

## ICT FOR EDUCATION

### *Integrating Instructional Multimedia and Cognitive Domain for Effective Interactivity*

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#### Introduction

Integrating Instructional Multimedia and Cognitive Domain for Effective Interactivity The aim of providing education is to develop the potentialities of individual learners for personal enrichment in the sense of developing their creative, designing, constructing, comparison, judgment, analytical and self appliance skills, as well as the requirements of social development and economic and employment growth.

E-Learning refers to educational processes that utilize information and communications technology to mediate asynchronous as well as synchronous learning and teaching activities. Information and communication technologies (ICTs) are a "diverse set of tools and resources used to communicate, create, disseminate, store, and manage information." These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony. There is increasing interest in how computers and the Internet can improve education at all levels, in both formal and non-formal settings.

The main objective of this study is to integrate the media and the potentialities of an individual in cognitive domain that involves knowledge and the development of Intellectual skills in accordance with Benjamin Bloom's Taxonomy.

Computer-based multimedia instruction is one of the important innovations of the 21st century in teaching-learning process. It is self-instructional technique for providing individualised instruction or learning experience to learners. Computer based multimedia Instruction emerged from the programmed learning.

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Computer-based Multimedia Instruction is a process of arranging material to be learned in a series of small steps designed to lead a learner through self instruction from what he knows to the unknown of new and more complex knowledge and principles. A programme takes the place of a tutor and leads the learner through a set of frames of specified behaviour designed and sequenced to make it more probable that he will behave in a given derived way. In programmed learning, it is said that the most efficient, pleasant and permanent learning takes place when the student proceeds through a course by a large number of small, easy-to-take steps.

This study focuses on the information design that the raw information in terms of content, scope and purpose of the interactive content, where the best ways to express these ideas? The Instructional package is designed in several formats ranging from slide shows, animations, sequential stories, quizzes, games, demonstrations and simulations. Brainstorming the possible methods of presentations can produce a wealth of ideas.

Multimedia instructional package effective development, Deployment, Curriculum Development, Content Availability, Training and Usage Support highlights issues which will be addressed for successful implementation.

Technology is an increasingly influential factor in education. Technology offers powerful learning tools that demand new skills and understandings of students. Higher educational institutions are increasingly moving toward the use of the Internet for delivery of their courses. As to develop the individual learner's cognitive skills Bloom's taxonomy is imparted with learning design.

### **Technologies Imparting Education**

Technology is an increasingly influential factor in education. Computers are being widely used to complement established education practices and develop new ways of learning such as online education (a type of distance education). This gives students the opportunity to choose what they are interested in learning. The proliferation of computers also means the increase of programming and blogging. Technology offers powerful learning tools that demand new skills and understanding of students, including multimedia, and provides new ways to engage students, such as Virtual learning environments.

Information and Communication Technologies (ICTs) are a "diverse set of tools and resources used to communicate, create, disseminate, store, and manage information." These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony. There is increasing interest in how computers and the Internet can improve education at all levels, in both formal and non-formal settings.



The Open University of the United Kingdom (UKOU), established in 1969 as the first educational institution in the world wholly dedicated to open and distance learning, still relies heavily on print-based materials supplemented by radio, television and, in recent years, online programming. Similarly, the Indira Gandhi National Open University in India combines the use of print, recorded audio and video, broadcast radio and television, and audio conferencing technologies.

Computer-assisted learning (CAL) has been increasingly used to describe the use of technology in teaching ICT based education, computer-based education (CBE), stored (like CDs, DVDs, video and audio cassettes) media based education, Web-based education (WBE), Internet2-based education, interactive TV-based education, open broadcast TV based education.

### **E-Learning**

Higher educational institutions are increasingly moving toward the use of the Internet for delivery of their courses, both on campus and at a distance (Ally, 2004, p. 5; Kim & Bonk, 2006). The Internet provides significantly different and interesting possibilities for computer-mediated communication and learning from other forms of educational technologies (Weller, 2002, p. 34).

Ally (2004) argued that in order to promote higher-order thinking through technology based learning environments, instructional strategies which promote learners to make connections with new information to old, acquire meaningful knowledge, and employ meta cognitive thinking skills are required within the E - learning environment. This requires an analysis of the learner, the learning context and the learners' specific learning needs.

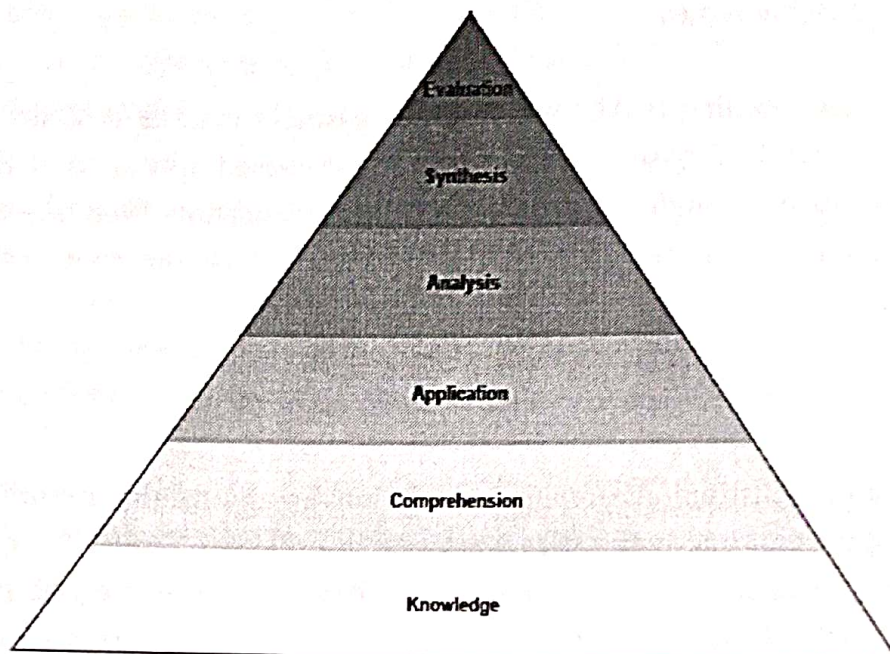
Ally, (2004) argued that E - learning designers should select learning strategies that motivate learners, facilitate deep processing, build the whole person, cater for individual differences, promote meaningful learning, encourage interaction, provide feedback, facilitate contextual learning, and provide support during the learning process.

As to develop the individual learner's creativity, designing, constructing, comparison, judgment, analytical and self appliance skills, Bloom's taxonomy of learning is suitable. There are six major categories Knowledge , Comprehension, Application, Analysis, Synthesis, and Evaluation that can be thought of as degrees of difficulties. That is, the first one must be mastered before the next one can take place. It is deduced that, depending on their preferred learning modality, different techniques have different levels of effectiveness.



**Knowledge** level student recalls or recognizes information, ideas, and principles in the approximate form in which they were learned write, list, label, name, state, and define.

**Comprehension:** Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.



Bloom's Taxonomy of learning. Adapted from: Bloom, B.S. (Ed.) (1956) Taxonomy of educational objectives: The classification of educational goals. Handbook I, cognitive domain. New York ; Toronto: Longmans, Green.

**Application** level is seen as a higher level thinking and requires students to use the new knowledge that was learnt in new or different situations. E - Learning activities that focus on this level includes those that guide students to arrive at a certain concept, rule, principle or method and use it in a new situation.

**Analysis** level is defined as the ability to break down material to identify its components and to analyze its organizational structure and content. Thinking at this level necessitates in-depth understanding of the content. E - Learning activities that focus on scaffolding thinking at this level includes those that guide students to study different components of a particular object, to better appreciate the relationships between the parts.

**Synthesis** level is often seen as the opposite of analysis. It involves the capability to assemble individual components to create a new product. E - learning activities that focus on scaffolding thinking at this level includes those that require students to construct a new product from the components given applying different aspects of their prior learning to put together a product.



Evaluation level of thinking requires students to evaluate or review the value or relative worth of ideas or objects based on predetermined criteria. This type of thinking is the highest level, often requiring the other five levels of thinking. E - Learning activities that focus on scaffolding thinking at this level includes those that require students to critic or review materials or ideas.

The E-learning design also satisfies the following modalities of learning while developing. It is to divide education into different learning "modes". The learning modalities are probably the most common: 1) Kinesthetic: learning based on hands-on work and engaging in activities. 2) Visual: learning based on observation and seeing what is being learned. 3) Auditory: learning based on listening to instructions/information.

Though there are various formats of eLearning, according to Sloan Consortium (2005), three formats were classified based on delivery modes and proportion of content delivered online including: complete online course, blended course, and web-facilitated courses.

Cognitive domain is one of the dominant theoretical positions in the field of learning with interactive courseware (Jonassen, 1991; Atkins, 1993; Hannafin, Hannafin, Hooper, Rieber, & Kini, 1996). Developments in design of such materials seem to have followed shifts in the dominant paradigms within psychology. Early computer-based materials are seen to be influenced by behaviorist concepts while discovery learning materials are felt to be founded on later cognitive models of information processing and constructivism. The increase in cognitive approaches in the 1980's may be due as much to technology developments in object-oriented programming, hypermedia and interactive video as to the rise within psychology of cognitive theorists (Atkins, 1993).

Park and Hannafin (1993) indicated that the psychological foundation, in general, focuses on how learners think, learn, and process information and is largely media-independent. This foundation is based on research and theory on meaningful learning, schema theory, prior knowledge, hierarchical cognitive structure, elaboration, depth of processing, generative learning, situated learning, conceptual models and metaphors, and dual coding theory. The pedagogical foundation is based on research and theories of instruction and teaching strategies including Gagné's work in learning hierarchies, elaboration theory, structural cueing, use of advance organizers, and anchored instruction. The technological foundation addresses the potential of technology to redefine teaching and learning, the capabilities of specific multimedia technologies, and the capabilities and limitations of interactive multimedia technology.

As advances in technology offer new opportunities for learning, it is important to use a range of theoretical perspectives to optimize use of new technologies in teaching and learning (Wild & Quinn, 1998).



This paper explores cognitive approach to interactive multimedia instructional design (ID). Basic concepts of the approach, characteristics of ID, Interface design guidelines for learning with multimedia will be presented, which link theory with practice in effective multimedia ID. Universal Design for Learning (UDL) is described, which sheds light on future research in ID to accommodate the diversity of learners.

### **CAI as an effective teaching method**

Ebenezer S. O. Collier (2004) surmised that instruction supplemented by properly designed CAI is more effective than instruction without CAI. Computers can be used for text and test reading, games, tutorial, drill and practice, and simulation of laboratory experiments.

Computer-assisted instruction can play an important role in classrooms and laboratory work not as substitute for other activities but as an additional tool. Cuoco and Goldenberg (1996) found in a mathematics curriculum that CAI offered the learner the ability to tinker with concepts in order to visualize results. Learners who could manipulate formulae, variables, and models independently using a CAI based tool gained a better working knowledge of these concepts compared to learners listening to the same concepts presented by lecture. Bergman and Cheney (1996) found CAI increases learner knowledge when it involves the synergy of multiple senses. Learners were found to retain new knowledge better when the curriculum was presented with a combination of formats of text, sound, graphics and video.

### **Cognitive concepts**

Cognitive psychology is concerned with meaning or semantics (Winn & Snyder, 1996). According to Wittrock's generative learning model, people learn meaningful material by generating relationships among new information and knowledge already stored in long term memory. Three kinds of learning are defined in Rumelhart and Norman's schema based theory of long term memory. Accretion, associated with memorisation, involves acquisition of factual information. Schema creation occurs as a result of encountering examples, analogies, metaphors, and tutorial interactions. Tuning or schema evolution involves gradual refinement of existing schema as a result of task practice or concept use (Shuell, 1986). Cognitive oriented instructional strategies are chosen for the likelihood of modifying schemata rather than of modifying behavior (Winn & Snyder, 1996).

### **Discovery Learning**

The goal of discovery learning is learning to learn, including the ability to question, evaluate one's strategies, and answer questions in the content domain. Discovery learning is not necessary to learn definitions, procedures and outcomes from an existing body of knowledge.

### **Scaffolding**

Scaffolding, based on Vygotsky's definition of zone of proximal development, is the gradual removal of a tutor's support for the individual to become an independent problem



solver as the individual appropriates knowledge and brings it under his/her own conscious control.

### **Problem-based Instruction/Learning**

Learning is organized around problem solving, rather than around subject matter. The teacher's role is to support students in their critical thinking skills, self-directed learning skills, and content knowledge in relation to problems. The teacher does not teach students what they should know or set a time for when they should know it.

### **Learner Control**

Giving learners control over pacing, sequence, and actual content of information presented is based on assumptions that learners know what is best for them and are capable of acting appropriately on that knowledge. If learners do not meet either assumption, then the computer or teacher is given control of content and learner tasks.

### **Assessment in Context of Learning**

In traditional settings, assessment is done after learning occurs. In a constructivist framework, assessment is embedded within an activity and must be in a context of problem solving. The distinction between learning and testing becomes blurred.

### **Cooperative Learning**

Groups work together to solve problems. The goal is to share, challenge, and form alternative viewpoints. Herrington and Standen (2000) proposed a constructivist shell to guide the design and development of an interactive multimedia program. Criteria include use of authentic contexts and authentic activities, access to expert performances and modelling of processes, multiple roles and perspectives, collaborative events, opportunities for articulation and reflection, coaching and scaffolding, and authentic assessment. Cognitive (information processing or constructivist) ID characteristics that fit this model include orientation activities, advance organizers, meta-cognitive devices, and active engagement, which Atkins (1993) described as follows:

#### **Orientation Activities**

Orienting activities prior to a learning task help learners to focus on new information, cut down the time needed to process information, and improve learning efficiency. Text, aural or visual cueing aim at holding new information longer in short-term memory for active engagement.

#### **Advance Organizers**

Advance organizers or anchoring concepts are introduced at the start of material to help learners make sense of information that follows. According to Ausubel (1960), however, the pedagogic value of advance organizers depends in part upon how well material is organized. Advance organizers probably facilitate incorporation and longevity of verbal



material in two ways. First, they activate whatever relevant concepts are already established in the learner's cognitive structure to increase the task's familiarity and meaningfulness. Second, appropriate advance organizers provide optimal anchorage, which promotes initial incorporation of new material and its later resistance to obliteration. If appropriately relevant concepts are not present, learners use whatever concepts are available.

### **Meta-cognitive Devices**

Meta-cognitive devices such as advice statements, help facilities, suggestions for more effective engagement and processing of information are employed. Providing a meta-cognitive framework is not easy, however. Much depends on the ability of learners to use such features.

### **Active Engagement**

Learners are expected to analyse, synthesise, summarise, describe, and solve problems. They are expected to build hypotheses, explanations, definitions, categories, rules, and so on, through study of examples and reflection on their own experiences. To help them, instruction uses frequent decision points and direct involvement in games, micro worlds, and simulations with results of decisions seen immediately. A variety of information sources are available to learners, who are moved back and forth between symbolic representations of phenomena and the real-life referent. Students also interact with experts (Atkins, 1993).

According to Winn and Snyder (1996), decisions regarding learning strategies should occur during instruction, not ahead of time. Learning and ID are best achieved by developing learning environments whose function is not entirely prescribed, but which can adapt in real time to student needs. The latest interactive multimedia systems and virtual reality environments allow students freedom to learn in their own way, rather than in the way a designer prescribes. Rodriques (2000) cautioned, however, that making software nonlinear by building in hyperlinks for learner control does not make software constructivist, though it may make it less behaviorist. Users can still navigate without reflective thought.

The problem in determining the effectiveness of cognitive design characteristics lies in the difficulty of knowing what is going on in the mind of learners. Evaluators are, therefore, forced back on measures such as apparent time on task; apparent engagement with the task presented, and subject estimations of its effectiveness (Atkins, 1993).

### **Conclusion**

In Instructional designing the cognitive approaches consider the role of unobservable mental states and introspection, which are part of human behavior (Winn & Snyder, 1996). Whether designers elect to use a cognitive approach depends on the nature of the materials to be developed and the context in which materials will be used. Designers have used objectivist models, such as the Dick and Carey instructional systems design model, to create materials focusing on human performance improvement. Constructivist models appeal to educators because of the diversity of learners and the need to motivate and engage them (Dick, 1996). However, the accountability movement in education with its focus on



identifying what students must know and be able to do and assessing students for mastery forces designers to write explicit objectives and criterion-referenced test items. Identify explicit objectives based on learner needs, but use instructional strategies that promote learning and content mastery in authentic settings.

## **References**

- Ally, M. (2004). Foundations of educational theory for online learning. In T. Anderson & F. Elloumi (Eds.), *Theory and practice of online learning*. Athabasca, Canada: Creative Commons: Athabasca University.
- Atkins, M.J. (1993). Theories of learning and multimedia applications: An overview. *Research Papers in Education*, 8(2), 251-271.
- Ausubel, D. (1960). The use of advanced organizers in the learning and retention of meaningful verbal material. *Journal of Educational Psychology*, 51(5), 267-272.
- Bergman, T., & Cheney, S. (1996). *Delivering Cost Effective Services to Small and Mid-Sized Companies: A Guide for Workforce and Workplace Development Providers*, <http://searcher.eric.org/ericdb/ed402481.htm> (ERIC Document Reproduction Service No. ED 402 481).
- Bloom, B., Englehart, M. Furst, E., Hill, W., & Krathwohl, D. (1956). *Taxonomy of educational objectives: The classification of educational goals, Handbook I: Cognitive domain*. New York, Toronto: Longmans, Green.
- Collier Ebenezer S. O. (2004), *The Enhancement of the Teaching and the Learning of the Sciences in Secondary Schools Using Computer Assisted Instruction*.
- Cuoco, A., & Goldenberg, E. (1996). A Role for Technology in Mathematics Education. *Boston University Journal of Education*, 178(2), <http://www.bu.edu/education/news/jedindex.html>. 15-32.
- Deubel, P. (2003). An investigation of behaviorist and cognitive approaches to instructional multimedia design. *Journal of Educational Multimedia and Hypermedia*, 12(1), 63-90.
- Dick, W. (1996). The Dick and Carey model: Will it survive the decade? *Educational Technology Research and Development*, 44(3), 55-63.
- Duffy, T.M., & Cunningham, D.J. (1996). Constructivism: Implications for the design and delivery of instruction. In D.H. Jonassen (Ed.), *Handbook for research for educational communications and technology*, 170-198.
- Gagné, R., Briggs, L., & Wager, W. (1992). *Principles of instructional design*, (4th ed), Fort Worth, TX: HBJ College Publishers.



- Green Gow, L. and Kember, D.(1990). Handbook I: Cognitive domain. New York, Toronto: Longmans, Does higher education promote independent learning? Higher Education, 19, 301-322.
- Hannafin, M., Hannafin, K., Hooper, S., Rieber, L., & Kini, A. (1996). Research and research with emerging technologies. In D.H. Jonassen (Ed.), Handbook for research for educational communications and technology 378-402. New York: Simon & Schuster Macmillan.
- Herrington, J., & Standen, P. (2000). Moving from an instructivist to a constructivist multimedia learning environment. *Journal of Educational Multimedia and Hypermedia*, 9(3), 195- 205.
- Kim, K. J., & Bonk, C. J. (2006). The future of online teaching and learning in higher education: The Survey Says... *Educause Quarterly*, 29(4).
- Monsakul Jintavee., Learning Management Systems in Higher Education: A Review from Faculty Perspective, Fourth International Conference on eLearning for Knowledge- Based Society, November 18-19, 2007, Bangkok, Thailand.
- Park, I., & Hannafin, M.J. (1993). Empirically-based guidelines for the design of interactive multimedia. *Educational Technology Research and Development*, 41(3), 63-85.
- Rodriques, S. (2000). The interpretive zone between software designers and a science educator: Grounding instructional multimedia design in learning theory. *Journal of Research on Computing in Education*, 33(1), 1-15.
- Shuell, T. (1986). Cognitive conceptions of learning. *Review of Educational Research*, 56(4), 411-436.
- Siragusa, L. Dixon, K.C. & Dixon, R. (2007). Designing quality e-learning environments in higher education. In *ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007*. <http://www.ascilite.org.au/conferences/singapore07/procs/siragusa.pdf>.
- Weller, M. (2002). *Delivering learning on the Net: The why, what & how of online education*. London: Kogan Page.
- Wild, M., & Quinn, C. (1998, January). Implications of educational theory for the design of instructional multimedia. *British Journal of Educational Technology*, 29, 73-82.
- Winn, W., & Snyder, D. (1996). Cognitive perspectives in psychology. In D.H. Jonassen (Ed.), *Handbook for research for educational communications and technology* 112-142. New York: Simon & Schuster Macmillan.