Visual Literacy – Basic skills for Engineering Undergraduates

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Abstract: - This paper explores visual literacy and its place in the basic literacy skills required in today's society. It presents the situation in Singapore educational system highlighting the reasons for the lack of visual literacy training in the schools; and while Singapore embarks on a knowledge-based economy, its previous successful policy in training engineers to meet its industrial needs is being challenged. It then studies, based on an elective visual literacy course introduced at Nanyang Technological University (NTU), the need for visual literacy training for engineering and business undergraduates. Observations and conclusions are drawn from the results of a survey of the effect of this course on the graduates in their jobs.

Key-Words: - Visual literacy, Engineering education, Life skills.

1 Introduction

Basic literacy has always formed an essential part of any school curriculum. In the past, basic literacy implies the ability to read and to write, usually in business language such as English or in the mother tongue, in order to communicate effectively with other human beings. For engineering and business undergraduates, other basic and essential literacy skills are the language of mathematics and the language of the computer, or quantitative and computer literacy.

In most developing countries, Singapore included, the successful development of its manpower and workforce, especially in science and engineering, is considered as a necessary ingredient for achieving successful industrial and economic development. As such, education programmes have invariably focused on mathematics and the sciences. Scant attention is paid to art education or training for visual literacy.

This paper explores visual literacy and its place in the basic literacy skills required in today's society. It then studies, based on an elective visual literacy course introduced at Nanyang Technological University (NTU), the need for this as a skills set for engineering and business undergraduates. Observations and conclusions are drawn from the results of a survey of the effect of this course on the graduates in their jobs.

2 Visual literacy

Studies into the human mind suggest that the human brain is made up of two distinct cerebral hemispheres, the left and the right, with each controlling different aspects of human behaviour and responsible for different "modes" of thinking.

The left brain generally performs linear, sequential, logical, and analytical thinking and deals with words and language and is developed with training in linguistics, mathematics, science and engineering. In contrast, the right brain thinks in sensory images and grasps the whole picture. It is involved with artistic endeavours such as visualizing, intuition, creativity and imagination. It controls emotion, psychomotor skills, and things we learn to do and develop a feel for. It is developed through training in art, philosophy and music [1].

The left brain has been better trained in traditional educational processes because of the focus on mathematics, science and technology. Good training of the right brain, however, is necessary for originality and creativity and, in the increasingly competitive world, this has been recognized as what is needed to gain that extra competitive advantage. And here is where visual literacy can play an important role.

So, what is visual literacy? According to A. Pennings, "Visual literacy is an emerging area of study which deals with what can be seen and how we interpret what is seen. It is approached from a range of disciplines that:

1. Study the physical processes involved in visual perception,
2. Use technology to represent visual imagery, and
3. Develop intellectual strategies used to interpret and understand what is seen" [2].

R. Hobbs defines visual literacy as "the ability to access, analyze, evaluate, and communicate information in any variety of form that engages the cognitive processing of a visual image" [3].

3 Why visual literacy

Up until recently, basic literacy had meant the ability to read and to express oneself through writing. It is essentially the basic life skills needed to function on the job and in society.

The National Literacy Act of 1991, passed by the United States Congress, defines literacy as "an individual's ability to read, write, and speak in English, and compute and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's goals, and develop one's knowledge and potential." According to this definition and in this present day and age, literacy will include not only language and quantitative (or numeral) literacy, but also science and technology literacy, computer literacy, and visual literacy.

Language and numeral literacy has long been recognized. In this modern digital age, science and technology, and computer literacy can also readily be accepted as necessary to "achieve one's goals, and develop one's knowledge and potential." But what about visual literacy? Why should we be concerned about this new literacy?

Paul Messaris argued that "by acquiring visual literacy, people enrich their repertoires of cognitive skills and gain access to powerful new tools of creative thought." [4]. Edmund Feldman (1982) while he was president of the American National Art Education Association, stated that "Art is a language of visual images that everyone must learn to read. In art classes we make visual images and we study visual images. Increasingly these images affect our needs, our daily behaviour, our hopes, our opinions and our ultimate ideals. This is why the individual who cannot understand or read images is incompletely educated. Complete literacy includes the ability to understand, respond to and talk about visual images."[5]. Furthermore, problem solving in art involves divergent thinking and multidisciplinary knowledge which in turn nurture creativity. The enGauge report on 21st –century skills has visual literacy as one of the key skills for the future, identifying it as "the ability to interpret, use, appreciate, and create images and video using both conventional and 21st-century media in ways that advance thinking, decision-making, communications, and learning [6].

Elliot Eisner, Professor of Education at Stanford University, contended that "the value of arts in education is that arts teach students that problems in life can have more than one 'right' answer and that they teach that complex forms of problem solving are seldom fixed, but often change with circumstances"[7].

The knowledge worker today will require visual literacy skills to create, communicate and interpret visual messages and be able to see the big picture in solving problems and making decision. It is quite clear thus, especially in this increasingly competitive world with a globalized economy, that visual literacy, and the greater development of the right brain, is no longer just a competitive advantage, but has become a necessary life skill.

4 Visual literacy in Singapore's education system

Education has always been one of the top priorities in resource-scarce Singapore. Ever since independence in 1965, no effort or cost have been spared in training a well educated and employable workforce to meet Singapore's industrial and economic needs. This has proven to be a successful strategy and has contributed much to Singapore's rapid economic development over the past decades.

To meet the needs of the rapidly growing industries, the focus of Singapore's education system had been on mathematics, science and engineering from primary and secondary to tertiary levels. Because students have different needs and learning abilities, they are "streamed" when they are in primary and secondary schools into groups with similar learning abilities so as to facilitate teaching. The academically better performing students generally chose, and were selected for, the Pure Science stream which provided them with greater career opportunities.

Almost all students strived to gain admission to university which, until recently, had been based purely on good academic performance. Students thus face tremendous pressure coping with a very demanding curriculum to achieve good academic results in a very competitive environment. This invariably forces the students to concentrate on their core mathematics and science subjects, foregoing the visual art or other subjects which trains the right brain.

With the recent rapid economic globalization leading to a shrinking world, and the intense competition from rapidly developing giants like China and India, it became quite clear to Singapore's leaders that there is a need for Singapore to prepare its young in ways substantially different from what had traditionally been done. Singapore now needs innovative people with creative minds.

In 2001, Aline Wong, a former Singapore Senior Minister of State for Education, while noting that art and

music have been an integral part of Singapore's curriculum since its independence, stated that "The problem is that art and music are not given the kind of emphasis they deserve. And this stems not just from the academic pressure, but from a lack of an ingrained artistic tradition, where art is valued for itself, as a fulfilling way to express our thoughts and emotions, a way of creating, a way of communicating and as the mark of a cultivated person." She went on to stress that "Economically speaking, our future lies in the knowledge economy. This calls for innovation, creative thinking, problem-solving skills and so on." [8].

Dr Ng Eng Hen, formerly Minister of State for Education & Manpower and currently Minister for Manpower stated in 2002, "We need to equip young Singaporeans with the necessary skills to compete in the global marketplace… Our educational endeavours must develop our students' imagination and creativity. Arts Education has a significant role to play in fostering and nurturing these qualities in our students." [9].

Former Prime Minister and current Minister Mentor Lee Kuan Yew, the creator of modern Singapore, in 2003 noted "They (Americans) see their future in a world where wealth is generated not by making widgets or cars or whatever, but by brain power, by imagination, artistry, art, knowledge, intellectual property."[10].

And Hawazi Daipi, Senior Parliamentary Secretary in the Ministry of Education & Ministry of Manpower, declared in 2004 that "The arts will help to enhance the school environment as one of discovery and learning."[11].

Responding to these calls and to prepare for a workforce which can better meet the demands of the knowledge economy, Singapore schools have, in recent years, incorporated creativity and entrepreneurship into their programmes. A special Arts school for secondary students has also been planned to start in 2008.

Singapore's universities have also responded by moving more towards the US model of a broad-based curriculum offering majors, minors and general electives. This is meant to give more choices to students and to provide for a holistic education with multi-disciplinary knowledge skills to enable employable graduates compete in a knowledge-based economy. Many of today's graduates will need not only creative minds but also basic multi-disciplinary knowledge skills and a mindset that is willing to venture into uncharted territory and re-train themselves for several careers over their working lives. In fact, 30% of current university students may eventually work in jobs that do not, as yet, exist [12].

5 Case study - nurturing visual literacy at NTU

5.1 Learning approach

The Nanyang Technological University (NTU) in Singapore is a technology-oriented university with 65% of its undergraduates in Engineering. In moving towards a more broad-based education system, NTU introduced General Elective courses which are open for selection by all its undergraduates.

One of these elective courses is "Aesthetic and Creative Use of the 2D Media", the objective of which is to inculcate visual literacy. It aims to lay a foundation for students' visual perception - how they make sense of images, how they recognize, interpret and analyze visual messages, how they develop their aesthetic sense, how they become more visually aware and more sensitive to their surroundings and to enable them to become more effective visual communicators.

This course, comprising a 3-hour lecture cum tutorial every week for 12 weeks each semester, was started in July 2002 and, since, has had good response from students and has been running every semester.

In the first level of our learning model, students learn how to respond to visual images using the elements and principles of design (line, shape, type, texture, colour, value, balance, contrast, unity, movement, depth and space), visual hierarchy and Gestalt Theory (the whole is more than the sum of its parts).

The second learning level requires students to find meaning in what is seen. After identifying the elements and principles used in the design, they learn to analyse and interpret the meaning and why the designer chooses to convey his message in a particular manner. The analyses are done verbally in class and in written form. This ability to interpret requires a higher level of cognitive skills than just observation and set the direction for critical analysis.

To achieve the skills of creation which is the third level in our learning model, students are given the opportunity to convey meaningful messages by creating design materials for promotional purposes which is carried out as a team project. This hands-on approach to nurture creativity requires students to apply what they have learnt and to experiment with novel ways in expression and creation. Although students enrolled in this elective course are mostly Engineering students who are likely to be working with skilled designers to produce visual messages rather than being the designers themselves when they embark on their professional careers, engaging students in production activities enhance key concepts learnt. Their comprehension and

discourse will also be enhanced significantly when they attempt to create works that embody analytical and synthetic principles. This level of involvement prepares Engineering students to be effective visual communicators with competencies that are crucial in the increasingly visual economy.

To encourage deep learning to take place, the progress of the team project is monitored. Students are constantly reminded to brainstorm thoroughly and not settle with the first idea that comes to mind. Various ways to think creatively, for example, divergent thinking, are also introduced to them. Assessment is also done on the process rather than solely on the end product. The team projects are presented in class so that ideas are shared and students can learn from one another. Comments from the lecturer are also given in class and through emails. Grades are not made known to the teams to reduce competition among peers and to encourage cooperation.

5.2 Survey of graduates

Engineering and business graduates who had taken this visual literacy elective course since July 2002 till May 2006 were surveyed by sending questionnaires to known email addresses.

Information requested in the survey include:

1. their current profession and nature of job,
2. whether their jobs require them to communicate using visuals and, if so, the types of visual communication required,
3. how much of the design theories learned in the course have they made use of in deciding the effectiveness of the visuals when they plan or choose their visual communications, and
4. whether their interest in the visual arts has changed (increase or decrease) after graduation and, if so, the factors contributing to these changes.

From email tracking facilities, an estimated 65 questionnaires emailed out were received and read. Of these, 41 (63%) were completed and returned.

As the course is relatively new, the working experience of the survey group is relatively short with 1 student graduated four years earlier, 8 three years earlier, 10 two years earlier, 11 one year earlier, and another 11 less than one year earlier.

From the responses, the 41 returns can be categorized into three groups, with 33(80%) in Group 1 and 2 making use of visuals for their communication in their jobs:

Group 1: 26(63%) have jobs requiring them to communicate using visuals.

Group 2: 7(17%) only help friends or colleagues in producing or making judgment on visual applications.

Group 3: 8(20%) have jobs which do not require them to communicate using visuals.

Among the 33 in Group 1 and 2 who used visual communication in their jobs, Figure 1 shows the visual types and design theories that they use. The types of visuals include Graphic design (e.g. for brochures, posters, etc.), photographs, logos, product packaging, computer presentations, Web designs, multimedia presentations, animations, and video productions. Design theories surveyed include principles and use of basic design elements (e.g. line, shape, texture, color, depth, balance, movement), Gestalt Theory, Visual hierarchy, design that suits its message, and its target audience.
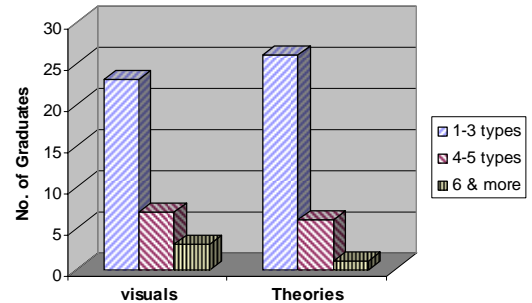

Figure 1. Visuals Types & Design Theories used by Group 1 & 2.

While 23(70%) used between one to three visual types in their work, a significant proportion, 10(30%), made use of four or more types. On the use of design theories gained from the course, 25(76%) made use of three theories while 8(24%) used four or more of the principles and theories that they learned from the course.

It is interesting to note that even for the 8 in Group 3, for which their jobs do not require them to make use of visuals, all except one made use of between one to three principles and theories that they have learned in their appreciation of the arts, media presentations and in their hobbies.

The survey results also show that 23(56%) had an increased interest in the visual arts after graduation; while the level of interest for 17(41%) remained the same. Only one(2%) had his interest decreased. As to the contributing factors for the increase in interest, 35% cited the training they received from the visual literacy course, 30% because of a greater awareness in visual art, and 17% from work experience gained.

Another interesting finding is that among the 41 respondents, a significant number, 23(56%), indicated

that they have started a profession/hobby, examples of which are in photography, and in logo, poster, brochure, T-shirt and web design.

A significant proportion, 17(41%) also indicated they would like to further their studies in visual art. Among the courses that they would like to see offered by NTU include photography, drawing, painting, web design, and multimedia presentation.

5.3   Results of the survey

A surprisingly high 80% of the working graduates indicated that they require basic visual literacy skills to perform their jobs. This would strongly support the views that that visual communication skills is needed and are indeed widely used in the engineering and business environment. The most common types of visual communication are PowerPoint presentations made to clients and in meetings, the conceptualization of ideas with clients, for web design, design for brochures, flyers, posters and logos, photography, and packaging design.

Although they are engineering and business graduates, some 76% of them were able to learn enough from just one elective course on visual literacy to be able to apply up to three design principles and theories in the visual communication required in the course of their work. Even for those whose jobs do not require visual communication, 7 out of 8 were still able to remember up to three types of design principles and theories. These results show that engineering and business undergraduates, for whom their major areas of studies primarily develop the left brain, can take a course in visual literacy, remember the basic principles and theories, and apply them even long after they have graduated. The results also indicate that the approach and learning model used in the visual literacy course discussed here is suitable for engineering and business students with the learning objectives achieved to a very good extent.

The survey results also show that as a result of taking a visual literacy course, more than half of the engineering and business graduates had their interest in the visual arts increased. More than half of the participants in the course have also started a hobby or profession involving visual communication as a result. This shows that while engineering and business students may do well in their chosen course of study, many of them also have hidden artistic talents and interests which could be brought out by taking appropriate courses in the arts.

It is quite apparent from the survey that many of the participants appreciate this additional communication language and have benefited from exposure to it. Among the benefits cited by the respondents include more effective communication, creating messages with impact, better conceptualization of ideas, better job performance and satisfaction, greater appreciation of the visual arts and a raised awareness of importance of visual communication for both work and business competitiveness.

The comments from the participants of the visual literacy course in the survey include:

"The insights provided by (the visual literacy course) are essential for (engineering and business) undergrads to have an all-rounded exposure beyond their core modules. An appreciation of how visuals and graphics communicate with target audiences allows us to be more effective in presenting ideas/concepts to shareholders, colleagues, and the public."

"The course has given me a good introduction to the visual arts and raised my awareness to effective visual communication to a higher level. Since then, I'd been more critical towards visuals and can apply some simple concepts learnt to my life..."

"The elements of design that you have taught us truly benefited and assisted me in my projects (poster design, product design, etc) as well as my own hobbies (spray painting. t-shirt design). I've gained confidence in graphic design and became a fanatic who would like to paint anything in my sight...The course has benefited us in both our appreciation and application of visual art. :)"

"My area of work involves development of presentations. The basic visual design principles that I have learned from the course have been helpful in ensuring the message is delivered in the most effective way. Also, as I work with a professional agency in creating point of sale materials, my understanding and knowledge has also helped me in sharing ideas and concepts with the agency in coming up with better visual communication materials that can effectively convey the marketing message."

One of the participants went on to start his own design company.

"I currently have my own shop which carries my own brand of graphic T shirts. It is called Accidental Portrait. It was started by me and my friend who is a graphic designer. My friend does most of the designs. My job in this partnership is

to give the direction as to where the label is heading and the image we want to create."

6 Visual literacy for engineering and business curriculum

Engineering and business undergraduate curricula routinely include basic literacy skills like language literacy, quantitative literacy and computer literacy, in addition to set skills in their core subjects in engineering and in business. With the recent rapid development of digital multimedia and the increased importance of presentation and marketing in the present competitive environment, visual communication has become an essential literacy skills needed for a graduate to function effectively in the job and in society, and to develop one's full potential. There is a real and widespread need in the engineering and business world to communicate using visuals and a graduate without visual literacy is "incompletely educated".

The experience gained from, and the results of a survey on graduates of, a course on "Aesthetic and Creative Use of the 2D Media" conducted at NTU in Singapore would strongly support the aforementioned observation.

Especially in Singapore where most students do not have a firm visual arts background, visual literacy training becomes more important for undergraduates. Visual literacy develops the right cerebral hemisphere and helps them to appreciate the visual arts, conceptualize creative ideas, solve problems with divergent thinking using a multi-disciplinary approach, see the big picture, and communicate more effectively with visual messages that have impact. The increased interests generated and appreciation developed from studying visual art and the skills learnt may also help them to venture into new business/profession/hobbies and, thereby improve their careers and their lives.

More courses in the visual art and visual literacy are needed as the results of the survey show. These are not only courses for undergraduates as 41% indicated that they would like to further their studies in visual communication.

7 Conclusions

Visual literacy has become a basic and essential skills in today's competitive economy where marketing and presentations are important ingredients for success, both for the individual as well as for enterprises. The present marketplace requires workers with multi-disciplinary skills, people who are effective visual communicators, people with creative minds and able to see the big picture. Those graduates who have not acquired visual literacy skills will be incompletely educated. To adequately prepare graduates to function effectively in their jobs and in society, universities will need to introduce courses on visual literacy into their undergraduate curriculum, including those for engineering and business.

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