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The Place of Interactive Multimedia and Hypermedia Instruction in Enhancing Information Management in Educational Settings

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ABSTRACT

In this technologically driven world, the use of digital contents for creating, storing, managing and sharing information has been a norm among teachers and students, witnessing a transformation that allows both parties to share their experiences in a more natural and compelling form using the key elements of multimedia (pictures, audios, videos, and word processed text) in an interactive manner. Drawing from these platform, it is possible to make learning occurs through interaction with rich learning environments using online or standalone interactive multimedia and hypermedia thus making a significant progress in information management in educational setting. Consequently, the interactivity embedded in these technologies will build a new layer of competency; encourage the growth of learner responsibility, commitment, initiative, decision-making, intentional learning and ownership over the acquired knowledge, thus making the learner an active processor of information. This paper discusses the basic elements of interactive multimedia and hypermedia for enhancing information management in educational settings, the structure of interactive multimedia and hypermedia instruction, the design principles of interactive multimedia and hypermedia instruction. Finally, the paper portrayed the potential benefits to teachers and students.

Keywords: Interactive Multimedia, Hypermedia, Information Management, Education

I. INTRODUCTION

The continued search for effective ways of managing information in educational settings especially in a technologically driven world have made educators to redeem the multiple approaches to instructional delivery by refocusing on how information meant for students can be better managed and presented using interactive multimedia and hypermedia devices. This is based on the believed that students are more enthusiastic learning with digital technologies such as ipods, ipads, laptops, graphing calculators and other electronic devices. However, a careful observation revealed that the use of these versatile technologies is mostly on entertainment purposes than on education with increased cravings for interactive games, phonographs and unnecessary social media chats. Consequently, Sharma, Oliver and Hannafin (2007) remarked that a drastic effort should be made by educators to incorporate interactive multimedia and hypermedia instruction by making the structure of learning multisensory using different approaches such as pictures, motion pictures, drawings, and animations and student thinking more evident using iconic links to clearly signal relationships between relevant concepts.

In stressing the importance of interactive multimedia and hypermedia instruction in educational settings, Sharma, Oliver and Hannafin (2007) added that they offer a complementary approach to the present method of instructional delivery system. The view agreed with Berlanga and Gracia (2005) who argued that "the best way to alter the modus operandi in delivering instruction such as; teacher centred approach to a learner centred approach, is to bring technology in the classroom using a new method of instructional design". Spector (2013) added that interactive multimedia instruction is student-centred and encourages learners to be active and responsible for their learning process with little or no guidance from the teacher. In addition, the interactivity embedded in multimedia has the flexibility of allowing students to navigate forward and backward based on their own choice and individual learning speed thus, self-pacing between topics and sub-topics within the multimedia learning environment in a systematic way. Moreover, interactive multimedia lays more emphasis on effective dialogue between the instructional content and the students, while hypermedia instruction stresses on the integration of hypertext with images, video, sounds, animation and simulations in a more coherent manner resulting in an instruction with multiple learning routes.

Specifically, Mishra (2006) defined hypermedia as an outgrowth of hypertext leading to the branching and sub-branching of learning concepts showing relationship, association, similarities and continuity of learning process. The important feature of hypermedia is the use of arrows and links which indicates branching of knowledge and relationship between concepts using hypertext and hyperlink within a file. These features of hypermedia according to Sharma and Hannafin (2007) will provide a learner with all the learning resources needed to access related information with minimal effort, encourage comprehension, retention and transfer of knowledge leading to the achievement of instructional objectives. Furthermore, as technology advanced, the term hypermedia was used to describe a system where the user creates interrelationships between text, ideas, images, and sounds using associative links entrenched with videos, articles, bibliographies, and more. These associative links according to Sharma and Hannafin (2007) are available in the new form of electronic encyclopaedias with the capability for automatic language translation, continuous updating, and unlimited expansion of the learning material. Additionally, interactive multimedia and hypermedia are considered as an alien approaches to instructional delivery among the practicing educators, although global awareness of interactive multimedia and hypermedia has been growing rapidly throughout the educational community, however, it's wider application in educational settings is limited. This paper examined how interactive multimedia and hypermedia instruction enhances information management and effective communication among teachers and students.

II. METHODS AND MATERIAL

A. Interactive Multimedia and hypermedia Instruction: The basic elements

In the field of education, media is being used for a long time as "audio-visual aids", to help teachers present concepts in a simple and logical ways. These media included things like audio tapes, overhead and slide projectors, transparencies, motion pictures among others along with various sorts of equipment such as cameras, recorders, television monitors and recently projectors. The term "multimedia" is a relatively new word used to describe a combination of different media elements. Moreover, Berlanga and Gracia (2005) defined multimedia as an integration of multiple media elements (audio, video, graphics, text, animation) into well-established learning package that provide a positive learning experience to the end user, than any of the media element can provide individually. Multimedia learning according to Mayer (2005) is defined as learning from words (spoken or printed text) and pictures (illustrations, photos, maps, graphs, animation, or video). Multimedia environments include online

instructional presentations, interactive lessons, e-courses, simulated games, virtual reality, and computer-supported in-class presentations where all or some of the media elements form part of their design and development.

Sharma, Oliver and Hannafin (2007) defined interactive multimedia as the process of empowering the user to control the learning environment by navigating forward and backward within the learning package using the software interface provided. This navigation ensures the control over the communication process and flow of information between the learner and the learning environment. The proponents of interactive multimedia instruction hold the view that learning is not simply a process of information transmission, students have to become actively engaged for deep and meaningful learning to occur. For this reason, learners are expected to be responsible active agents in the process of information management (Moreno & Mayer, 2005). Thus, interactive learning environments are viewed as a promising option not merely for presenting information but for allowing the learner to be engage actively in the learning process (Mayer, 2005). Studies focusing on interactive learning environments emphasise pacing or sequencing of the instruction with the learner being at the centre of managing information. For instance, Mayer (2005) examined what they termed simple interaction – whether or not participants were able to control the pace of a multimedia presentation by choosing when to start each segment of the presentation. Sharma, Oliver and Hannafin (2007) noted a comfort in learning when interactivity having narration, pop-up menus and provide answers to students questions is embedded in a learning environment. Conversely, from a technological perspective, interactivity has been classified in terms of delivery media (web, videoconferencing), input devices (keyboard, mouse, touch screen) or features provided by (hypertext, simulations, animations and multimedia).

Hypermedia on the other hand is an emerging technology which uses information and knowledge management techniques appropriate for the integration of hypertext with images, video, sounds, animation and simulations for teaching and learning purposes. Sharma and Hannafin (2007) considered it as an application that shows direction and relationships among concepts and information already integrated with multiple media elements. The application is mainly for the purpose of facilitating access to, and manipulation of the information encapsulated in the data bank. In addition, hypermedia systems offer the user a direct access to all information units represented in the hypertext base by means of two information retrieval modes, browsing and searching for both stand alone and World Wide Web (WWW). In line with this, Berlanga and Gracia (2005) remarked that hypermedia is particularly appropriate for adult students or students who are already familiar with searching information in the library and reading books and encyclopaedias thus facilitating easy access and retrieval of information using their previous experience and background knowledge. Similarly, students who are familiar with internet browsing would find a links and cross-references leading to the bulk of information for their careful systematic search within an encompassing, up to date learning environment.

B. Fundamental Structures of interactive multimedia and hypermedia instruction

An interactive multimedia package comprises of words and pictures all combined together to deliver an interactive instructional content. Mayer (2009) clarified that words are verbal representations such as printed text (delivered on a page or screen) or spoken text (delivered face-to-face or via speakers); pictures are visual-spatial representations such as static graphics (including illustrations, drawings, photos, maps, diagrams, charts, figures, and tables delivered on a page or screen) or dynamic graphics (including animation and video delivered on a screen). The structure of interactive multimedia instruction is designed by integrating all these different multimedia elements in which special attention is given to the "user control", choice of colour combination, screen resolution, text style and animation using a common screen navigations and buttons to trigger interactivity. The screen design includes:

Main Screen: The main screen contains navigation arrows and buttons that lead to the retrieval of information units. These buttons were designed and linked to different elements such as text, pictures, graphics and animations.

Text: A text with robust style and large font size which stimulates the reader is a good feature of screen design for interactive multimedia and hypermedia. Robberecht (2007) is of the view that not more than two or three types and sizes of fonts are used per screen and preferably one font type/face per screen be used unless

certain material needs to be emphasized. However, the implication of varying the size and font face of text can divert student's attention.

Graphics: Illustrations and drawings that clearly represent an idea or topic are added to the interactive multimedia with a view to make abstract ideas concrete.

Sound: Sound is another feature of interactive multimedia used to tease and stimulate mental alertness among students and is added to each button to give the direction of the lesson or the title of the button.

Animation: In addition to the sound effect attached to each button, abstract concepts such as dangerous animals (crocodile), large objects that are difficult to be move to classrooms (ship), and a process of cloud formation and volcanism can be animated to show their real life process or activity. The incorporation of these elements into one coherent lesson makes a learner an active processor of information with a potential benefit to the end user.

Similarly, according to Spector (2013) there are different fundamental structures common to all hypermedia programs; such as nodes, links, and buttons. Nodes are the basic unit of information in hypermedia which may take the form of text fields, digitized sound, visual images, or QuickTime movies while links connect nodes of information from linear to open- ended, buttons are the vehicles which activate links. As their name implies, they often appear graphically as buttons, knobs, or icons which are activated by a mouse click. Modern hypermedia is delivered via electronic pages using media players, web browsers or stand-alone applications (i.e., software that does not require network access). These newest features of hypermedia make it available and affordable to a community of learners even to those living in non network areas. Typically, a hypermedia page according to Beverly, Martha and Diana (2014) is embedded with a composite of several sheets of transparent film overlaying one another, each sheet containing its own unique information, with the top layer sheet providing the initial information to be viewed and also serves as a menu for accessing information available on the underlying pages. This process follows a systematic pagination with additional secondary pages having text or graphics viewed by the reader alongside the original page. Similarly, the reader has option to return to the original screen from a secondary page, or continue pursuing new information in additional windows. These enhancements according to Victor and Wang (2008) are typically accessed through the use of a mouse which controls cursor movement and selection of computer functions without the need for a keyboard. For instance, selecting a word for example, "photosynthesis" could give a choice of the word's definition or pronunciation, or provide a picture associated with the word. Further selections on the second layer pages or on any subsequent layer "chlorophyll" could take the reader to additional areas of information with pictures, video or animations.

Accordingly, Mishra (2006) noted that the additional screen in hypermedia page can be used to provide readers with supporting information in form of supplementary text or graphics that can aid the understanding of a particular concept. Conversely, the idea of hypermedia as described by Beverly, Martha and Diana (2014) included different types of hypermedia forms, from simple links between chunks of related text (linear hypermedia), to a more loosely structured text and graphics (hierarchical hypermedia) or more sophisticated concept and related linkages with navigation system connected to a vast knowledge library including all pertinent information about a subject (relational hypermedia). For instance, Victor and Wang (2008) noted that hypermedia environment is very rich with knowledge structure capable of giving students a free hand exploration with a controlled presentation sequence programmed into the hypermedia document itself. Thus, students using hypermedia are at liberty to surf through the learning material in a totally open-ended manner corresponding to their interests and needs, or to use the guided exploration.

Recently, audio hypermedia with voice command devices and voice browsing is emerging with flexible voice command features, thus allowing the user to navigate through files and folders using simple voice command. In fact, the most recent technology with interactive features is the brain mapping technology which has the ability to connect peoples' brain to a computer via thinking process, analyze the brain activity and decode which word or phrase one is thinking about. These technologies according to Beverly, Martha and Diana (2014) are capable of combating speech to text within a click of a mouse thus, eliminating the typing and editing process with a high level of information management and can be beneficial to normal students and those with special needs. Indeed, these designs of

hypermedia instruction are made with a logical knowledge structure built in, where students are given choices for accessing information such as text definition or description, a graphic representation, a video clip, or digitized sound or voice. For instance, in a more structured programs, a table of contents is designed where the user can return to, or start a new unit of instruction. As each unit is completed, it is automatically checked off on the table of contents permitting the user to verify their progress at a glance or move to the remediation page and remedy the learning material.

C. Interactive Multimedia and Hypermedia Design Principles

The development of interactive multimedia instruction is based on the multimedia designed principle which focuses on how human brain process information in form of text, verbal and visual and equally reduce brain load using multimedia to help learners receive, process, retrieve and automatize new knowledge. These principles according to Mayer (2005) include:

- Multimedia Principle: Students learn better from words and pictures than from words alone.
- Spatial Contiguity Principle: Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.
- Temporal Contiguity Principle: Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
- Coherence Principle: Students learn better when extraneous words, pictures, and sounds are excluded rather than included.
- Modality Principle: Students learn better from animation and narration than from animation and on-screen text.
- Redundancy Principle: Students learn better from animation and narration than from animation, narration, and on on-screen text.
- Individual Differences Principle: Design effects are stronger for low-knowledge students than for high-knowledge learners. Design effects are stronger for high-spatial students than for low-spatial students.

In the light of these principles and features, Mayer (2009) pointed out that multimedia applications are used in education based on the following reasons. They include among others;

- It allows students to learn according to their own learning speed by giving them control over their own learning.
- Provides personalized instruction and cater for individual differences.
- It aids retention and transfer of information to real time application.
- Encourage student's participation actively in a lesson.
- Increases the students' interest and provides motivation. This simplifies and accelerates learning.
- Gives students the problem-solving and decision-making skills.
- Increases students' ability to focus on.

The above multimedia design principles can be used concurrently with interactive multimedia development tools such as HyperCard, ToolBook, Macromedia Authorware, Macromedia Director and Macromedia flash to professionally author interactive multimedia content for instructional purposes.

In the same vein, hypermedia development tool as highlighted by Victor and Wang (2008) is a software applications specifically designed using the hypermedia principles and was developed to resolve a particular educational problem or learning need, and are thus limited to the solution of the problems arising from that need. To effectively design hypermedia applications, Spector (2013) cautioned that authors should begin with the production of a conceptual model, which represents the various aspects of the subject matter following a software development methodology by integrating the perspectives of the main agents involved in the development process. Additionally, Bryant (2007) noted that such a methodology must establish the educational requirements for the particular subject matter in the preliminary stage, and then, in subsequent stages develop the application in response to the requirements of the conceptual model and the educational specifications.

Thus, the current development tools that aim to support both professionals and do-it- yourself endeavours include: Adobe Flash, Adobe Director, Macromedia

Authorware, and MatchWare Mediator which can be used to create stand-alone hypermedia applications. Others include database software such as Visual FoxPro and FileMaker Developer which has limited scripting and hyper linking features built in. Likewise, Spector (2013) added documentation software such as Microsoft Office Suite and LibreOffice that allow for hypertext links to other content within the same file, other external files and universal resource locator (URL) that links to files on external file servers. For more emphasis on graphics and page layout, hyperlinks may be added using current desktop publishing tools that includes presentation programs (Microsoft PowerPoint and LibreOffice Impress) add-ons to print layout programs (Quark Immedia) and tools to include hyperlinks in portable document format (PDF) (Adobe InDesign for creating and Adobe Acrobat for editing). Similarly, Compact disc (CD) and digital versatile disc (DVD) authoring tools such as DVD Studio Pro, Adobe premiere pro and pinnacle studio may be used to hyperlink the content of DVDs for DVD players or web links when the disc is played on a personal computer connected to the internet.

The use of the above software's according to Victor and Wang (2008) should be based on the seven primary constructivist values that include: collaboration; personal autonomy; generativity; reflectivity; active engagement; personal relevance and pluralism, from which a set of general design principles to be used in the design process for hypermedia instruction are drawn. These design principles suggested that designers and developers of hypermedia instruction should strive to:

- make instruction relevant to the learner by providing a context for learning that supports both autonomy and relatedness;
- balance the tendency to control the learning situation with the desire to promote personal autonomy;
- support self-regulation through the promotion of skills and attitudes that enable the learner to assume increasing responsibility for the developmental restructuring process;
- increase emphasis on the affective domain of learning, treating learning and motivation as part of a unified whole process;
- Strengthen the learner's tendency to engage in intentional learning processes, especially by encouraging the strategic exploration of errors.

The adoption of these different design strategies creates a multifarious learning environments involving a large range of activities, some active, some passive, some reactive, some creative, some focussed, and some exploratory resulting to a better managed information to the end user.

D. The Potentials of Interactive Multimedia and Hypermedia Instruction in Information Management

The potential benefits of interactive multimedia instruction are numerous. Thus, claims ranging from reduced learning time to cost effectiveness abound. One major benefit of interactive multimedia instruction according to Atienza and Tai (2009) is the degree of information control by the learner. Indeed, learner-controlled instruction allows the student to study material at their pace and are under less pressure to perform within certain time limits. In the same way, Chang and Yang (2010) affirmed that learners can choose a logical route through the instructional material moving between text, images and sound, stopping for a time to interpret, analyse, and explore. As such, interactive multimedia adapts well to individual differences due to its variety of learning styles and high degree of learner control. Furthermore, the importance of interactivity in the context of multimedia-based instruction, suggest that interactivity makes it easy for students to re-visit or explore specific parts of the instructional contents to test ideas, and to receive feedback. In these and many similar claims, Evans and Gibbons (2007) noted that interactivity is presented as an attribute of learning environments that enhances the quality of information management in educational settings.

In addition, Mayer (2005) emphasised that learning from material made with more than one medium is usually more effective than material comprised of only one medium. This is partly due to the fact that different parts of the brain process different information. For example, Mayer (2009) observed that some parts of the brain process text while other parts process visuals information. Likewise, when interactive multimedia elements (text, pictures, video, graphics, and animations) activate more regions of the brain, there are increase in information management resulting in learning and retention compared to materials that require fewer parts

of the brain to process information. In continuation, Atienza and Tai (2009) added that students manage information more effectively when the instruction is consistent with their cognitive style. Moreover, in situation of continual under-funding, Adegoke (2011) remarked that interactive multimedia can provide an enhanced or augmented learning experience at a low cost per unit, making the process of learning more purposeful, participatory, and flexible in time and space, and modified toward individual learning styles that unleashes a long-term gain to all. Conversely, Evans and Gibbons (2007) noted that interactive multimedia programmes combining text, audio, video, and animated graphics in an easy-to-use fashion enables information management through exploration, discovery, and reflective experience. Similarly, Sharma, Oliver and Hannafin (2007) observed that with interactive multimedia, teachers can use the combinations of media elements to create interactive educational content that are student centred and provide a way by which learners can experience their subject in an explicit manner. Indeed, the key to providing this experience is having simultaneous graphics, video, audio, animations and text using interactive multimedia development tools such as HyperCard, ToolBook, Macromedia Authorware, Macromedia Director and Macromedia flash.

Conversely, Mishra (2006) noted that hypermedia appears to hold many possibilities for educational use, from a highly unstructured document for exploring just about any subject, to a more specific, directed teaching tool such as a study guide for a content text or a basal reader supplement. Concepts and ideas might be linked with other hypermedia software applications, databases or even computer mediated communications facilities, to achieve the learning needs of students (Robberecht, 2007). It may be used to facilitate several important functions of the information and knowledge management in a school setting, including: (1) a learning function helping to acquire, structure, and integrate knowledge, (2) a memory function helping to access and manage information, and (3) a communications function helping to share the acquired knowledge within and outside the learning community. In a similar view, Robberecht (2007) reiterated that hypermedia instruction provides a number of benefits for the learner, including: self-paced, self-selective learning; private learning and experimentation in a 'safe' environment; accommodation of different ability levels and types of learner; open access to information; reduced teaching costs; provision of reliable and timely information; and reduced publication costs. Similarly, Dunser and Jirasko (2005) noted that hypermedia materials can facilitate the collection of information that might otherwise require a time-consuming or search of multiple sources and as a tutee by allowing learner control over the paths they follow and the knowledge structures they create while searching for information.

Deimann and Keller (2006) added that information in form of word definitions and spoken pronunciations for new vocabulary along with pictures, animated graphics, or video clips that illustrate processes or concepts being introduced or reviewed can be delivered through the hypermedia format providing students with new experiences related to the topic being studied. Hypermedia proponents Dunser and Jirasko (2005); Mishra (2006) pointed out that hypermedia environments have the potential to transform the structure of teaching and practice of instructional delivery that respects and serves the needs of both the individual learner and the larger community. Experts in educational technology have advocated the use of hypermedia instruction in educational settings to include: non- linear access to vast amounts of information; in-depth exploration of information on demand (Robberecht (2007); interaction with the instructional material in a self-paced manner with attention- capturing or engaging capabilities (Dunser and Jirasko, 2005). The high value and potential of hypermedia as an educational technology tool cannot be obtained without paying attention to the hypermedia development tools.

III. CONCLUSION

The concepts of interactive multimedia and hypermedia have been elaborated and the discussions portrayed that interactive multimedia and hypermedia have the potential to improve information management in a school setting, improve the general quality of instructional delivery and improve collaboration between researchers, developers and end users-students. The major attribute of interactive multimedia and hypermedia as noted by Sharma, Oliver and Hannafin (2007) is the degree of learner control which involves delegating instructional decisions to learners so they can determine what help they need, what difficulty level or content density they wish to study, in what sequence

they wish to learn material, and how much they want to learn using interactive multimedia, simulations, hypermedia, animated concepts and online databases. These attributes suggested that as learners control over the learning material increases, so does instructional effectiveness and efficiency, as well as learner independence, mental effort, and motivation.

IV. REFERENCES

[1] Adegoke, B. A. (2011) Effect of Multimedia Instruction on Senior Secondary School Students' Achievement in Physics. European Journal of Educational Studies 3(3),12-19

[2] Atienza R. O., Tai T. W. (2009). Interactive Electronic Reader to Support English Education, International Conference on Computer Technology and Development, ICCTD '09, 475 - 479.

[3] Berlanga, A., & Garcia, F. (2005). Learning technology specifications: semantic objects for adaptive learning environments. International Journal of Learning Technology 1(4),458–472.

[4] Beverly, B. R., Martha M. H., and Diana H. (2014). Use of an online Simulation to Promote Content Learning International Journal of Online Pedagogy and Course Design 43-57. www.irma-international.org/article/use-of-an-online-simulation- to-promote content-learning/106815

[5] Bryant, L. (2007). Emerging trends in social software for education. In Emerging Technologies for Learning: Volume 2 (pp. 9-18). Coventry, UK: Becta. Available from http://emergingtechnologies.becta.org.uk/index.php?section=etr&catcode=ETRE_0001&rid=14167

[6] Chang C. C., Yang F. Y. (2010). Exploring the cognitive loads of high-school students as they learn concepts in web-based environments, Computers & Education, 55 (2), 673-680.

[7] Deimann, M. and Keller, J. M. (2006). Volitional aspects of multimedia learning. Journal of Educational Multimedia Hypermedia 15(2), 137–158.

[8] Dunser, A. and Jirasko, M. (2005). Interaction of hypertext forms and global versus sequential learning styles. Journal of Educational Computer Research 32(1), 79–91.

[9] Evans, C., Gibbons, N.J. 2007). The interactivity effect in multimedia learning, Computers & Education, 49 (4), 1147–1160.

[10] Mayer, R. E. (Ed.). (2005). The Cambridge handbook of multimedia learning. New York: Cambridge University Press.

[11] Mayer, R. E. (2009). Multimedia learning (2nd ed.). New York: Cambridge University Press.

[12] Mishra, P. (2006). Affective feedback from computers and its effect on perceived ability and affect: a test of the computers as social actor hypothesis. Journal of Educational Multimedia and Hypermedia 15(1), 107–131.

[13] Moreno, R. and Mayer, R. E. (2005). Role of guidance, reflection, and interactivity in an agent-based multimedia game. Journal of Educational Psychology 97 (1), 117–128

[14] Robberecht R (2007). Interactive Nonlinear Learning Environments. The Electronic Journal of e-Learning 5 (1), 59 - 68.

[15] Spector, J. M. (2013). Emerging Educational Technologies and Research Directions. Educational Technology & Society, 16 (2), 46.

[16] Sharma, P., Oliver, K., and Hannafin, M. (2007). Teaching and learning in directed environments. In Handbook of Distance Education, 2nd ed., edited by M. Moore, pp. 259–270. Mahwah, NJ: Lawrence Erlbaum Associates.

[17] Sharma, P. and Hannafin, M. J. (2007). Scaffolding in technology- enhanced learning environments. Interactive Learning Environment 15(1), 27–46.

[18] Victor C. X. Wang (2008). Active Learning Online. Encyclopedia of Information Technology Curriculum Integration (pp. 9-13). www.irma-international.org/chapter/active-learning-online/16673