual aids etc.affect the participants.

**Pillar 1**- Attitude: author is proposing to support the evaluation of 'reaction' based on the first leg that is an attitude. Attitude can be positive or negative. Willingness to learn and to achieve is built over the years. A person is influenced by family for having fearful or fearless attitude towards learning. Teacher role is important in motivation or lack of support for learning or dropping the subject and skill. Prior knowledge and interest of the subject can also influence the attitude.

Tools developed initially to check the attitude can be a good support in measure of the success of the program. A questionnaire and a scale may be used to measure attitude.

As the first level in Kirk Patrick model talks of reaction which is based on "conscious voluntary responses and momentary memory" of the first impressions of the website within a short span of a few seconds. Experience of the process is about the complete program is long term and influenced by long term "unconscious memory involuntary" which will be from level-2 evaluation of learning to level 4 that is evaluation of result.

**Pillar 2**- Culture and language: Itcan be two important factorsinfluencing the use of technology. Differential gender treatment may lead to different cultural attitude towards the technology. Male members of society being encouraged in a culture to select subjects like engineering, maths, science and computers etc. while female members being suggested subjects like arts, interiors and design etc. may show differential preparedness in the genders towards e-learning and may result in different learning outcomes.

**Pillar 3**- Social and economic dimensions: This pillar includes availability of infrastructure, investment in education, sharing of computers with the peers, low bandwidth of internet, and scarce availability of electricity can be some of the components effecting the learning confidence in the user as these factors may have tendency to linger on in the unconscious mind and affect the available mental resource for learning.

## 5. CONCLUSION

Extension of Kirkpatrick model with three additional pillars, namely Learners Attitude, Cultural Dimensions and Socio-Economic Dimensions is proposed to help develop a framework for evaluation which can be useful while evaluating e-learning success in developing countries. The tools can be created and differentially applied to measure these aspects on the basis of how strong or weak the influence of each pillar is in a given situation.

## REFERENCES

[1] "UNESCO 2006," UNESCO (2006) Teachers and Educational Quality: Monitoring Global Needs for 2015. http://www.uis.unesco.org/Template/pdf/Teachers2006/Teachers Report.pdf, 2006.

[2] Å. Grönlund, "A conceptual Framework For E Learning in zdeveloping" *EJISDC,* vol. 38, no. 8, pp. 1-16, 2009

[3] Y. Levy, " Comparing Dropouts and Persistence in E-Learning Courses, Computers & Education, .," vol. 48, no. 2, pp. 185-205, 2007.

[4] M. D. Merrill, L. Drake, M. J. Lacy, J. Pratt and & ID2 Research Group, "Reclaiming instructional design," *Educational Technology,* pp. 36(5),5-7, 1996.

[5] R. E. Mayer, "Cognition and instruction : Their historic meeting within educational pshychology," *Journal of Educational Pshychology,* vol. 84(4), pp. 405-412, Dec 1992.

[6] T. M. Duffy and D. J. Cunningham, "Constructivism : Implications for the design and delivery of instruction," pp. 170-198, 1996.

[7] T. M. Duffy and D. H. Jonassen, "Constructivism: New implications for instructional technology," in *Constructivism and the technology of instruction*, T. Duffy and D. jonassen, Eds., Hillsdale,NJ:Erlbaum, 1992, pp. 1-16

[8] R. G. Morrison, Designing Effective Instruction, 6th Edition ed., John Wiley & Sons, 2010.

[9] R. A. Reiser and J. V. Dempsey, "Trends and issue in instructional design and technology," 2012.

[10] B. Clark, "History of instruction Design and Technlogy," 2009. [Online]. Available: http://www.slideshare.net/benton44/history-of-instructional-design-and-technology

[11] T. M. &. S. d. Freitas, " Review of e-learning theories, frameworks and models :," 2010. [Online].

[12] R. M. Gagne, The Condition of learning and theory of instruction, 4th edition ed., Holt, R. and W. , Eds., New York, 1985, p. 361.

[13] J. Biggs, Teaching for quality learning at university, Buckingham: Open University Press, 1999.

[14] R. Hill, P. Malone, S. Markham, R. Sharma, J. Sheard and G. Young, "Researching the size and scope of online usage in the vocational education and training sector," 2003.

[15] V. Reding, "http://europa.eu/rapid/press-release_SPEECH-03-48_en.htm," 4 Feb 2003. [Online].

[16] B. H. Khan, "Dimensions of E-Learning," *Educational Technology,* pp. 1,42,59-60, 2002.

[17] J. Freydenberg, Quality Standard in E-Learning: Matrix of Analysis.International review of research in open and distance learning, 2002.

[18] D. Hung and M. Nichani, "Constructivism and E-Learning :Balancing between the individual and social levels of congnition," *Educational Technology,* pp. 40-44, 2001.

[19] M. Jasinski, "E-Games:Improvisation through open platform design," in *Gold Coast*, 2001.

[20] M. Brodsky, *E-Learning Treands, Today and Beyond. Learning and Training Innovation Magazine,* 2003.

[21] J. M. Smith, Blended Learning An Old Friend Gets a New Name, 2001

[22] D. Morrison, "The search for the holy recipe," May 2003

[23] F. J. Troha, "Bulletproof instructional design: A model for blended learning," *USDLA,* p. 16, 5 May 2002.

[24] J. Barbian, "Blended Works: Here's Proof!," pp. Online learning,6,26-31, 2002.

[25] J. Zenger and C. Uehlein, "Why Blended will win," *T + D,* vol. 55, pp. 8,54-59, Aug 2001.

[26] D.L. Kirkpatrik, The four legs of evaluation-Tips, tools and intelligence for trainers, published by American Society for Training and development, Jan 2007, Issue 0701