Communication as a cognitive tool in visual learning

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***Abstract*—** Increasing globalization and the move towards more knowledge-based economies in the new millennium brings new challenges to the traditional approach in the education of engineers. Equipping engineering graduates with multidisciplinary knowledge and visual language skills will give them that additional competitive advantage, developing the other half of their brains and allowing them to be more innovative and creative. This paper explores the effectiveness of an approach in developing visual language skills in engineering students who have little or no background in the visual arts. Their performance in their group projects are discussed together with the effect of group dynamics in their learning process.

***Keywords*—** Classroom communication, Communication as cognitive tool, Engineering education, Pedagogy, Visual language.

I. Introduction

IN response to increasing globalization and the transition to knowledge-based economies, many institutions of higher learning are positioning themselves to produce graduates who can excel in the 21st century. Students are provided with more opportunities not only to major in a discipline of their choice but to also take other disciplines as double majors, or minors or as electives. The objective is to develop not only depth in the students' specialization but also breadth. It is expected that when students are well grounded with multidisciplinary knowledge, their knowledge inquiry skills will be sharpened and they will be more effective in their quest for, and creation of, new knowledge.

This paper presents the results and the experience gained from an elective course on visual language designed for students who have little or no background in the visual art. Course enrolment is 50 with the majority of the students from the Engineering and the Business faculties. One of the goals of this elective course is to inculcate in the students a strong interest in the visual art so that they will continue a life-long visual inquiry which will benefit them in their future careers. As some of these students may just choose to take only one such visual art course in their undergraduate years, much attention is paid to the pedagogical approaches needed to generate student engagement in the classroom so as to facilitate their learning. These pedagogical approaches are derived from the author's own experience as well as those of other educators, especially those in art education. Highlighted are the role of the teacher in a large classroom, the pedagogical approaches used to engage students involving the teacher facilitating communication and visual interpretation in the classroom, interaction between teacher and students, interaction among students, and interaction in a learning community using hands-on group design projects. Also discussed are the outcomes and implications of fostering greater engagement in the classroom for developing visual language skills.

II. Use of Communication as a Cognitive Tool in the Classroom

Rudolf Arnheim defined the term "cognitive" as "all mental operations involved in the receiving, storing and processing of information: sensory perception, memory, thinking, learning" [1]. Thus the use of communication as a cognitive tool in the visual art classroom would entail the use of language that can be shared meaningfully and understood by all learners, and enhance thinking, sensory perception and learning.

In the teaching of art, art educationist Professor Elliot Eisner remarked that linguistic tools are useful to perceive, to construct and to define the nature of works of art. The use of "terms such as *value, intensity, composition*… stand for quality to be perceived" and "theories of art are important for students to understand" [2]. Thus, in order to perceive and share meaningfully in a visual art classroom, students need to first comprehend and understand the theories of art and the symbolic and syntactical forms they represent [3]. This knowledge building and sharing in the classroom requires students to articulate and express what is learned in order that meaning can be constructed and shared with others. Meaning making can meaningfully result from conversation [4], [5]. Edmund Feldman went further to say that "In disclosing their visual discoveries students should be encouraged to take part in a dialogue about meanings and values. Their discourse ought to be carried to the point where dialogue, as well as the art objects on which it centers, becomes a significant focus of human interaction…Our discourse in teaching revolves around ideas and feelings we have already apprehended with our eyes. Without a prior act of criticism or visual

interpretation, no really significant teaching can take place" [6-8].

Thus the author believes that students can be purposefully engaged in this mode of communication which creates and encourages a community of learners with each contributing to the learning process through discourse. This is also what Mary Zander referred to as "the classroom as a community in which students create meaning by participating in a variety of discourses" [9].

Art educators have been noted to be more concerned with engaging the students and in enabling them to do to the extent that the important process of helping the students to acquire linguistic tools with which to think about art has been neglected [2]. Teachers can help extend students' thinking about art in their communication. Barkan in his book, *Through Art to Creativity,* recorded conversations of effective teachers to illustrate how teachers could encourage and influence artistic development and creativity [10]. What Zander found in her studies was often not what the teacher said that encouraged creativity but rather "the teacher *created opportunities* for multiple forms of discourse and how he or she constructed a safe place in which to share ideas" [9].

III. Pedagogical Approaches to 2D Media Elective at NTU

A 3AUs (Academic Units) Media elective course entitled "Aesthetic and Creative Use of the 2D Media" has been running every semester at Nanyang Technological University or NTU since July 2002 [11]. It is offered to all NTU undergraduates and has been particularly popular among students from the Engineering and Business Schools. Because of high demand, the maximum class enrolment has been increased from 40 to 50 since July 2005. Over the past years, classes for this course met once a week for 3 hours over 12 weeks and were often fully subscribed.

Surveys conducted indicated that the majority of the students enrolled in this course had no prior background in the visual art. The curriculum, teaching style, approach and content of this course are specially designed for learners who have no background in the visual art [12]. The specific needs of these students who have very little or no background in the visual art are carefully addressed in order to motivate the students and engage them in a meaningful learning process.

A. Role of the teacher

The teacher in this course plays multiple roles - as facilitator, guide, coach, tutor and advisor. The approach adopted is "one of guiding the learner, focusing on knowledge construction rather than knowledge transmission" [13] ,[14]. Lessons are planned and designed to make learning a meaningful and enjoyable experience, and to promote a life-long interest in design and the visual art. Most importantly, the aim is to become "a trusted partner in the educational journey of each student" [15].

B. Communication in the classroom

The teacher is the facilitator who "orchestrates the context, provides resources and poses questions to stimulate students to think up their own answers" [16]. The teaching strategies are tailored to student responses. Students are encouraged to analyze, interpret, and predict information.

For example, when learning and comprehending the design element *line*, Swan Poster by McRay Magleby was used as illustration and was projected onto a large screen. Questions were posed to the students with each taking turn to answer and to add on to the meaning. Questions like the nature of the lines used, the colors of the lines, the kind of swan and the mood these lines have created, were used to guide and encourage students to visualize, to think and to interpret.

Other than verbal clues, questions were phrased in a simple manner so as not to intimidate the students as most of them have no prior background in the visual art. Initially, some students may take time to find their voice in the large classroom as there is the concern of giving the wrong answer and losing face, which is prevalent in our local culture.

To encourage participation, generous amounts of comments were given by the teacher aimed at creating a light-hearted and relaxing atmosphere, and the neighbors were roped in to continue the answer when a student faltered. Each student's voice was valued and encouraged [17]. The aim was to help them to perceive, to think and to make meaning of what they saw on the screen [18]. Additional examples and "verbal directions were given to help students make connections or come to new understanding based on those connections" [9].

While each student was invited to be a contributor and active participant in the learning process, knowledge was constructed by the students with the teacher acting only as a guide. Teacher and students join together in the learning process to form a community of learners [19], [20].

The teacher sets the pace of the lesson and the communication. For example, when students have grasped the idea and started to be distracted, the pace would be quickened. The pace could also be slowed down or a pause given to allow thinking and recollection. For example, this was done after students learned the abstract cubist style. Picasso's painting *Guernica* was left on the screen for a while to let the students perceive and feel the sense of confusion, panic and anguish of the victims depicted by the cubist style. In this type of situation, sensitivity was applied on when to talk and when to refrain from talking and allow expressions from the students to come forward.

C. Encouraging interaction among peers

Starting from the fifth week to the eighth week and during one third of the class time after knowledge learning, students took turns to present to their peers their analyses of graphic images that they brought to the class. With the help of the theories of art they learned, each had to examine how he/she perceived the graphic image and gave his/her interpretation. The class was challenged to pose questions to the presenter. This is how Elliot Eisner identified as one of the outcomes of art education. He said, "when asked about the works they (students) encounter, they will be able to say something about them (art works) with insight, sensitivity, and intelligence. It means that they will know not only what they like or respond to in a work but why." [21].

In this course, students were also given hands-on group projects to come up with a creative solution to promote an event or launch a new product. Students formed groups, each of four to five, to brainstorm, conceptualize, analyze the design problem and solution, write the message, and design the promotional materials which comprised a poster, an invitation and a pamphlet or brochure. Students were encouraged to meet up outside class in a relaxed environment and have fun while brainstorming. As noted by Thompson and Bales, "Sporadic nature of peer talk provides a rich source of different perspectives and opportunities for collaborative learning. Differences in ideas are challenged and negotiated" [22]. "Learning is strengthened by group collaboration," dialogue, and learning from one another [23]. This was especially so when students from different disciplines like Engineering and Business worked together. There tended to be exchanges in different experiences, knowledge, verbal expressions and talents. Students also had to learn to negotiate differences in opinions and learn from one another's talent.

Finally, students had to present their group projects in class. This provided the opportunity for them to share with their peers how they conceptualized their design solution, their design process, how they applied what they learnt, their design outcomes, and challenges faced. This would also "help our students learn to be verbally clear and convincing in explaining their design" [24] and for the class, to learn to respond to others' presentations, to be inspired by others' achievements and to learn from their mistakes.

D. Dialogue with teacher during hands-on group projects

Prior to their final group presentations, each group met up with the teacher to share their progress and challenges faced. Students shared with their teacher their problem definition and problem solving approaches. They were encouraged to talk spontaneously about their ideas, concepts and design drafts. Through dialogue, the teacher was able to get to know the students better, to find out what they were thinking and whether they were on the right track. The teacher was also in a good position to facilitate further development of the design process when the solution was not original. If necessary, students were pushed to re-think their initial idea and encouraged to brainstorm again to find new solutions. Interactions like this were intended to help students to self examine, to explore, to build more meaningful understandings based on their own experience.

For example, during one of these dialogue sessions, it was revealed that one group was trying to take short cuts in brainstorming resulting in a design that was not original. The group was persuaded to spend more effort in brainstorming and to understand that conceptualization is a life-long skill which they will find useful in their future careers. The group heeded the suggestion and went on to create designs that were original with the number of applications surpassing what had been asked for. For example, they had gone one step further to have their T-shirts printed with their designs and wore them during their final presentation.

Carmen Fies and Jill Marshall advocated this kind of learner-centered interactions where "instruction is sensitive to and takes into account the learner's prior knowledge and needs, connects new knowledge to existing knowledge structures in ways that support meaning-making and transfer, continuously assesses in a formative manner what the understanding of a given concept is, and acknowledges the social context in which learning takes place" [25].

IV. Learning Outcomes

A. Hands-on group projects

To understand whether learning had taken place and, if so, to what extent it had taken place, the hands-on group projects were evaluated based on several criteria. These are concept (20%), content (20%), public appeal (40%) and delivery (20%). The projects in the past six years were then categorized into three categories.

The first category comprised projects for which the teams showed good understanding of what constituted creative design using appropriate visual language to express their message. The designs and layouts were unique, artistic, surprising and full of impact. The teams' reports were well-written with indications of thorough brainstorming for concept and how the design evolved in the process. These projects can be said to be on par with that of professional designers. 39% of the teams achieved this classification.

An example of a project in this first category is shown in Appendix 1 which illustrates a series of five posters and an invitation to the launch of the latest and smallest digital

products designed by four Engineering students. With a single, simple and relevant message "Living More with Less", the design features the small digital products being measured or weighed by oversized instruments. This contrast in size enables viewers to understand the "smallness" of the products and, together with the Bauhaus style of "less is more", a lot of empty space is used to draw attention to and create emphasis on the products. Lines are consistently employed to link the information on the products' unique features to the products being measured. There is also consistent use of sans serif type to give a simple, straightforward and modern feel. The invitation comes in strips featuring one product in each strip with the strips capable of being opened into a fan. Similar design elements are employed in the posters and in the invitation creating a family resemblance of a new visual identity for the products. The team spent much time in brainstorming for original ideas. One of them acted as the leader facilitating the contribution of interests and ideas from each member. Feedback from this group indicated that they enjoyed the sharing of ideas with one member in particular, frequently coming up with a lot of "crazy" and thought provoking ideas. One of them had very good Photoshop skills and was able to have the posters done in a professional manner. Another member assisted in the making of the invitation. All of them commented on the valuable experience gained and the joy of working together.

Another example in the first category is shown in Appendix 2. This project was for the launch of a new brand of unique and stylish, yet affordable, apparels for young males. The promotional materials, designed by three Mathematic and Science students and two Business students, include a poster, a flyer and 30 moving images to be placed in the mass rapid transit tunnel. The poster features a young male model in stylish outfit and his mirror image. The passers-by are made dull with no reflection. The mirror image lends emphasis to the unique style and makes it stand out from the monotony. Tilting lines and stamp-like and handwritten fonts are used to convey an upbeat mood. There is consistent use of design elements in the flyer which has a reflective front bearing the logo "ID" and a catalogue of apparels at the back giving viewers a general idea of the products the brand can offer. The moving images to be placed in the mass rapid transit tunnel carry the message "differentiate yourself by integrating style" further. Viewers on the mass rapid transit will be confronted with the same model but with a different outfit in each frame. The logo is integrated in all the promotional collaterals. There is visual correspondence and family resemblance in the new brand identity created. All team members worked very closely in the brainstorming and development of the concept. Having two Business students in the team enabled good marketing strategies to be observed. The Mathematics and Science students executed the ideas in digital forms. The team had a wonderful time learning and developing the creative solution.

The students in this first category clearly demonstrated and applied creatively and successfully what they learned in class in their projects. They enjoyed and worked very well together and did more than required.

The second category, which was achieved by 49% of the teams, comprised projects for which team members demonstrated very appropriate designs that suit the intended message and the target audience. The design layouts were simple but effective. Their reports showed good understanding of the visual language learned. The collaterals created fulfilled the requirement of their promotional objectives. More experimentation on their designs would enable these students to achieve greater heights with results that can have even more impact.

An example in this category is shown in Appendix 3 which illustrates a poster and an invitation created by two Engineering, one Accountancy and one exchange students for a sculpture exhibition by Asian artists. A stone sculpture of a female subject highlighting her posture and sad expression is employed in the poster to convey the theme of "Behind every sculpture is a story". The background is darkened to give emphasis to her one visible eye which is spot-lighted and looking in the direction of the headline. The information on the exhibition is set in sans serif simple and modern font which runs along her curved shoulder providing rhythm to a sensual form. The invitation bears the shape of another sculpture, also with its eye looking at the headline. When opened, the same font is used for the body copy and the font gets bigger towards the bottom to create an interesting perspective. Visual identity is maintained by having similar color, contrast, texture and rhythm in the body copy. Every member of the team contributed to the brainstorming and execution of the designs.

Another example in the second category is illustrated in Appendix 4, which is a project to promote a pop art exhibition. Students had just learned Andy Warhol, the famous pop artist and his painting "*Two Hundred Campbell's Soup Cans*". To solve the problem of the lack of awareness of art around us, this group associated the act of shopping in a supermarket to the act of going to a pop art exhibition. The objective of the message is to close the gap between the everyday activity of purchasing groceries and appreciating and experiencing art that is around us. In the same manner, Andy Warhol closed the gap between art and our everyday experience of life by focusing on the things (Campbell's soup cans) we see every day in his painting. By juxtaposing a female shopper (posed by one of the members), the design further suggests that people do not have to be sophisticated and refined to be able to appreciate art. This group had applied what they learned in

class successfully. They had demonstrated great potential to be creative in visual communication.

The remaining 12% of the teams did not performed as well, showing that they still lacked an understanding of what constitutes an effective message and a visual form that has impact. Some of the students in this category had problems in coming together as a team. These problems could be due to communication, differences in personalities, working habits and/or commitment to the projects.

B. Analyses of graphic images

Based on the results in this same course over the last six semesters when students were tasked to analyze a graphic image of the student's choice in verbal and written form, it has been found that there is no statistically significant difference in the performance of students from the different disciplines. Business and Accountancy students scored an average of 77%, Communication Studies students scored 78% while Engineering students scored 75%. For the examination which involved only a written analysis of a given graphic image, Business and Accountancy students scored an average of 75.7%, Communication Studies students 73% and Engineering students 70.8%.

The experience from this module over the past six semesters also showed that 45% of the students did an excellent job in identifying the message of the visual image while 6% did poorly. When identifying the design elements and principles, 47% did an excellent job while 8% did poorly. On their ability to interpret, 35% put forth arguments that were persuasive, reasonable, convincing, enlightening, and informative while 22% lacked these qualities and were inclined to describe what they saw rather than attempting to put forth an argument. The rest fell into the acceptable range [8].

V. Student Feedback on Teaching and Course Delivery

On the mode of teaching and course delivery for the module, exit surveys of students conducted for the last six semesters indicate very positive outcomes. Under the criteria for teaching: preparation and organization; knowledge; enthusiasm for the subject (whether the subject was delivered with passion, and interest in the subject simulated in the students); learning and thinking (whether the teaching approach stimulates thinking and problem solving); delivery (whether teacher-student communication was effective and whether the pace and pitch of the class sessions appropriate); effectiveness (whether student learnt a lot about the subject); and overall rating on the teaching of the course, students gave an 87% score as compared to the mean teaching score of 80.7% for all courses in the School as shown in Figure 1. The percentage of students who strongly agree/agree with all the criteria when applied to the teaching for this course is 94.4%; under 'delivery', 87.5% of the students strongly agree/agree; under 'enthusiasm for the subject', 94%; under 'learning and thinking, 85.9%; under 'effectiveness', 90.7%. This is shown in Figure 2.

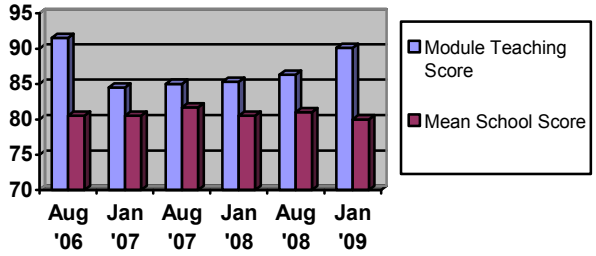


Fig. 1 Student Feedback on Teaching in Percentage score

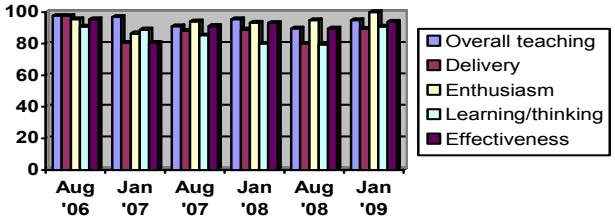


Fig. 2 Percent of students who strongly agree/agree on effectiveness of teaching & delivery

A majority of the students fed back that the topics had been presented in a very interesting manner. Students found themselves engaged all the time and were encouraged to speak and to participate in the learning process. This is in line with research studies which have also found that students appreciate and rank high in importance the level of structure and clarity of the course together with the oral expression and the teacher's skills to communicate with them [26]. Students in this study also found the environment informal, light-hearted, fun and non-threatening. Some of their comments are highlighted below.

"She used a lot of examples to illustrate her point and she asked a lot of questions to stimulate thinking." "Her way of posing questions during class initially seems to be 'stressful' but it significantly helps me to put more thought into interpreting her questions. This is good as it helps me understand the subject better." "Professor has been very patient with her students, always prompting us to speak out, giving our individual opinions. Her teaching style is clear and precise, capturing the essence of the lecture. Lessons are always very interesting, keeping us glued and inducing us to pay great attention to her." "Thoroughly enjoyed the course. By far the most interesting elective that I've taken. Skills learnt in this course I believe will be

useful in future… The whole course was generally taught in a very engaging manner and rarely was there a boring moment for me." "There was a sufficient variety of topics addressed taking on a critique approach where we as students are encouraged to freely respond and voice out opinions in a non-threatening environment…Lessons are conducted in an light-hearted and enjoyable manner…" "Love the class ☺. It's very interesting and engaging. Very fun class ☺. Makes us truly apply what we learned." "Her enthusiasm can be felt easily, and it is infectious because I will want to learn more." "Very fun environment for learning. Makes us not afraid to make mistakes and ask questions."

Other comments include the group projects being time consuming and the need to learn more software skills such as Photoshop and Illustrator which are deemed necessary for the production of visually effective presentations and collaterals in their projects.

Exit surveys on group learning indicate that 84% of the students found working in a group an enriching learning experience. While they encountered and learned to appreciate differences in opinions, they also, at the same time, learned from one another's talent and made new friends. Overall, students enjoyed working with one another. They were able to apply what they learned in the design and felt a sense of achievement. Some of their comments are highlighted below.

"This module is very interesting because our group consists of students from Engineering, Communication Studies, Business and Accountancy. Everyone contributed his/her part and skills. We enjoyed gathering in one of our members' room and discussed till late night. We learned how to really involve in the design process. We brainstormed many solutions and finally came to one final idea. We had dinner and discussed at the same time. We also learned how to tolerate and accept others' ideas." "The entire experience was very fun, building new friendships in the process. Our final product is something I am very proud of. Overall, this experience is something I will remember after my university life." "The project was quite time consuming actually. I remember spending over 6 hours straight during one project meeting, brainstorming for ideas, IDEAS and MORE IDEAS! We nearly died after the whole discussion. However, this was a great learning experience for me because I got to work with several creative people who forced every creative juice out of me! I wouldn't mind doing this all over again☺." "I enjoyed brainstorming with my team members. When we finished the design, there was a sense of achievement. I never thought I could translate ideas into reality using just basic principles learned in class. It was fun and satisfying for me. :)"

VI. Conclusions and Implications

The study into the dynamics of communication in the classroom in an elective course "Aesthetic and Creative Use of the 2D Media" for Engineering and Business students shows clearly the crucial impact that the teacher can make in forming a community of learners through discourse.

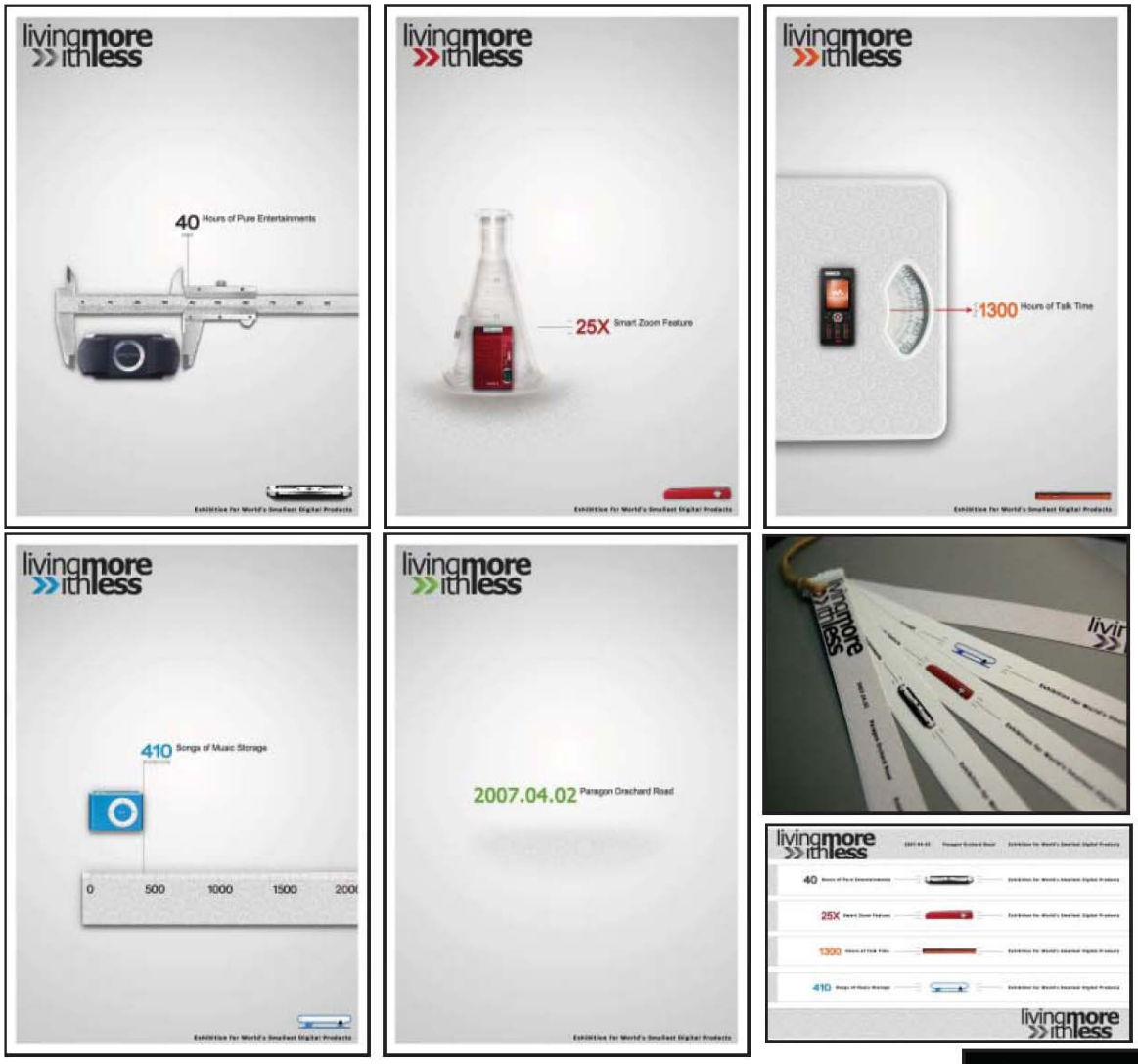
Even though the class size is 50, communication can still be facilitated by the teacher so that students are engaged and involved in the construction of knowledge and building meanings in what they perceive. Opportunities can also be provided by the teacher for students to communicate with one another, to share in and gain from each other's thought, experience and talent.

The learning outcomes, obtained through student-feedback surveys have been very positive. The majority of the learners fed back that the course has been a fun way of learning and this has helped develop in them a life-long interest in the visual art. They felt that communication in the classroom had provoked and organized their thinking, learning and analyzing process. They indicated that they have also learned how to brainstorm creative ideas which lead to concrete satisfying results. This can be seen in their hands-on group projects in which the majority of the groups understood and applied effective designs that suited their message and their target audience. They were proficient in the visual language.

More than a third or 39% of the group projects had surprising and attention getting results with much impact. This working in groups allowed more informal exchanges, sharing and communication between members outside the classroom, benefitted not only their learning but also inculcated in them the confidence to be able to create original ideas for effective visual communication. The learning outcomes also indicate that the majority or over 70% of the students had attained the proficiency to analyze visual images effectively using the visual languages they learned. There is also no significant difference between the performance of the Engineering students and students of other disciplines although Engineering students are more exposed to subjects that require numerical understanding than visual analyses. Further study on the effect of their learning on their subsequent careers should be very useful and informative.

Engineering students who are well-versed with the language of the visual art and who can express their perceptions and thoughts through the visual media and are effective visual communicators would have attained a competitive edge in the globalized visual economy. They will be well positioned to create new knowledge and ideas on top of their major discipline of study. Facilitating good communication to engage students in the visual art classroom is an important and effective way to improve the students' learning process.

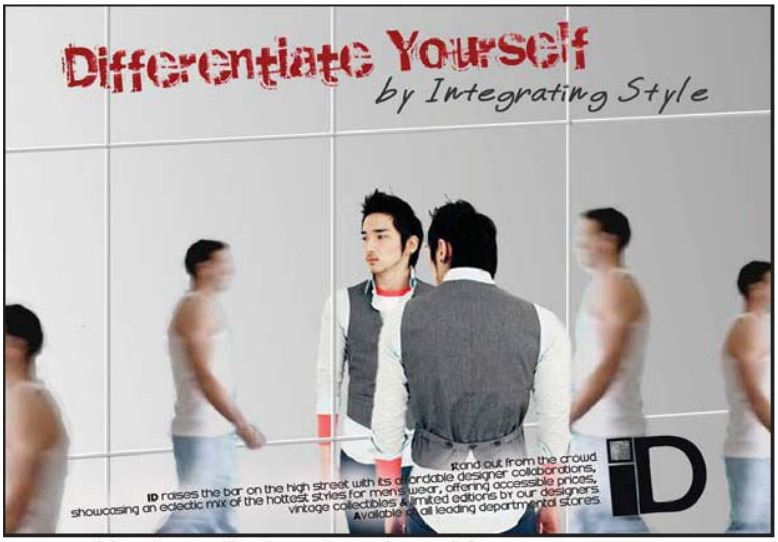
Appendix 1

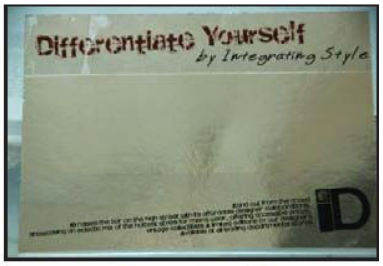


A series of 5 posters with the theme "Living More with Less" to promote an exhibition for the world's smallest digital products designed by Sun Zhongyinan, Xiong Siyu, Li Xiaowei & Kuang Juening. Invitation comes in strips which can open in the shape of a fan.

Appendix 3 Cover and inside page of the invitation

Poster and invitation to Sculpturette, an art exhibition designed by Leung Yuen Fai, Leong Hooi Hwang, See Junsong & Adrian Sim.

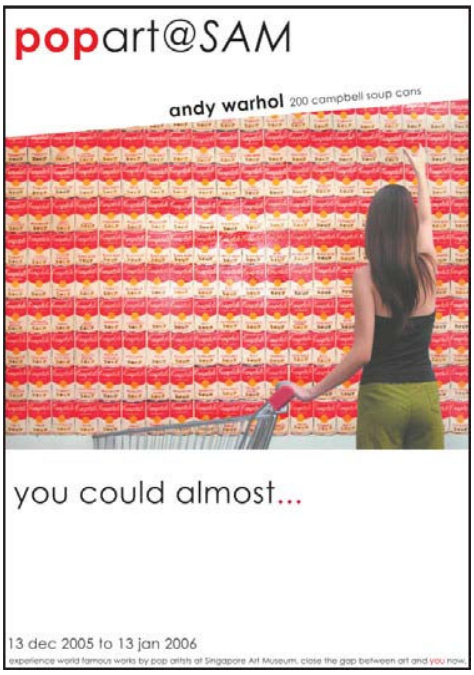




Appendix 2
Flyer with reflective front & back showing apparels

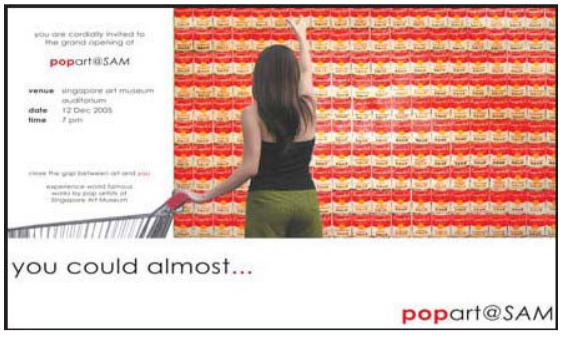
Poster with mirror reflection of a male model

Poster, flyer and 30 moving images at the mass rapid transit tunnel to promote a new brand of stylish apparels for young men designed by Cai Wanwei, Chan Chi Teng, Lim JingYi, Li Peishan & Tan Teng Ee.



Appendix 4

Cover opened to reveal inside pages of the invitation



Poster and invitation to a Pop art exhibition at the Singapore Art Museum (SAM) designed by Loo Ying Zhi, Mohamed Syahid Bin Hassan and Tan Jun Hao Eugene.

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