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EFFECT OF VISUAL 3D ANIMATION IN EDUCATION

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ABSTRACT: *The primary purpose of this study is to explore the effectiveness of animations and graphics with text on students' learning. This paper demonstrates the strategy of how visual representations in the form of 3D graphics provide help in the field of education for the students of class 1 to class 7. It describes all the facts which help in strengthening the statement that graphical aids i.e. animation adds a lot in the field of education and how it positively affects the lives of students. It also states how 3D animation provides opportunities to the students to show their creativity and adapt creativity in quite an easy manner. Multimedia products in different combinations of text, still images, animation, video and sound, are available. Few research studies identify the principles by which we can combine these media effectively within instructional materials to their full potential for learning. Students might get bored of regular lectures but if we provide them something easy and understandable it will add much more to their memory. Graphically animated content have the finest and positive impact on student's life as it helps them understanding the concepts more easily and memorable. The paper is all about how things are getting improved with the use of animation in the field of education.*

KEYWORDS*:* Computer Assisted Instruction (CAI)

INTRODUCTION

The success of computer assisted instruction (CAI) has been the subject of continuing examination for over a decade (Fletcher-Flinn & Gravatt, 1995). The use of CAI as delivery media is expanding, but our understanding of how Students learn and benefit from such computer-based instruction is disputable. Use of appropriate graphics with text has been demonstrated to be effective in learning. However, computers can make static graphics into dynamic animations. This study explores the potential of combining animations with text in a computer assisted instructional environment. Animations can be used as a delivery media where learning can be conducted as occurring (1) from technology, (2) with technology, (3) around technology, (4) through technology, and (5) assisted through technology (Goldsworthy, 1999). *Animation* refers to computerized simulation of processes using images to form a synthetic motion picture. It is a process of putting still images together in a sequences or manner so they will appear one after the other creating the illusion movement. One can feel or see the images are moving. In the context of learning. Animation assists learners to visualize a dynamic process, which, otherwise may be difficult to visualize. Animation might thereby reduce the cognitive load (Rieber, 1990). In Kehoe's (1996) review of studies on animation in education, visual aids are found to have a positive effect on learning if certain conditions ("explanative text", "sensitive tests", "explanative illustrations", "inexperienced learners") are met (Mayes 1989).

Visual Representation

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Visual representations are maps, charts, diagrams, static graphics, computer animations, hypertext and multimedia that are incorporated into instruction. Visual representations relate to the components of the subject matter (Goodman, 1968). They show a spatial relation and may refer to the concrete objects and real-world relations, or, by analogy, to abstract concepts and conceptual relations (Winn, 1989).Maps is an example of the former, which refers to the real-world relations. The real territory, such as buildings, mountains and lakes, describes them. For useful navigation, they are reduced in scale and correspond to the virtual distances among the features of the territory (Schlichtmann, 1985). Diagrams often illustrate abstract domains of reference (Winn, 1989). Charts represent the procedural steps and exclude physical objects. The joining lines help create a sequence of the steps. Animation refers to a series of computer screens that illustrate movement (Hannafin & Rieber, 1989). Animation provides visual and spatial information. Hypermedia, characterized as "a generic term covering hypertext, multimedia, and related applications, involves the chunking of information into nodes that could be selected dynamically" (Dillon & Gabbard, 1998). Multimedia corresponds to using more than one sense modality (Mayer & Sims, 1994). Multimedia learning occurs when students utilize information presented in two or more modalities – such as visually presented animation and verbally presented narration to construct knowledge (Mayer & Sims, 1994). Generally people understand the information presented by the visuals better; it is well said "a picture is worth a thousand words." Understanding occurs when a visual interacts with the psychological process active in the person who receives it (Salomon, 1979). It requires that perceptual and cognitive processes act on the representative elements of visuals and become influenced by them (Winn, 1991).

Effect of visual representation on human cognitive system

There is substantial confirmation that creating visual spatial structures improves people's ability to recall and understand (Bellezza, 1983, 1986: Decker & Wheatley, 1982; Clark & Pavio, 1991; Mayer 2001). Bellezza (1986) concluded that subjects recalled more words when they were presented with visual presentation because the visuals were encoded as intact images in memory and were retrieved intact in response to cue words. The visuals were helpful in organizing the information in the brain and cues served a connection between stored information and thus retrieved it effectively (Kulhavy, Lee & Caterino, 1985). It is expected that creating structural arrangements improves recall and comprehension of information in visuals by helping students organize the information (Winn, Li & Schill, 1991). When the information is visually presented, it is encoded as it is presented. Meaning is then assigned to it, and it is connected with previous information already in store (Hirtle & Jonides, 1985). Careful

Spatial construction makes it easier for people to organize the visual representation meaningfully (Winn, Li & Schill 1991).

Many questions regarding the interaction between a visual representation and the human cognitive system relate to time. Background knowledge and presentation of the information and graphics can be associated with the construction of a mental model in the human brain (cf. Pinker, 1990). It can be helpful in reducing cognitive load (Bruning, Schraw & Ronning, 1998). Dual coding makes it simpler to recall and understand the information. Dual coding theory (Pavio, 1986) provides theoretical support for the use of visuals. According to this theory, words and visuals stimulate autonomously and encode the information separately in long term memory.

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Graphics for Instruction

Graphics are used when teaching specific lesson content such as facts, concepts, processes, procedures, and principles in computer delivered instruction. Mayer (2001) summarizes the following principles for use of graphics for teaching different content types. Process information is effectively visualized with animations. Here is an image that illustrates how plants are regenerated from tissue culture.

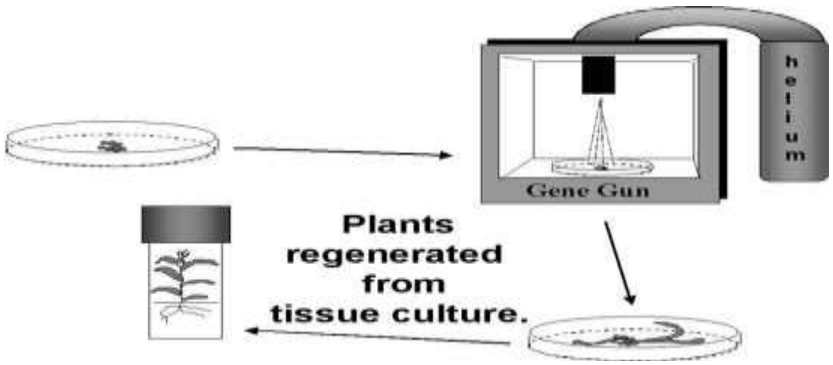

Fig. 1: how plants are regenerated from tissue culture

Figure below explains the principle of herbicide intake by leaf. It is a screen capture from an animation of herbicide intake by a leaf.

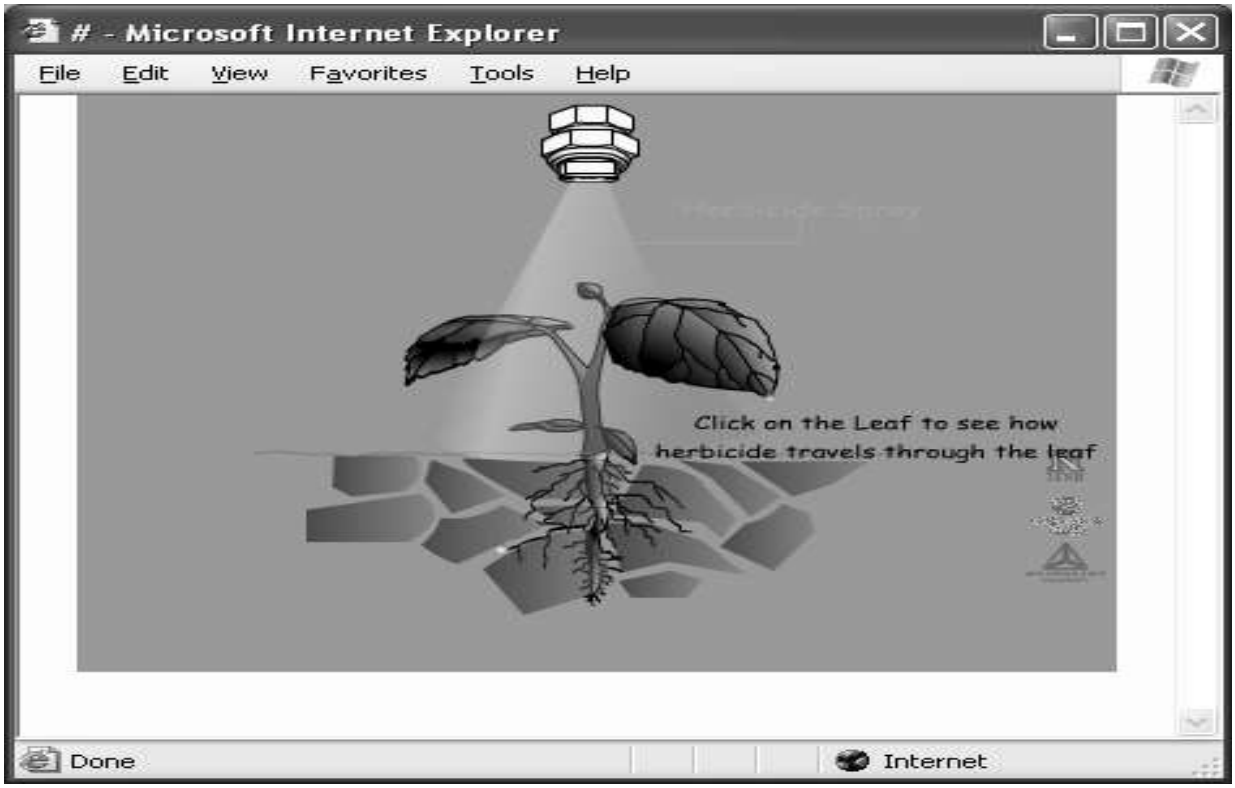

Fig. 2 the principle of herbicide intake by leaf

Graphics show relationships

Dynamic and static graphics can be helpful in constructing invisible phenomenon visible and

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show relationships. Imagine a lesson to teach how a chlorophyll molecule captures light energy and excites an electron to begin photosynthesis. Figure below is a screen capture of an animation that shows the relationships among the interacting entities.

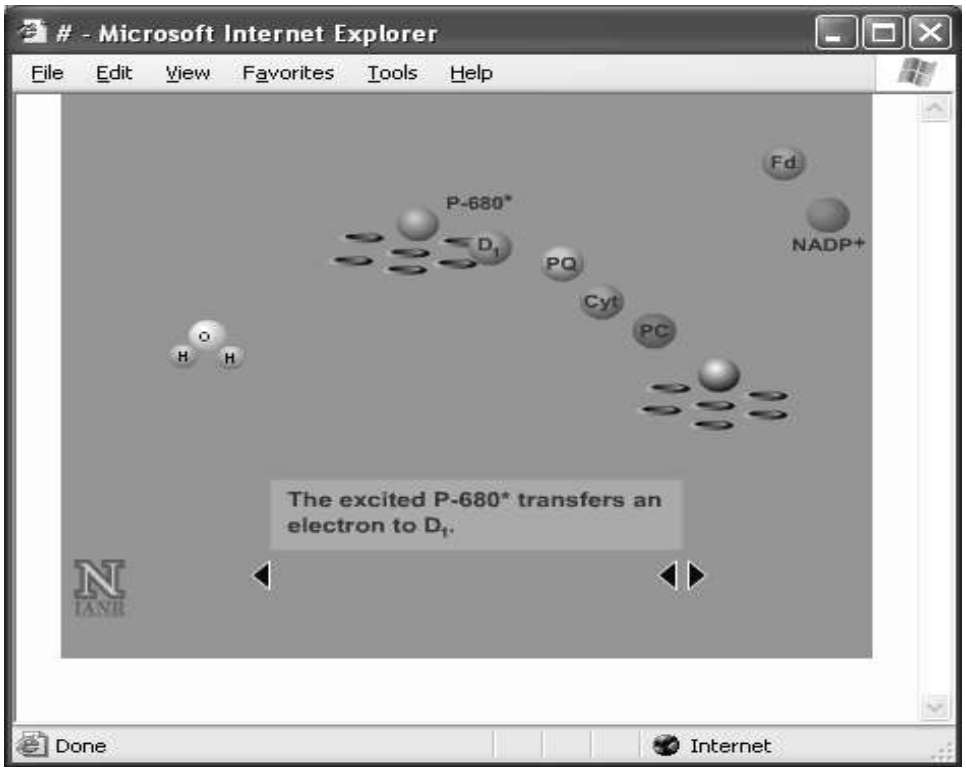

Fig. 3 relationships among the interacting entities

Previous research on Visual Representation: Here are some of the previous researches mentioned

Static Graphics

Graphics have played key roles in scientific textbooks for centuries (Brooks, Nolan & Gallagher, 2001). They have been used to stimulate interest in students and increase their involvement for instructional purposes. There has been a considerable amount of research on the process of knowledge acquisition by means of text and graphics (Anglin, Towers, & Levie, 1981; Levie & Lentz, 1982; and Willows & Houghton, 1987). There is a general consent on the beneficial contribution of graphics with the related text information for the readers (Morrison, Ross, & Kemp, 2001). Graphics are a good source of visual communication and can deliver the textual message effectively (Levie & Lentz, 1982). Graphics capture the attention of the learner by arranging the components spatially and they thereby use particular capacities of human visual system for perception of spatial configurations (Schnotz, 1993). Instructional material consists of written texts and graphics such as maps, charts, graphs, diagrams, etc (Schnotz, 1993). The purpose of graphical displays in text is not a mere accessory to texts or to decorate the text and thus appeal the readers. Rather, graphics to illustrate abstract concepts, organize complex sets of information, integrate new knowledge into existing knowledge structures, facilitate retention of

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information, and foster the process as of thinking and problem solving which are effective aids for learning (Schnotz, 1993). Comprehension of graphics is a process of constructing meaning, which learners acquire within an active processing framework and the prior experience with the stimuli (Schnotz & Kulhavy, 1994). Task expectations and ability make a difference in how the individuals learn (Schnotz & Kulhavy, 1994). Graphics can serve various functions like depicting data, explaining complex relationships, organizing information, improving memory for facts, and influencing problem solving. These functions are not inherent in graphics, however, but result from the way in which such graphics are processed cognitively (Schnotz & Kulhavy, 1994).

Diagrams and Illustrations

In science instruction, diagrams are often used to present the information (Lowe, 1993). Larkin & Simon (1987) have supported the effect of diagrams on learning with the empirical studies emphasizing the advantages of constructing a mental representation and cognitive processing because of diagrams (Glenberg & Langston, 1992; Winn, Li, & Schill, 1991; Dwyer's, 1970, 1972). An analysis on the effectiveness of different types of illustrations (realistic drawings, simple line drawings, and photographs) concluded that, if the time available is appropriate and sufficient simple line drawings tend to be most effective. If the learning environment is self-paced, then the learner takes more advantage in the realistic pictures.

Animations

There are several instructional opportunities that can be explored with the change in the representation form from static graphics to graphical computer simulations. Animation is one of those components (Rieber, 1990). In several studies involving scientific subject areas, Mayer (2001) has pointed to the importance of animation. Animation facilitates descriptive and procedural learning (Rieber, 1990; Lih-Juan ChanLin, 2000; Mayer, 2001). Animation is an important component in designing interactive multimedia which creates a visual interest and makes scientific learning more appealing and enjoyable for learners (Lih-Juan ChanLin, 2000). Furthermore, animation is one such component which can be part of computer based instruction and which cannot be combined with any other media (Rieber,1990). Animation adds two unique components as compared to the static graphic – *motion and trajectory* (Klien, 1987). Animated visuals explain the visual and spatial information when these two components are used effectively. The pace of animations, when controlled by the learners, allows the users to view the motion and replay as many times as desired. This series of actions allows students to explore the different strings of actions (Klein, 1985). Through computer-based instruction, a student constantly creates, manipulates, and interacts within a dynamic conversation of his own creation. S/he constructs mental models (Klein, 1985). Other information delivery media have important similarities and distinctions that may make a difference for the learner. Animations are created symbols which differentiate the real life events but create an opportunity for the learner to interact and move from being a passive information receiver to an active interact or (Klein, 1985).

Animation and simulation features have been used in engineering (Wozny, 1978), physics (diSessa, 1982) and mathematics (Hooper, 1982; Wegman, 1974). These have made effective contribution to instruction by conveying the information through the help of its interactivity and special effects (Hellet, 1999). There are many variables which can affect learning with

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the aid of animations. Practice and rehearsal is one of them (Bruning, Schraw & Ronning, 1998).

"Wyzt's Playground," a multimedia tool, was created for animation research in fourth grade mathematics. This tool emulates and simulates the real-life scenario of building a playground, and creates an environment that engages the students in active learning (Johnson & Neil-Jones, 1999). This study used interactive videodiscs to discover the nature and proportion of the different learning activities exhibited by group 12-13 year old student to ascertain that the repeated use of disc improved their problem solving skills. The study found that well designed applications could enhance learning (Blissett & Atkins, 1993).

Reports by Hamel & Ryan-Jones (1997) reviewed the use of state of the art graphic and animation for instructional material, and laid a set of guidelines for using interactive graphics:

- Interactive graphics, especially 3-D graphics, views the object in ways that enhance three dimensional interpretations by producing more accurate depth information.
- It directs attention to important parts of the objects.
- It uses interactive graphics, with hints on viewing strategies.
- It presents procedures that enhance visual learning.
- It includes practice of the procedure in the instructional sequence.

Flash Animation Development

The lessons can be designed using Flash animations and with the help of this technique the simple boring for children lessons can be converted into interesting visual animation.

Figures below are the screen shots of Flash animation.

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The animation had a control bar at the lower end of the screen that was always present. There were buttons on this control bar that allow a user to go back and forward in the animation,

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giving them full control of the pace of the animation. The animation was embedded with graphics and text that were relevant to the content text.

CONCLUSION

From all the above explanation I thereby reach the conclusion that animated educational lessons are easy to understand for the children. They capture images in their minds and as a result it is much easier for them to recall these images rather than plain text from a book. They find it fun to learn as learning becomes part of their recreational activities. It benefits them a lot.

REFERENCES

Anglin, G. J., Towers, R. L., & Levie, H. (1996). Visual message design and learning: The role of static and dynamic illustrations. Handbook of Research for Educational Communication and Technology. New York : Macmillan Library Reference USA.

Baddeley, A. (1986). Working Memory. New York:Oxford Science Publication.

Bellezza, F.S. (1996). A mnemonic based on arranging words in a visual pattern. Journal of Educational Psychology, 78, 217-224..

Blissett, G., & Atkins, M. (1993). Are they thinking? Are they learning? A Study of the use of interactive Video. Computers Education, Vol. 21, No. ½, pp31-39, 1993.

Brooks, D. W., Nolan, D. E., & Gallagher, S. M. (2001). Web-teaching: a guide for designing interactive teaching for the world wide web. New York: Kluwer Academic/Plenum Publishers

Bruning, R. H., Schraw, G. J., & Ronning, R. C. (1998). Cognitive Psychology and Instruction (3rd ed.). New Jersey:Prentice Hall.

Burgess, R. G. (1988). In the Field. London: Allen & Unwin..

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. Educational Psychology Review, 3, 149-210.

Clark C. C., & Mayer, R. E. (2003). E- Learning and the Sciencs of Instruction. California : Jossey-Bass/Pfeiffer.

Cooper, G. (1998). Research into cognitive load theory and Instructional Design at University of New South Wales.

Decker, W. H., & Wheatly, P. C. (1982). Spatial grouping, imagery, and free recall. Perceptual and motor Skills, 55, 45-46.

Goldsworthy, R. (1999). Lenses on Learning and Technology: Roles and Oppurtunities for Design and Development. Educational Technology / July-August 1999, 59-62.

Kehoe, C.M. (1996), Algorithms and Animation [On-line]. http://www.cs.gatech.edu/grads/k/Colleen.Kehoe/papers/lit_review/lit_review.html. J. Jones. (1991, May 10). Networks (2nd ed.) [Online]. Available: http://www.atm.com

Hooper, K. (1982). The use of computer graphics in the development of mathematical imagery. Paper presented at the annual meeting of the American Educational Research Association, New York [On-line].

http://www.icbl.hw.ac.uk/ctl/mayes/paper4.html.

Klein, E. L. (1985). Children and Computers.Jossey-Bass: CA, WA, London.

ISSN 2054-0957 (Print), ISSN 2054-0965 (Online)

Mayer, R. E., & Anderson (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. Journal Of Educational Psychology, Vol. 84, No. 4,44-452.

Mayer, R. E., & Anderson (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. Journal of Educational Psychology,1991, Vol. 83, No. 4, 484-490.

Macromedia, (2000). Macromedia Flash5 Using Flash.

Lowe, R. K. (1993). Diagramatic information: techniques for exploring its mental representation and processing. Information Design Journal, 7, 3-17.

Mayer, R.E. (2001). Multimedia Learning. Cambridge University.

Salomon, G. (1979). Interaction of media, cognition and learning. San Francisco: Jossey Bass.

Salomon, G. (1984). Television is "easy and print is tough": The differential investment of mental effort in learning as a function of perceptions and attributions. Journal of Educational Psychology, 76, 647-658.

Salomon, G. (1979). Interaction of media, cognition and learning. San Francisco: Jossey Bass.

Liao Y-K. C.,(1998). Effects of Hypermedia Versus Traditional Instruction on students' Achievement: A Meta-Analysis. Journal of Research on Computing in Education, Vol. 30 Number 4 pp. 341-357.

Wozny, M.(1978). Interactive computer graphics for engineering education. Professional Engineer, 1978, 48(6), 14-18.

Winn, W.D. (1989). The design and use of instructional graphics. In H. Mandal and J. R. Levin (Eds.). Knowledge Acquisation from text and pictures. North Holland: Elsvier, 125-144.

Winn, W. D., Li, T. Z., & Schill, D.(1991). Diagrams as aids to problem solving: their role in facilitating search and computation. Educational Technology Research and Developmant, 39, 17-29.

Willows, D. M., & Houghton, H. A. (1987). The Psychology of illustration: Volume 1. Basic research. New York, NY: Springer-Verlag.

ISSN 2054-0957 (Print), ISSN 2054-0965 (Online)