Interactive Visual Art Learning in the Development of Young Children's Creativity

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ABSTRACT

Interactive visual art- centered learning creates new insight and understanding that intersect abstract concepts of art in relation to core content areas in academic disciplines, e.g. science, math, and geometry. Technologies integration would give such a creative approach a vital means of reaching younger students in and through the arts as investigative methods.

This article is an attempt to shed light on "how to keep young children's creativity alive", and how the exploration of arts shapes new ways for our children to improve their practice and interaction in an increasingly intelligent setting. The paper emphasizes the use of ICT in interactive computer based techniques as an integral component of reforms to deal with ongoing technological changes. It focuses on the interaction between technology, visual arts and creativity, and overviews different digital platforms, tools, art-tech/software, and web-based applications that support the benefits of innovative active learning, and which differentiate teaching methods in traditional classes.

The author confers that recently, integrated digital aesthetic learning has shifted the focus from not only fulfilling the existing education system, but to also develop new interactive friendly environments, where educators are encouraged to establish a creative digital curriculum in order to engage younger students in an informally constructive way. Furthermore, it discusses how arts and humanities-based initiatives are taking a prominent place in our integrated learning systems in private elementary schools in Alexandria. This provides an accessible way for educators to design specific educational activities to merge technology, pedagogy, artistic experiences within academic disciplines.

The paper then concludes with an emphasis on the efficient use of digital technologies through primary education as a tool to create and conduct art activities in order to help improve children learning in a creative process.

Keywords: Interactive learning; creativity; interactive art; creative teaching; younger students; technology; educators

1. INTRODUCTION

In a digitally connected world, challenged by an increasing growth of technologies, learning methods have to remotely adjust to these changeable environments where a premium must be placed on creativity as an efficient process and ingenious action. Though, 21st century children in elementary levels are more engaged in technology and digital activities than ever, what is means to students' learning is not yet satisfactory. Educators are challenged to reconsider the features of creative process, and encouraged to apply innovative ways of teaching in computer-mediated environments to further advance the curriculum. They eventually need to move beyond direct observation to think about relating creative ideas in learning to using the technologies for cultivating creative thinking. Visual art as a potential source of creation creates the aesthetic dispositions without which thoughtful attention to imagination, perception and discovery could not successfully function [18]. Every visual art form has a significant part to enable continuous exploration of new ideas and newer artistic learning methods; it reflects the creative thinking process to improve children learning outcomes [11]. Nevertheless, aesthetics percolate each form of the visual arts into specific areas of the school curriculum to evoke thoughts, feelings, and understandings of meaning [18]. Incorporating digital creative approaches and dynamic representation of conceptual forms in academic subjects through visual art learning activities will change learning and subtly enhance the student's imagination. However, not many educators recognize this new way of learning academic subjects in a dynamic visual art setting instead of traditional static learning instruction alone as a means to foster creativity in digital natives.

The article represents the need for designing an interactive educational art-based activity crafted for specific content upon two areas; Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge (TPCK) in the Technological Pedagogical Content Knowledge (TPACK) conceptualization to be fully embraced within a modern creative elementary school curriculum, and based on the inter-relation of visual art and creativity development in non arts-contexts. The mixture of forms in interactive art, which arises from a conjunction of elements of the visual art combined with digital technologies, can provide a methodological foundation that is suitable for interactive digital visual art.

Interactive digital visual art provides open exploration of imagery and more opportunities for co-engagement to communicate traditional visual art content. Thus a shift in the focus of the way aesthetics of interactive visual art is to be represented in the learning practices within the current education system becomes more interdisciplinary, interactive, and often integrated. For more understanding interactive art, Stern (2013) indicated its four core areas:

- artistic inquiry and process;
- artwork description;
- inter-activity;
- and, relationality"

For stern, technologies and digital processes are more than just informational processing. The understanding of how content and technology complement and contrast each other is to be taken in consideration, rather than focusing on the technology that drives the work. In this sense, interactive art is about developing, feelings and imagination, to learning; view,

interpret, and respond. The most pressing issue currently facing educators in elementary schools concerns 'how educational activities should be carried out in interactive/creative ways! Ways in which younger students can develop symbolic thought, and translate knowledge into innovative actions.

The article investigates the potential role of visual art in pedagogic interactivity as a goal to develop the spontaneous levels of students' creativity at the primary school level. Initial materials were generated to comprise overviews of research into how the attribution of aesthetics and interactivity as principles of instructional technology can promote technological thought [16] to enhance creativity, when particular technologies are used in particular ways.

2. INTERACTIVE VISUAL ART DRIVING REFORM

Lately, visual art initiatives supported by technological tools have been approached in elementary class room teaching, and many studies have been investigating whether learning by visual art in conjunction with interactive technology may bridge conceptual boundaries between the arts and all other subjects in the academic primary curriculum, such as science, mathematics and technology, to acquire the creative thinking associated with innovative skills.

At the primary level, the visual art is the most steadily established of the arts disciplines in elementary schools, and art aesthetic is the bond which gives each area of the curriculum its common purpose [30]. Nevertheless, aesthetics percolates each form of the visual arts into specific areas of the school curriculum to evoke thoughts, feelings, and understandings of meaning. Anderson (2004) Visual art training can take a particular art form to imagine the unimaginable. In relation to aesthetic considerations, each form of the visual arts can be seen and understood to give further insight and understanding with more opportunities to engage in related practical activities in academic teaching.

Morrison (2001) explicated that visual art feature more than servicing agencies for a science-driven curriculum; nature, form and the artistic – they can mutually benefit and enrich each other as imagination and intuition are the main potential of the sciences and mathematics. The aesthetic experience is concerned with increasing conception awareness of line, form, design, and their dynamics, and art is the characteristic way in which aesthetic experiences, like creativity, shall be fostered throughout the curriculum [27]. In this sense, learning "in and through" interactive visual art offers the best kind of unconstrained thinking. It is about developing imagination, and feeling associated with meaning to learning. For that reason, learning apps activities have to be based on artistic interactivity, and designed as an analytical, critical, verbal reasoning, hypotheses testing or deconstructive model of interactivity to be aesthetically attractive to younger students. Dewey (1934) explained how gaining an experience of art that is ‘‘educative’’ in nature determines the balance of the parts in the context of the whole to intelligently develop and increase the visual perception of the learner in order to think deliberately and effectively in terms of symbols and mathematical. In this sense, Dewey, among others, argued that artistic experience produces creative and constructive outcomes. Since art contributes to increasing the power of appreciation, it should be developed to a level where interactive aesthetic can transform passive viewers/learners into participants/active learners [30]; [9] and [24].

The TPACK framework is the understanding of the impact of technology into traditional learning activities to integrate art, science, and mathematics into a creative setting, and how content and technology complement and contrast each other [28]. It can support "constructivist" learning theory, in which appropriate interactive technologies integrated into visual art-based applications facilitate younger students' investigation to direct their own discovery. With a focus on visual art as one of the major forms of arts, attention is drawn on aesthetic experiences in art that embrace more the creative mode than the arts, and to infiltrate the lines separating the disciplines [4]. TCK transforms the content in specific subject matter, e.g., visual art, science, and mathematics to adapt them to be taught as integrated activities shaped by aesthetic experiences, in which art is the representation and science the explanation [30]. Anderson (2004) articulated the potential of the arts to reform and to inform the broader elementary curriculum so children become more open to new ideas and concepts. Incorporating Information and Communications Technology (ICT) develops visual thinking strategies that empower plentiful integration of digital technologies, with artistic ideas into the learner creative practice. It does not replace an emphasis on creativity, reasoning and critical thinking, but it re-emphasizes those skills while highlighting ways to communicate new knowledge [8]; [13]; [15]. Lee (2015) identified flexibility as a creative process, so children can constantly explore utilizing a particular range of smart tools, and move freely between making and receiving. Jagodzinski (2009) argued that utilizing digital technologies then the freedom associated with creativity and initiative becomes innovation and knowledge is actively decomposed and recomposed so the comprehensibility within representation will emerge thinking.

When science, mathematics, and arts creatively come together with other instructional activities, and are properly taught through the support of new forms of technological tools, then learning becomes more enjoyable and promptly engages children in the full use of their senses to visualize a range of further possibilities within a work in term of another subject area. In fact, experiencing in appropriate forms of visual art gives a reasonable transfer for younger students to become more focused and responsive, and better at envisioning structures in forms to carefully observing and noticing continual changes in nature [20]; [29]. This process must take place in dynamically interactive ways that involve creative thinking in the context of interactive art. It also acquires broad and adventurous thinking that is clear, deep, and organized to make it easier for students to grasp scientific concepts.

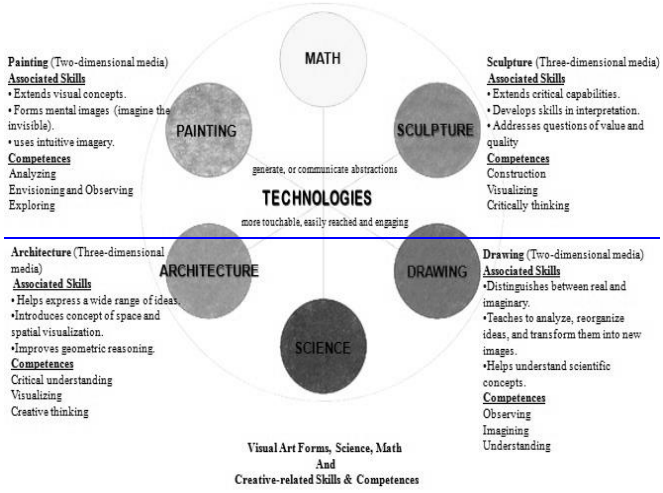
3. TECHNO-VISUAL ART: AN INTEGRAL ROLE IN EXPLORATION AND DISCOVERY

Interactive multimedia software applications do not seem to have been specifically developed for use by elementary school students. There is even less research regarding proper pedagogy related to the development of appropriate instructional design for digital applications in art-based educational activities.

In relation to a previous study done by the author; a qualitative survey conducted with science and math teachers, art educators, and IT specialists in six private elementary schools in Alexandria to translate the impact of art into traditional learning activities in order to plan effectively to integrate art, science, mathematics, and technology into a creative setting. The findings have shown a link between practices in visual art;

painting, drawing, sculpture, and architecture, and the ability to improve geometric reasoning to mentally envision forms [5]; (see Figure 1). A common line was drawn between critical thinking associated with the perception of the interaction-based visual art, and the developmental curve of creative thinking which seemed to increase as a result.

Figure 1. Visual art forms and creative-related skills



The aesthetic in the relationship of science and arithmetic to visual art is virtually experienced in a digital environment and is continuously developed to find new forms of visualization for complex scientific structure of compositions to geometrically describe many natural theories. No doubt, mathematic and scientific ideas are to be better expressed in dynamic visual arts than in static written or drawn forms; virtually constructing and deconstructing conceptual theories opens up ways for creative thinking to develop as an outcome of interaction with art in a creative context [12]. Loveless (2003) examined the interconnection between creativity, technology and learning as: building knowledge in multimodal and dynamic ways; composing and presenting with mediating artifacts and tools; extending the context of activity; exploring and working with different dimensions of interactivity. She explained that creative activities with new technologies should be geared toward developing a more comprehensive vision that is effective in interacting intelligently with visual art.

Smart technologies establish a positive account of dynamic formative interventions to visual art inquiry-based learning activity design that embeds interactive art media that may adapt well to brainstorming digital humanities activities. Bringing in interactive media of this type can be a great way to perform complex tasks in a simulated activity, transform an assignment, and add artistic practices outcomes to a range of disciplines. The teachers noted that based on the emerging trends, children who e-read become more responsive and creative in the interplay between academic content and digital interactive platforms. The "doing" may open possibilities for the "seeing", and interactive visual-based application must be about exploring, drawing out hidden connections and symbolic ideas as a means of expressing and communicating ideas.

As part of the same study, the author observed that digital applications with multi-modal functions such as video and audio, and aesthetic communicative functions allow youngsters to visualize the interactive, exploratory component of mathematics and architecture. Their observation increases, as they become more attentive visually about what is being shown in front of them that they ditch their imaginative and creative curiosity. Challenges mentioned for these innovative ideas to become more widespread included: The need for time and the proper budget to collaborate the development of arts-based content activities from a static medium to an interactive platform. Also, the lack of knowledge in visual art interactivity among educators is a barrier and that should be taken into consideration when evaluating the effectiveness of the application on the platforms with which they interacted, and what should be actually integrated.

According to respondents, the efficient interaction of mathematics with visual art in combination with smart technology offers a clear perspective on a particular subject and allows learners to conduct lab experiments to manipulate geometric shapes in two- and three-dimensional space, and perform mathematical simulations in an artistically intelligent environment. Thereby, learning in such an interactive informative environments, younger students are simultaneously active while engaged in observing and reacting in the process of art related perception in interactive art. In situations involving creative expression or composition, incorporating the digital environments creates an intimate interactive aesthetic correspondence between visual and academic language as a form of translation of science, mathematics, etc. into sets of visual languages. In conclusion, creativity is whenever imagination and divergent thinking come first [3], the ability to reconstruct reality to mentally envisioning the formation of images which can then overt action.

In light of the Assessment and Teaching of 21st Century Skills project (AT21CS), arts formulate a core subject, which includes skills such as creativity and innovation, critical thinking and problem solving, communication and collaboration. Rabkin and Redmond (2004) claimed that any arts integrated curriculum meets a high standard of authentic intellectual work and children will naturally be more engaged. Taylor (1992) reported the use of art be an instrument for teaching in-depth understanding of all subjects in the academic curriculum. Artistic practice is an indispensible tool for strengthening imaginative consciousness and developing creativity, awareness, understanding, and visual knowledge. Visual arts are clearly gaining ground as a way to make academic subjects learning more innovative. Tsai (2013) recognized involving skills such as creative and critical thinking could grow better thinkers as a crucial part of the creativity process.

A contemporary approach to creativity research has adopted a definition that creativity is the human process leading to novel ideas [21], whereas creative thinking "innovative" encompasses the acts to: inquire, explore, imagine the outcome, take risks, reflect, and innovate. It also focuses upon the nature of the interaction between the human and medium [7]. Cassirer (1996) and Kozhevnikov et al (2013) implied that creativity involves a dynamic procedure of active generation. Hence, artful educator and teacher should pay great regard on the thinking process and how to engage younger students emotionally, intellectually, and not to settle with one perspective to nourish their natural creativity and adaptability.

Some of the ideas or questions that have been investigated to design an appropriate interdisciplinary constructivist approach to informally learn academic content in a computational design

context aimed at improving the creative thinking skill, and which is based on the TPACK model are:

Should training in interactive visual art be integrated across the content subject areas in elementary curriculum as a means to promote new ways of thinking, doing and acting?

How does creating new relations across disciplines and practices feed into new ways of thinking, doing and acting?

How technology can impact younger students' creativity in visual art to communicate ideas in current, traditional, and emerging forms?

How to design-related activities that embed interactive art media that can adapt well to brainstorming digital humanities activities?

How can we improve digital application interactivity?

4. "TPACK" CONCEPTUALIZATION A QUEST FOR CREATIVE CONSTRUCTIVIST METHOD

As art educator programming and librarian creating activities for the children' library, the author have noticed that the presentation of the visual elements of art, particularly color and form in abstract art, alters and affects children ability to view, think, and feel. Through wedding elements of art from different cultures with techniques adapted from geometric abstraction, abstract expressionism, and cubism the child's spatial intelligence and depth of perception improve. Although, the author did not discuss contemporary visual art directly in relation to abstract art-forms and scientific contents, the author nevertheless compared skills similarity involved in the art domain to the skills tested in the science and mathematics domains. The findings of the previous survey discussing visual art forms and creative-related skills was sought as the basis for informing the activity design to The relevance of interpreting contemporary forms of visual art benefits to areas like science to understand factual and theoretical nature then grows into deeply sensed experience through interactive practices as a language of representation.

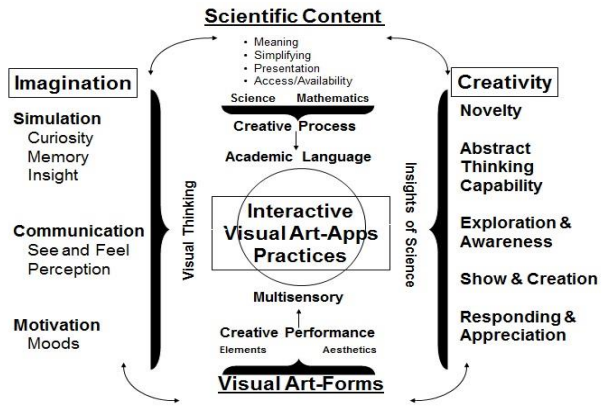
They fulfill his needs for using his imagination and his need to explore. The author was particularly interested in the use of haptic/smart boards e.g., tablet computers or whiteboards and related software for using art to teach thinking. Visual art and interactive media, through the use of interactive smart boards was found by the author to be advantageous in teaching and learning visual imagery with youngsters.

The data collected by the author from the 20 participants' responses (12 science/math teachers; 6 art educators; &4 IT specialists) would help to indicate how successfully children learned the core concepts within such an educational imaginary. As a result, the research questions that are discussed above are to be revised for use in designing an interdisciplinary method in a computational design context aimed at improving the child's ability to think creatively. According to jagodzinski's view (2009), supported by cognitive science and psychological constructivism, teacher-centered knowledge is replaced by student-centered approaches that emphasize the active and constructed character of knowledge. In other words, learning practices mediated by various forms of technological tools encourage learners to enjoy the learning process and freely contribute to their own learning, to be creative in making a discovery and shaping meaning into expressive and comprehensible forms.

The key insight of a creative curriculum is the critical exploration; integrating a variety of technologies into visual art reactivates the brain to make mental changes by looking deeper, and in more refined, informed, and systematic ways [25]. Therefore, learning by visual art in a techno-interactive setting is beneficial for its transformative effect on a variety of factors including creative abilities. Combining visual art with digital technologies and ICT maximizes the expectations for exploration and reflection in multiple modes of understanding concepts so younger students become more critical in thinking and learn to observe and see the discovery in science or simple geometrical nature in mathematics [1]. Educators and teachers whom the author interviewed demonstrate less technological pedagogical knowledge and technological content knowledge skills. Implementing ICT knowledge throughout the entire activity design shall introduce them to new technologies; hardware or software applications to be more encouraged shifting in their exiting practices. The new integration of technologies and visual art activities with other scientific subject area in such interactive programs will have to be thought through as a contribution to the creativity development of young children.

It was said that interactivity is the dialog that occurs between the brain and the thoughts, the link between education in the arts and understanding the aesthetics of digital interactions, which builds a new path towards creative learning methods. That should be grounded in the arts to move beyond standardized teaching methods across all content areas [5]. Young children perform significantly above average in intellectual and creative areas when they spend more time learning through interactive activities in which the artistic realm is integrated [17]. Through visual art technology-oriented reform, new ways of representing and interacting with information modify the idea of what inquiry can be, changing it from an examination of a static object into a performance. Mathematics, science and computer graphics are moving forward together to produce an interactive aesthetic educational model that is moving beyond the formal structure of a static context. This way, children can experiment with concepts of engineering to play in a creative context, as they are able to turn things on, move them around, and change their locations. Such processes involve thinking, visualizing and doing in which interactive technology allows teachers to stimulate younger students to become involved in their discovery, able to determine central ideas, develop, and analyze them in dynamic visual forms. Art based-applications program added to the curriculum is expected to work well because of such empowerment that younger students could explore not just a visual static reference but also combined with dynamic content to more fully understand important relationships between form and function.

Figure 2. Reflected Arts-based Learning *Framework, related to the intersection of technological imagery in visual art and academic disciplines.*



Stern (2013) demonstrated how the viewers and artworks connect in interactive art as interactive form, content and process mood are invaluable aids to engaging, analyzing, and responding practice. Younger students shall be used to the idea of translating ideas into different forms as interactive visual arts put that aspect of the feeling into it. Niess (2005) signaled the inclusion of artistic pedagogical agent in interactive software applications as a particular techno-aesthetic that essentializes interactivity. Daniels (2008) argued that the common ground of technology of interactivity is basically based on 'programs instead of instruments', each component: technology, pedagogy, and content must all be within a given contextual framework, that technological medium and pedagogy have been interacted at a deep level where cross-arts implications are dynamically implemented, and relevant to the whole curriculum. Thus, the manifestation of technology can be an expressive venture that facilitates creative possibilities.

In the final phase, the author focus turned to the evaluation of the adequacy of dynamic design as a challenging question arises about how to define developmentally appropriate activities and content in computer-based artworks activity for younger learner for these innovative ideas to become more widespread. The need for time and the proper budget collaborate the effective development of arts-based content activities from a static medium to an interactive platform. The lack of knowledge in visual art interactivity among educators is also a barrier and that should be taken into consideration when evaluating the effectiveness of the application on the platforms with which they interacted, and what should be actually integrated.

This overview study has led the author to the following consideration:

- The ICT development demands a collaborative interaction between software designers, art educators, and subject specialists to the ongoing development of software applications to create a proper interactive learning pedagogy, an intimate correspondence between visual and academic language that is compelling and easy for elementary school students to follow and adapt.
- Software in Apps/web-based activities must be designed to facilitate full integration of visual art with other instructional activities which involves imaging, modeling, planning, making, and link them with the aesthetic field of making, presenting, responding and evaluating.
- Exploration is characterized as being fast, immersive, and data-focused. Interactivity should be based on exploratory strategies; discovery and reflection on content; involvement; active and interactive.
- Presentation is characterized as being precise, reflective, and view-focused. The computer as a motivating medium, the graphic interface is designed to increase concentration and engagement, and decrease destruction.

In accordance with interactive technologies, the following factors must be incorporated in computer-mediated environments to create well-tempered educational applications that aspire towards visual art:

- The activities on i-apps are carried out through constructivist, reflective practices to serve two outcomes: visualizing /constructing mental images and concepts in math-science program to create in the mind of the observer perceptions and senses; meaning into images beyond what can be captured by the static shapes on papers; as well as switching between the imagination and attentional control through visual art.
- Digital activities should be deeply aesthetic in nature and fused with drawing, painting, etc. Thus content material which is developed based on aesthetics, art criticism, and methods of inquiry from the visual art disciplines serves the curriculum objectives for the different educational settings.
- Adapt computer-generated graphics which offer simple translation from outline concepts to working interactive images and interconnect language more logical and more primitive. simple and visible graphical interface features, in which games are easy to navigate

5. CONCLUSION

This fast changing educational environment requires collaborative teachers to effectively employ visual thinking methods and strategies to work in partnership with art educators and computer specialists to identify the links and possibilities between visual art and the rest of the curriculum in ways learning could be aesthetically simulated with computing.
Technological innovations combined with the visual art provide new possibilities for training the mind in the process of producing new ideas to naturally transfer creative thinking over to other content to increase creativity. It is now possible to interact with new developments to more clearly locate the potential place of the dynamic nature of visual arts, and its relevance to the creative act to be vividly illustrated in the capacity of younger students to employ their creative ability to learn at heightened levels of involvement and originate new ideas.

6. REFERENCES

[1] A. Loveless, "Creating spaces in the primary curriculum: ICT in creative subjects", **Curriculum Journal**, Vol.14, No.1, 2003, pp.5-21.

[2] A. Wilson, **Creativity in Primary Education**, SAGE Publications Ltd, 2014.

[3] A.C. Wilson & D.A. Myhill, "Teachers' Views of Creativity", **Thinking Skills and Creativity**, Vol. 10, 2013, pp. 101-111.

[4] B. Arnold, **Aesthetics beyond the Arts: New and Recent Essays,** Ashgate Publishing Group, 2012.

[5] C.M. Walker, E. Winner, L., Hetland, S. Simmons, & L. Goldsmith, "Visual Thinking: Art Students have an Advantage in Geometric Reasoning", **Creative Education,** Vol. 2, No. 1, 2011, pp. 22-26.

[6] D. Daniels, "The Art and Science of Interface and Interaction Design", **Studies in Computational Intelligence**, Vol. 141, 2008, pp 27-62. Retrieved November 15th, 2015, from http://link.springer.com/chapter/10.1007/978-3-540-79870-5_3

[7] D. Erik., B. Markus, G.P. Michael, & R.O Greg, "Rational Versus Intuitive Problem Solving: How Thinking "Off the Beaten Path" Can Stimulate Creativity", **Psychology of Aesthetics, Creativity, and the Arts**, Vol.5, No.1, 2011, pp. 3-12.

[8] D. Laverick, "Teaching with Technology and Interactive Media to Promote Creativity and Arts-based Learning in Young Children". In **Young Children and Families in the Information Age**, Educating the Young Child, Vol.10, 2014, pp. 61-75

[9] D.N. Perkins, **The Intelligent Eye: learning to think by looking at art**, Santa Monica, CA: J Paul Getty Trust, 1994.

[10] E. Winner & M. Cooper, "Mute those claims: No evidence (yet) for a casual link between arts study and academic achievement", **Journal of Aesthetic Education**, Vol. 34, No. 3-4, 2000, pp. 11-75.

[11] E. Winner, T. Goldstein & S. Vincent, **Art for Art's Sake?: The impact of Arts Education, Educational Research and Innovation**, OECD Publishing, 2013. Retrieved August 10th, 2015, from http://dx.doi.org/10.1787/9789264180789-en

[12].G. Morrison & B. Wallace, "Imagery vividness, creativity and the visual arts", **Journal of Mental Imagery**, Vol. 25, No. 3-4, 2001, pp. 135-152. Retrieved August 10th, 2015, from http://www.xunesis.org/publications/morrison%26wallace_JMI_2001.pdf

[13] H. Alexander, "Aesthetic inquiry in education: Community, transcendence, and meaning of pedagogy", **Journal of Aesthetic Education**, Vol.37, No. 2, 2003, 1-17.

[14] H.J. Eysenck, **Educational Consequences of Human Inequality**. London: Dent, 1975.

[15] J. Jagodzinski, "Beyond Aesthetics: Returning Force and Truth to Art and Its Education", **Studies in Art Education**, Vol. 50, No. 4 (Summer 2009), pp. 338-351. Retrieved November 24th, 2015, from http://www.jstor.org/stable/40650346

[16] K., Ferneding. (2007). "Understanding The Message Of The Medium: Media Technologies As An Aesthetic". In **International Handbook of Research in Arts Education**, Springer, pp.1353–1354.

[17] K. Lee & J. Jun, "Developmental Characteristics of Creative Thinking Ability and Creative Personality of Elementary School Children in Korea", **Advanced Science and Technology Letters**, Vol. 92, Education 2015, pp. 46-51. Retrieved November 3rd, 2015, from http://dx.doi.org/10.14257/astl.2015.92.10

[18] K.Tavin, "Eyes Wide Shut: The Use and Uselessness of the Discourse of Aesthetics in Art Education", **Art education,** Vol. 60, No. 2, 2007, pp. 40.

[19] K. C. Tsai, "Being a Critical and Creative Thinker: A Balanced Thinking Mode", **Asian Journal of Humanities and Social Sciences (AJHSS)**, Vol. 1, No. 2, 2013, pp. 1-9. Retrieved August 30th, 2015, from http://ajhss.org/pdfs-1/Being%20a%20Critical%20and%20Creative%20Thinker.....pdf

[20] L. Hetland, S. Winner & K. Sheridan, **Studio thinking2: The real benefits of visual arts education**. New York: Teachers College Press, 2013.

[21] L.K. Mishra & A. P. Singh, "Creative Behaviour Questionnaire: Assessing the Ability of Managers to Produce Creative Ideas", **Journal of the Indian Academy of Applied Psychology**, Vol. 36, No. 1, 2010, pp. 115-121. Retrieved August 10th, 2015, from http://medind.nic.in/jak/t10/i1/jakt10i1p115.pdf

[22] M. Kozhevnikov, J.Y. Chen, & O. Blazhenkova, "Creativity, visualization abilities, and visual cognitive style", **British Journal of Educational Psychology** , Vol. 83, No. 2, 2013, pp. 196-209. Retrieved August 9th, 2015, from http://onlinelibrary.wiley.com/doi/10.1111/bjep.12013/full

[23] M. L. Niess, "Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge", **Teaching and Teacher Education**, Vol. 21, 2005, pp. 509-523.

[24] N. Austerlitz, **Unspoken Interactions: Exploring the unspoken dimension of learning and teaching in creative subjects**, London: The Centre for Learning and Teaching in Art and Design, 2008.

[25] N. Stern, **Interactive Art and Embodiment: The Implicit Body as Performance**, Canterbury: Gylphi, 2013.

[26] N. Rabkin & R. Redmond, **Putting the Arts in the Picture: Reframing Education in the 21st Century**, Chicago: IL, Columbia College, 2004.

[27] P. Abbs, **A is for Aesthetic: Essays on Creative and Aesthetic Education**. London: Falmer Press, 1989.

[28] P. Mishra & M.J. Koehler, "Technological pedagogical content knowledge: A framework for teacher knowledge", **Teachers College Record**, Vol. 108, No. 6, 2006, pp.1017–1054.

[29] R. Taylor, **The Visual Arts in Education: Completing the Circle**, London: The Falmer Press, 1992.

[30] R. Taylor & G. Andrews, **The Arts in the Primary School**, London: The Falmer Press, 1993.

APPENDIX

Suggested bellow free access samples for "edtech" software apps & web-based art.

Table 1. Interactive Apps, platforms, and creative-related skills

App.	Grade	Platform
Mystery Math Museum &Mystery Math Town /Artgig Studio (Critical Thinking)	1-6	iPad
DIY/Design & Creation/ The Lawrence Hall of Science (Creativity + Critical Thinking)	K 3-10	Website
Animated Paintings Using Gifs/Art Room (Creativity)	5 +	Website
New Angles on Art / Counting on Art/National Gallery of Art (Creativity)	5–12 / K -8	Website
The Land of Venn - Geometric Defense/ iMagine Machine LLC (Critical Thinking)	1-4	iPad