

On-Line Measurement of Material Properties for Composite Wing Structures

S.H. Cheng and Chyanbin Hwu*

Institute of Aeronautics and Astronautics, National Cheng Kung University, Tainan, Taiwan, R.O. C

Email:chwu@mail.ncku.edu.tw

Paper published in Composites Science and Technology, Vol. 66, pp.1001-1009, 2006

Recently, the technologies of non-destructive evaluation have attracted more and more attention.

These technologies play

increasingly significant roles in maintenance of structures and in-service monitoring. However, most of them such as ultrasonics and X-ray are concerned with point-measurement using detectors to scan a specific area or a spatial region. Obviously, it costs a lot of time to finish scanning procedures; besides, without any further analysis it can't provide information about entire structures. To get global information of the structures, inverse analysis through optimization or neural network techniques is popularly used in the literature. To determine material properties, the commonly used detectors in the inverse analysis are natural frequencies, static strains and displacements, etc. Most of the aforementioned researches dealt with simple plates; very few of them studied complicated structures such as composite wing structures (Figure 1) discussed in this paper. As usual, before implementing inverse analysis it is better to have a detailed study for the forward analysis. Recently we introduced a matrix form representation which makes most of the equations for the vibration analysis of composite wings bear almost the same form as those of the classical beam theory. From the forward analyses provided in our recent study, we see that static strains (Figure 2) and natural frequencies (Figure 3) can be selected as detectors to get the global material properties of the composite wing structures. If the composite laminated wing skin is made up of one kind of unidirectional fiber-reinforced composites with known fiber orientation of each lamina and stacking sequence, the detected averaged global material properties can further lead to the mechanical properties of each lamina.



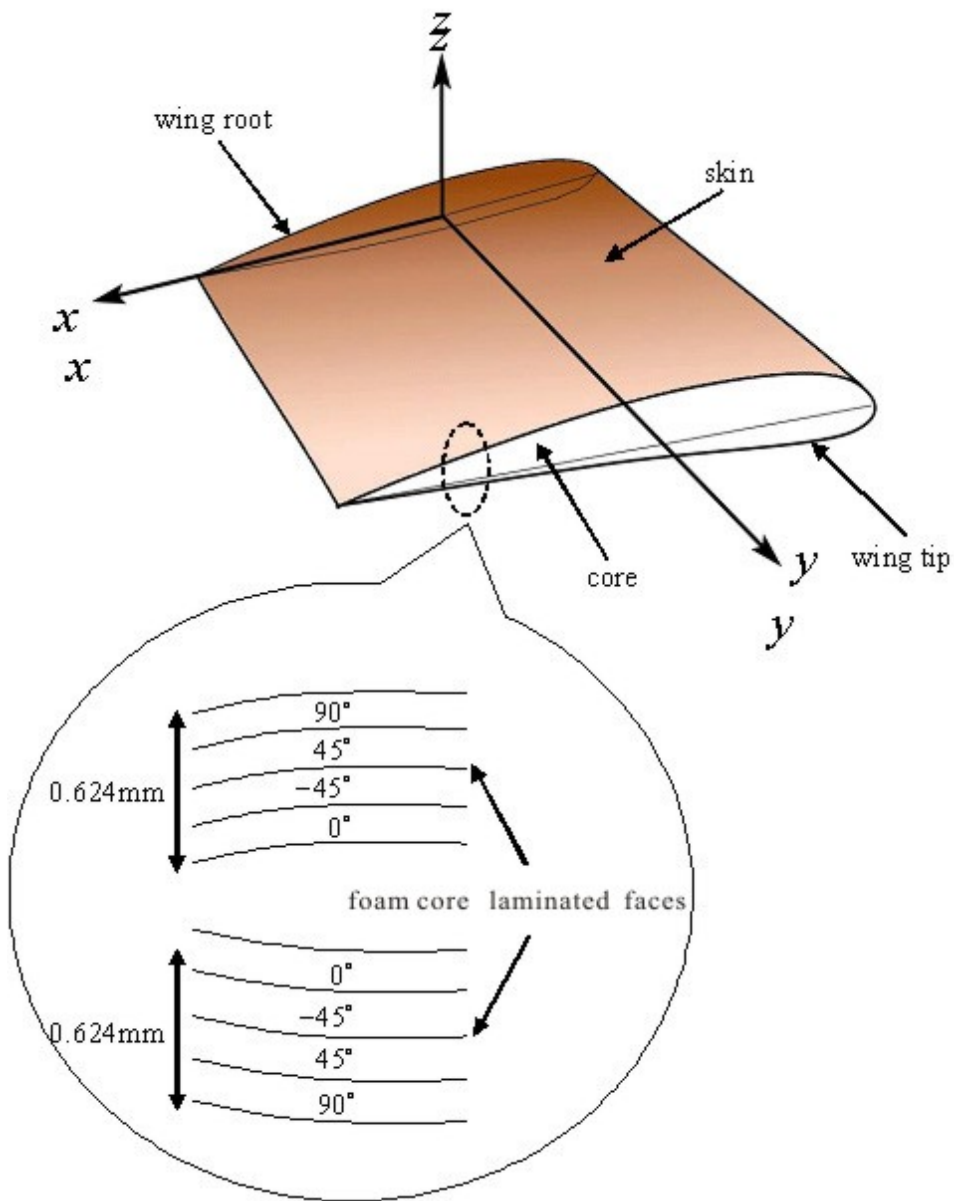


Figure 1. Composite wing structures

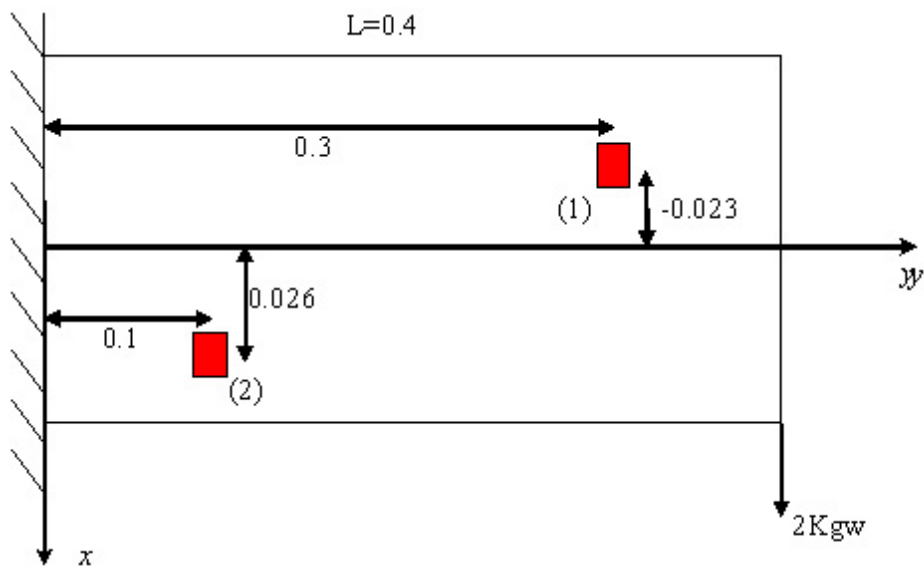


Figure 2. Placement of strain gauges and external force

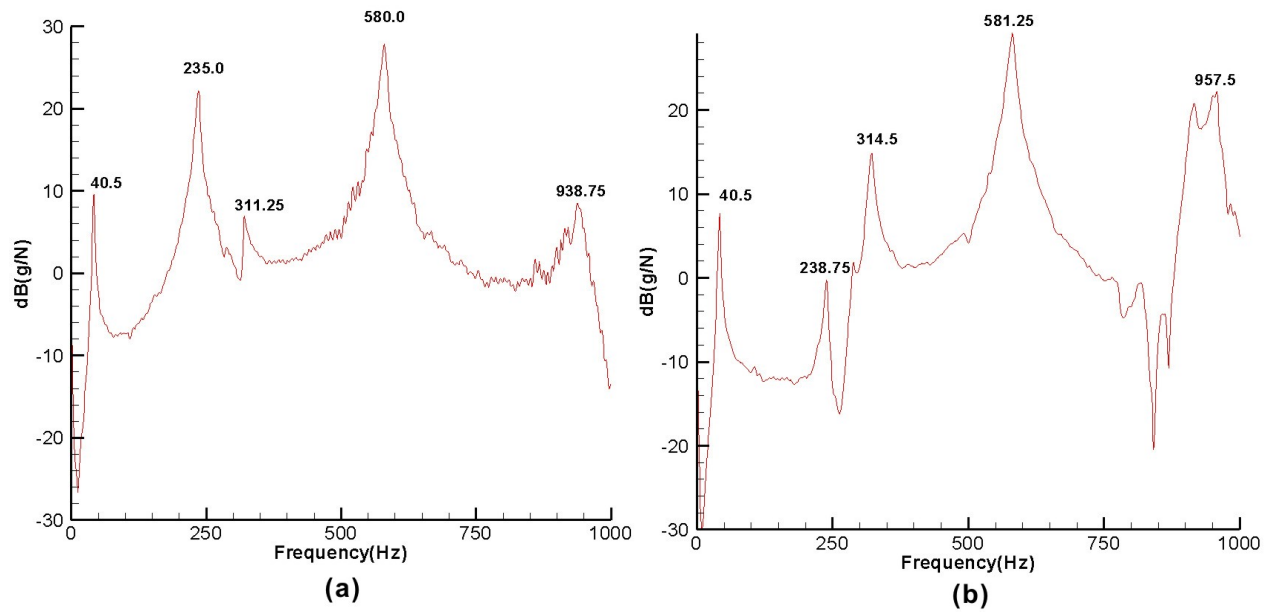


Figure 3. Frequency response spectrum where (a) and (b) represent different placements of accelerometer and locations of impulsion

With the information from forward analysis, in this paper we utilize the matrix form comprehensive dynamic model developed previously and finite element software ANSYS to compute natural frequencies and static strains as detectors. For an on-line and real-time demand, artificial neural networks are adopted to determine the material properties inversely. To show the feasibility and accuracy of the present inverse model, the experimental evaluation (Figure 4) of material properties of NACA 2412 composite wing is made by both the present and conventional methods. Comparison of their results shows that the material properties in fiber direction do well agree with each other. Thus, the on-line and real-time detection of global material properties of composite wings are feasible at least for particular material properties. Because accurate measurement of all material properties and consideration of all possible effects such as wing carrying external stores are of great importance, following the present results further studies are necessary.

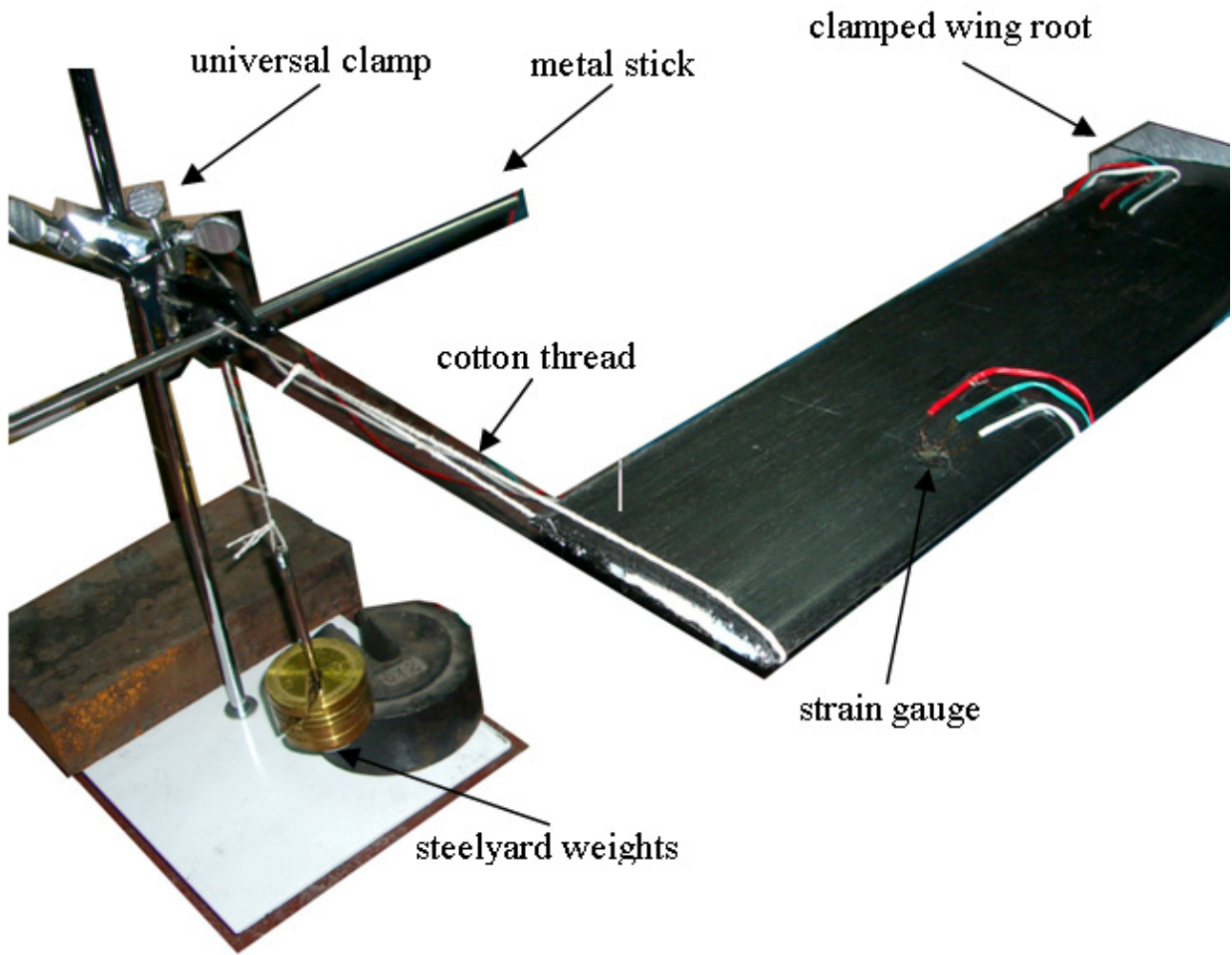


Figure 4. Arrangement of static strain measurement

Copyright 2009 National Cheng Kung University

Modification of multi-walled carbon nanotubes by plasma treatment and further use as templates for growth of CdS nanocrystals

Chun-Hao Tseng¹, Cheng-Chien Wang² and Chuh-Yung Chen^{1,*}

National Cheng Kung University

Email:ccy7@ccmail.ncku.edu.tw

¹Department of Chemical Engineering, National Cheng-Kung University, Tainan, 70148, Taiwan

²Department of Chemical and Material Engineering, Southern Taiwan University, Tainan, 710, Taiwan

Paper published in Nanotechnology, Vol. 17, No. 22, pp. 5602-5612 (2006)

Carbon nanotubes (CNTs) have attracted considerable attention because of their extraordinary properties and potential applications in various fields [1]. With extremely high mechanical strength and chemical stability, CNTs represent attractive possibilities for developing composite materials with extraordinarily high standards of performance, as well as applications for devices, such as fuel cells or sensors [2, 3]. However, the field of CNTs has been beset by a number of problems. For instance, because of the intrinsic van der Waals attraction of the CNTs to each other, which is associated with their aspect ratio (up to 1000), CNTs tend to form bundles and ropes, having very low solubility in most solvents, a condition which limits the applications of the CNTs [4]. In light of this problem, considerable attention has been devoted to improving the solubilities and processability of CNTs.



In this work, we propose a straightforward onestep method for functionalizing MWCNTs via a shorttime plasma treatment. A chelating vinyl monomer, 2-methacrylic acid 3-(bis-carboxymethylamino)-2-hydroxypropylester (GMA-IDA) [5, 6] is introduced onto the surface of MWCNTs by the plasma-induced method [7-9]; the resulting polymer is then further applied as a nanotemplate to fabricate the hybrid CNT/nanoparticle complex. The chelating groups of the GMA-IDA are used as the coordination site for chelating cadmium ions, at which ultrafine CdS nanocrystals (quantum dots) are grown. The advantage of the *in situ* technique presented herein is not only that the process of functionalization can be achieved in a simple step, but also that the MWCNTs were preserved in their original length. Additionally, this approach can be further utilized for preparing various other nanomaterials, such as copper (Cu) and nickel (Ni) metal nanocomposites, as well as cadmium selenide (CdSe) and zinc sulfide (ZnS) semiconductor nanocomposites in optoelectronic nanodevices.

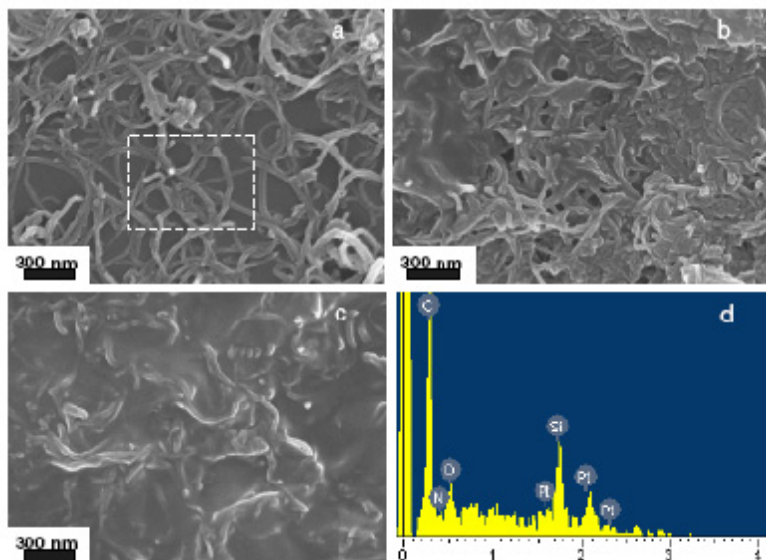


Figure 1. SEM images of the CNTs-G-I with grafting concentrations of GMA-IDA monomer of (a) 15%, (b) 22%, (c) 33%, and (d) EDS spectrum of the selected region in (a).

Figure 1 shows SEM images of the CNTs-G-I when the grafting concentrations of the GMA-IDA monomer are 15%, 22% and 33% respectively. Figure 1(a) illustrates the change in the CNTs-G-I after grafting by the GMA-IDA monomer (15%); compared with the unmodified MWCNTs, the modified MWCNTs of figure 1(a) show a more dispersed, less tangled organization instead of crowded bundles. Notably, the GMA-IDA polymer layer spreads extensively over the CNTs with the increase of the concentration of the GMA-IDA monomer (figures 1(a)–(c)). The SEM images illustrate that the CNTs were covered by the grafted GMA-IDA polymer, and clearly the amount of the GMA-IDA polymer increases as the concentration of GMA-IDA monomer increases. Moreover, figure 1(d) shows the EDS spectrum of the CNTs-G-I (15%) (the selected region in figure 1(a)). Compared with the result of the unmodified MWCNTs, the functionalized CNTs show a new peak of N components, and the peak of O becomes more pronounced, changes which can be attributed to the grafted GMA-IDA polymer. The Si peak comes from the silica wafer used as the CNTs substrate for SEM observations. Figure 2(b) illustrates the change of the CNTs-G-I (15%) after grafting of the GMA-IDA polymer, apparently showing that a layer of grafted GMA-IDA polymer has covered the tube walls of the MWCNTs. Moreover, the GMA-IDA polymer layer becomes thicker and spreads extensively as the concentration of the GMA-IDA monomer increases from 15% to 33% (figures 2(b)–(d)). The TEM observations are consistent with the SEM results.

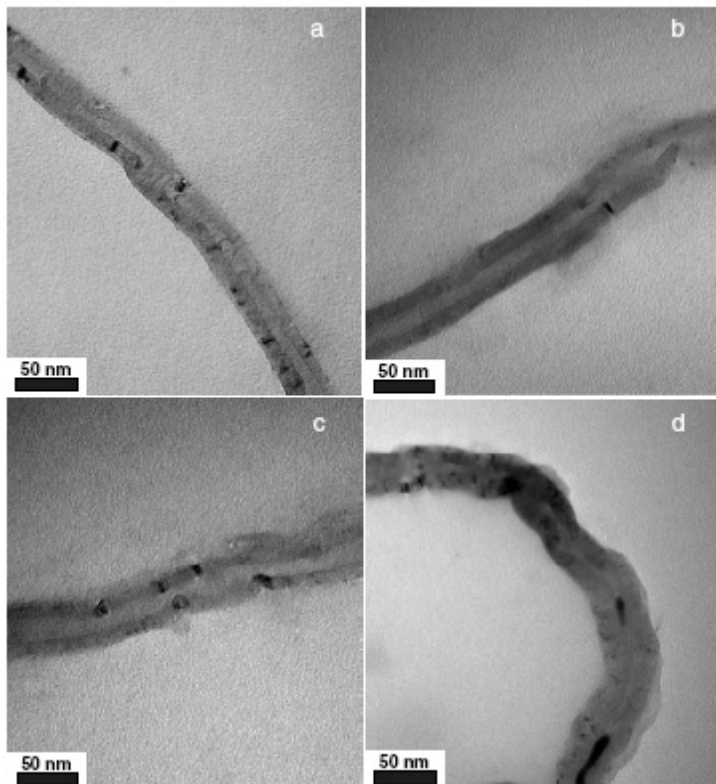


Figure 2. TEM images of (a) unmodified MWCNTs and the CNTs-G-I with different grafting concentrations of GMA-IDA monomer (b) 15%, (c) 22%, and (d) 33%

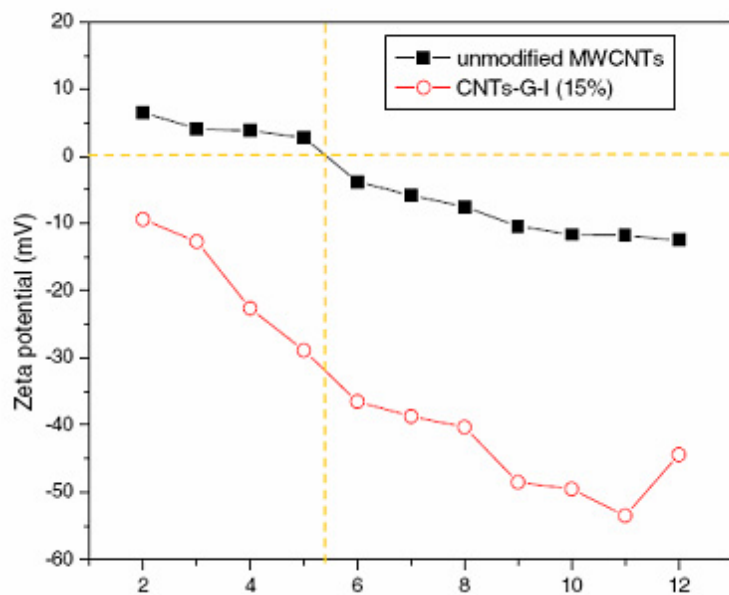


Figure 3. Zeta potential versus pH value of (a) 0.2 wt% unmodified MWCNTs, and (b) 0.2 wt% CNTs-G-I (15%).

The zeta potential is generally used to quantify the electrical potential of solid particle surfaces. By measuring the zeta potential (ζ) as a function of pH value, the acidity or basicity of the CNT surfaces and the isoelectric point (isoelectric point = pH value for zeta potential = 0) can be determined. The zeta potentials of the CNT dispersions as a function of pH value before and after GMA-IDA polymer grafting are given in figure 3. The ζ values are calculated from particle velocities by means of the Helmholtz–

Smoluchowski equation [10], $\zeta = 4\pi \mu \eta / D$ where μ is the electrophoretic mobility and η and D are, respectively, the viscosity and the dielectric constant of the liquid in the boundary layer. From the result of the unmodified MWCNTs, the absolute value of ζ is smaller than 15 mV, and the isoelectric point is approximately pH = 5.5. This ζ value is in accord with the low dispersability of the unmodified MWCNTs in aqueous solution, clearly a result of the low surface charge on the unmodified MWCNTs, which is insufficient to prevent MWCNT aggregation and precipitation. The GMA-IDA polymer-grafted MWCNTs (with a CNTG-I of 15%) have a higher ζ potential value over a wide range of pH values (2–12), which indicates that they are fairly stable in aqueous solution. The increase in the ζ potential value is due to the fact that the carboxylate groups ($-\text{COO}^-$) of the grafted GMA-IDA polymer provide an electrostatic repulsion which stabilizes the CNTs against van der Waals attraction [11]. Moreover, the ζ potential value increases as the pH value increases but starts to decrease when the pH value is over 11. These changes in ζ potential value as a function of pH can be attributed to the propensity of the carboxylate groups ($-\text{COO}^- \text{Na}^+$) of the GMA-IDA polymer to form a $-\text{COO}^-$ structure under a base aqueous condition; as a result the GMA-IDA polymer chains become more hydrophilic and stabilize the CNTs in aqueous solution.

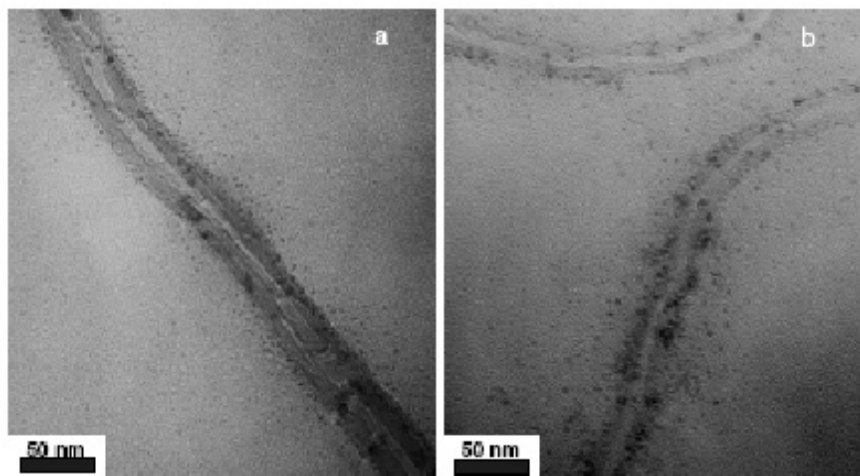
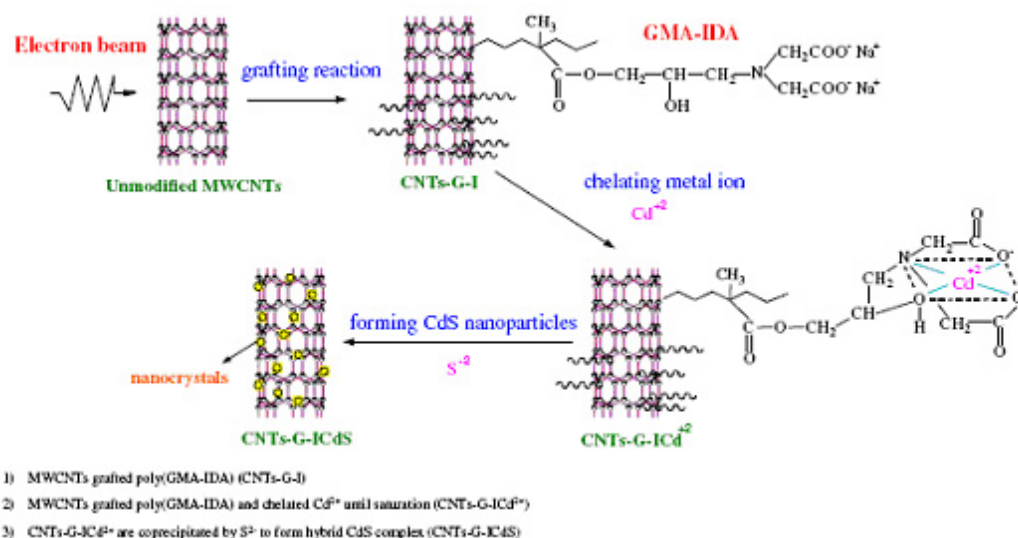


Figure 4. TEM images of the CNTs-G-I (15%) reduced by different concentrations of S^{2-} solution: (a) 5.0×10^{-3} M, (b) 1.0×10^{-2} M.

The above experimental results reveal that the functionalized MWCNTs (CNTs-G-I (15%)) obtained by plasma modification have a marked ability to disperse, as well as remain unprecipitated in aqueous solution. These characteristics can be attributed to the grafted GMA-IDA polymer, which not only promotes dispersion in aqueous solution, but can also subsequently function as a nano-template for the growth of CdS nanocrystals. The morphology and size of the CdS nanocrystals on the surface of the CNTs-G-ICdS complex were investigated by TEM. Figure 4 presents TEM images of CNTs-G-ICdS complexes prepared in S^{2-} solutions with a concentration of 5.0×10^{-3} M (figure 4(a)) and 1.0×10^{-2} M (figure 4(b)) which have a mean diameter of 2.5–3.0 nm and 5.0–6.5 nm, respectively. Evidently, the higher the S^{2-} concentration, the larger the particle size of the CdS nanocrystals will be. This result can be attributed to higher concentrations of S^{2-} resulting in larger amounts of CdS nanocrystals that can, owing to their greater quantity, aggregate more easily. Moreover, from the TEM images, we can observe that nearly all of the CdS nanocrystals grow along the tube walls of the CNTs, demonstrating that the grafted GMA-IDA polymer can be used as a template for the growth of CdS nanocrystals.

Conclusion:

The GMA-IDA chelating groups were successfully grafted onto the MWCNTs via a plasma-induced method, from which the resulting CNTs-G-I (15%) were used as nano-templates for the growth of CdS nanocrystals.



Scheme1: Overall procedure for the preparation of CNTs-G-ICdS complex. (1)MWCNTs grafted poly (GMA-IDA) (CNTs-G-I). (2)MWCNTs grafted poly(GMA-IDA)and chelated Cd^{2+} until saturation (CNTs-G- ICd^{2+}) (3)CNTs-G- ICd^{2+} are coprecipitated by S^{2-} to form a hybrid CdS complex (CNTs-G-ICdS).

Reference

- [1] Thess A 1996 *Science* 273 483
- [2] Kong J, Chapline M C and Dai H J 2001 *Adv. Mater.* 13 1384
- [3] Bezryadin A, Lau C N and Tinkhan M 2000 *Nature* 404 971
- [4] Ausman K D, Piner R, Lourie O and Ruoff R S 2000 *J. Phys. Chem. B* 104 8911
- [5] Tseng C H, Wang C C and Chen C Y 2006 *J. Phys. Chem. B* 110 4020
- [6] Tseng C H, Wang C C and Chen C Y 2006 *J. Nanosci. Nanotechnol.* 6 1
- [7] Sawy N M E 2000 *Polym. Int.* 49 533
- [8] Cardona F, George G A, Hill D J T, Rasoul F and Maeji J 2002 *Macromolecule* 35 355
- [9] Ulbricht M and Belfort G 1996 *J. Membr. Sci.* 111 193
- [10] Ries H E 1970 *Nature* 226 72
- [11] Vigolo B, Penicaud A, Coulon C, Sauder C, Pailler R, Journet P and Poulin P 2000 *Science* 290 1331

A Studentized Range Test for the Equivalency of Normal Means under Heteroscedasticity

Miin-Jye Wen* and Hubert J Chen

Department of Statistics, National Cheng Kung University
Email:mjwen@stat.ncku.edu.tw

Computational Statistics and Data Analysis 51 (2006) issue 2, Nov 15, 1022-1038.

1. Preface

In analysis of variance (anova), we generally assume that the error terms are independent and normally distributed with a common unknown variance. However, in practice, one often encounters situations where the error variances are not only unknown but also unequal (it is so-called heteroscedasticity). Therefore, there is a need to search for a suitable statistical method to solve this kind of problems in anova. Furthermore, in classical hypothesis testing the interest is often to test the null hypothesis that the population means are all equal. It is well known that, for a large enough sample size, the classical test will almost always reject the null hypothesis. In many real world problems (for example, to test generic drug vs innovative drug in pharmaceutical study), the practical interest is frequently to examine whether the normal population means fall into an indifference zone, not just the equality of means. This idea leads to the consideration of equivalence hypothesis under the situation of heteroscedasticity of error terms stated as $H_0 : (1/k) \sum_{i=1}^k |\mu_i - \bar{\mu}| \leq \delta$ versus the alternative of inequivalence $H_a : (1/k) \sum_{i=1}^k |\mu_i - \bar{\mu}| \geq \delta^* > \delta$, where $\bar{\mu}$ is the grand average of the means μ_1, \dots, μ_k , $\delta \geq 0$ is a predetermined indifference constant and $\delta^* \geq 0$ is a detective amount specified in advance. Thus, the expression on the left side of the inequality in the null hypothesis is often regarded as the average deviation of the means from their grand average, and the null hypothesis claims that the means are falling into a negligible zone.



2. Introduction

When there are only two treatments ($k = 2$), the two one-sided tests by Schuirmann (1987) for bioequivalence of the treatments become a guideline in the field of pharmaceutical industry for drug development and medical studies. In situations where there are three or more treatments ($k > 2$) under study, the equivalence/bioequivalence of these treatments has barely been touched by Giani and Finner (1991), Chen, Xiong and Lam (1993), and Chen and Chen (1999). In this paper, when the population variances are unknown and possibly unequal. We propose an equivalence hypothesis

$H_0 : (1/k) \sum_{i=1}^k |\mu_i - \bar{\mu}| \leq \delta$ against an inequivalence alternative $H_a : (1/k) \sum_{i=1}^k |\mu_i - \bar{\mu}| \geq \delta^* > \delta$,

where $\delta (>0)$ is an equivalent constant specified by experts in advance.. It has been shown that this measure of equivalence is equivalent to the interval hypothesis of equivalence for $k = 2$. When the variances are unknown and unequal, a studentized range test using a two-stage and a one-stage sampling procedure, respectively, is proposed for testing the null hypothesis that the average deviation

of the normal means is falling into a practical indifference zone against the alternative of inequivalence. Since the level and the power of the test are functions of all unknown means and unknown variances, it is necessary to find a least favorable configuration (LFC) of the means to guarantee a maximum level (the probability of rejection region) at a given null hypothesis and a LFC to guarantee a minimum power at a given alternative. By our findings the level under a given null H_0 and the power under a given alternative are fully independent of not only the unknown means but also the unknown and unequal variances. Therefore, the critical values and required sample sizes can be simultaneously determined by solving system of integral equations. Statistical tables to implement the procedure are provided for practitioners and an example is given to demonstrate the use of the test.

3. Summary and Conclusion

Testing the null hypothesis of equal treatment means is sometimes impractical in real applications. An alternative measure to detect the difference among means is the average deviation of the means, which extends the idea of equivalence among means. The test of equivalence receives more attention in health sciences, pharmaceutical industry, and other applied areas. When the variances are unknown and unequal, a studentized range test using a two-stage and a one-stage sampling procedure, respectively, is proposed for testing the null hypothesis. The two-stage sampling procedure is a design-oriented procedure that satisfies certain probability requirements and simultaneously determines the required sample sizes (which can be largely increased at the second stage) in an experiment while the one-stage sampling procedure is a data-analysis procedure after the data have been collected, which can supplement the two-stage sampling procedure when the latter has to end its experiment sooner than its required experimental process is completed. At that time the level and power can be approximated, and the one-stage sampling procedure is shown to be quite feasible under heterocedasticity.

Acknowledgement : This research with the second author being principal investigator was supported by National Science Council Grants NSC92-2119-M-006-007, 2003-2004 and NSC93-2118-M-006-008, 2004-2005, Taiwan, ROC.

4. References

1. Chen, S. Y. and Chen, H. J. (1999). A Range Test for the Equivalency of Means under Unequal Variances. *Technometrics*, Vol. 41, No. 3, 250-260. (SCI)
2. Chen, H. J., Xiong, M. and Lam, K. (1993). Range Tests for the Dispersion of Several Location Parameters. *Journal of Statistical Planning and Inference*, 36, 15-25. (SCI)
3. Giani, G. and Finner, H. (1991). Some general results on least favourable parameter configurations with special reference to equivalence testing and the range statistic. *Journal of Statistical Planning and Inference*, 28, 33-47. (SCI)
4. Schuirmann, D. J. (1987). A Comparison of the Two One-Sided Tests Procedure and the Power Approach for Assessing the Equivalence of Average Bioavailability. *Journal of Pharmacokinetics and Biopharmaceutics*, Vol. 15, No. 6, 657-680. (SCI)

Long-Term Cognitive and Motor Deficits After Enterovirus 71 Brainstem Encephalitis in Children

Mei-Chih Huang¹, Shih-Min Wang², Yung-Wen Hsu³, Hui-Chen Lin⁴, Chia-Yu Chi⁴, Ching-Chuan Liu^{4,*}

Departments of ¹Nursing, ²Emergency Medicine, ³Occupational Therapy and ⁴Pediatrics, National Cheng Kung University & Hospital, Tainan, Taiwan
Email: meay@mail.ncku.edu.tw; liucc@mail.ncku.edu.tw

Pediatrics 2006;118;1785-1788

There are more than 60 distinct serotypes of enteroviruses within the family Picornaviridae. Enterovirus 71 (EV71) was first isolated from patients with encephalitis, aseptic meningitis, or myocarditis in California between 1969 and 1972. Several epidemics of EV71 infections occurred in Taiwan since 1998. EV71 usually causes hand-foot-and mouth disease (HFMD) or herpangina, but the infection can progress to a polio-like, acute flaccid paralysis or brainstem encephalitis (BE). BE is the most common neurological complication in children. The highest mortality rate occurs in children who developed pulmonary edema.



This study was designed to determine the long term outcome of children who survived hospitalization for EV71 BE. Attention was focused on cognitive and motor outcomes because the disease is most often localized to the brainstem, pons and midbrain.

The study population consisted of Taiwanese children who were under the age of 12 years when they were hospitalized for EV71 BE. They were prospectively followed at at the Department of Pediatrics and Emergency Medicine of National Cheng Kung University Hospital from 1998 to 2004 and were invited to return for further assessment.

BE (stage II) was defined as an illness characterized by myoclonus, ataxia, nystagmus, oculomotor palsies, and bulbar palsy, in various combinations, with or without confirmation by neuroimaging. ANS dysregulation (stage IIIa) was defined as the occurrence of cold sweats, mottled skin, tachycardia, tachypnea, and hypertension. PE (stage IIIb) was defined as the occurrence of respiratory distress, tachycardia, tachypnea, rales and copious frothy sputum with chest radiological findings of bilateral pulmonary infiltrates without cardiomegaly.

A pediatrician used a standardized questionnaire to obtain information from parents or guardians and healthcare providers. This included information on demographic characteristics, co-morbid illnesses, current medications, memory loss, cognitive function and ability to perform activities of daily living.

The Wechsler Pre-school and Primary Scale of Intelligence-Revised (WPPSI-R) was used for subjects 3 to <6 years of age. The Wechsler Intelligence Scale for Children-Revised (WISC-R) was used for subjects 6 to 16 years of age. The Movement Assessment Battery for Children (M-ABC) test was used to assess general motor performance. M-ABC consists of four age bands suitable for a specific age group. Each age band consists of eight items that measure three aspects of motor ability: manual dexterity, ball skills, and balance. Total scores were expressed as percentile. Children with scores at or below the 5th percentile for their age were identified as having motor difficulties. Scores between 5th and 15th percentile were considered to be borderline. The Beery-Buktenica Developmental Test of Visual-Motor Integration (VMI) was used to assess visual-motor skills. Children with scores at or below 5th percentile for their age were identified as abnormal.

Sixty-three previously healthy children with EV71 BE (49 stage II, 7 stage IIIa, 7 stage IIIb) were followed for 2.8 ± 1.0 years (range: 1.4~4.9 years). The mean age at the time of diagnosis was 2.4 ± 1.4 years (range: 0.3~7.1 years). There were no significant differences in social or demographic characteristics by stage of BE. Neurological examinations were completed in 63 subjects. Cognitive and M-ABC tests were completed in 54 and the VMI test in 53. Three children with stage IIIb disease died during the follow-up period.

The neurological findings during hospitalization and at follow-up are summarized in Table 1. The most frequent neurological abnormalities during hospitalization were abnormal activities of daily living (52.4%), followed by altered consciousness (47.6%), cerebellar dysfunction (17.5%) and cranial nerve palsy (15.9%). Most of these had resolved by the time of follow-up.

Residual cognitive or motor disorders were noted at follow-up in nine of the 63 patients (14.3%) (Table 2). Among the 9 children with residual deficits, 3 (4.8%) had cognitive and 7 (11.1%) had motor defects (mostly cerebellar dysfunction). Two children with stage IIIb disease continued to have severe motor dysfunction and respiratory failure complicated by urinary and fecal incontinence.

This is the first study to evaluate the long-term cognitive and motor sequelae of EV71 brainstem encephalitis. The inflammatory lesions in this disease are usually localized to the posterior two thirds of the medulla oblongata and pons and the anterior two thirds of the spinal cord. There is increasing evidence that subcortical structures, including the basal ganglia, brain stem, and cerebellum are involved in cognitive and behavioral processes in humans. Cerebellar dysfunction is the most common neurological deficit in children with stage II disease. Pulmonary edema with hypoxia is the major cause of death in children with stage IIIb EV71 infection. Failure to provide prompt pulmonary resuscitation with a patent airway may lead to a hypoxic-ischemic encephalopathy superimposed on the direct brain stem insult caused by the virus. Aggressive resuscitation needs to be instituted as soon as possible to prevent global brain damage.

Altered consciousness during the acute illness and the potential to develop cognitive impairment in EV71 BE appears to be multifactorial. The current findings indicate that long term cognitive function is usually preserved in children after EV71 BE. This is based on both objective tests as well as confirmatory reports by parents and guardians.

In conclusion, we found that the long term cognitive function of children with EV71 BE was generally quite good. Nevertheless, residual defects, mostly consisting of cerebellar dysfunction, were still present in 10.2% of children with EV71 BE stage II at about three years following hospitalization. Children with EV71 BE stage IIIb continued to have severe respiratory and motor impairment. Close monitoring of cerebellar dysfunction and early rehabilitation are recommended. Long term follow-up of

this cohort is needed to determine the ultimate prognosis.

Table 1. Abnormal Findings on Neurological Examination of Children with EV71 BE on Admission and at Follow-up

Characteristics	Stage II N=49 (%)	Stage IIIa n=7 (%)	Stage IIIb ^a n=7 (%)	Total N=63 (%)
Altered consciousness				
Admission	18 (36.7)	6 (85.7)	6 (85.7)	30 (47.6)
Follow-up	0	0	0	0
Activities of daily living^b				
Admission	22 (44.9)	5 (71.4)	7 (100)	33 (52.4)
Follow-up	0	0	2 (28.6)	2 (3.2)
Cranial nerve palsy^c				
Admission	2 (4.1)	3 (43.9)	5 (71.4)	10 (15.9)
Follow-up	1 (2.0)	0	2 (28.6)	3 (4.8)
Sensory coordination^d				
Admission	0	0	0	0
Follow up	1 (2.0)	0	2 (28.6)	3 (4.8)
Cerebellar dysfunction^e				
Admission	7 (14.3)	4 (57.1)	0	11 (17.5)
Follow-up	5 (10.2)	0	2 (33.3)	7 (11.1)

^a Three patients expired during the follow up.

^b Abnormal activities of daily living disorders on admission were: stage II - attention, 1; movement, 6; feeding, 15; stage IIIa - feeding, 2; attention, movement, and feeding, 2; attention, movement, respiration and feeding, 1; stage IIIb - respiration, 4. On follow-up, two stage IIIb patients developed additional attention, movement, respiration, feeding, and defecation and urination abnormalities.

^c Cranial nerve (CN) palsies noted on admission were: stage II - CN VII, 1; CN VIII, 1; stage IIIa - CN VII, 2; CN VIII, 1, and stage IIIb - CN VIII, 4. On follow-up one stage II patient developed a new CN II palsy; two stage IIIb patients developed new CN I, V and CN VIII palsies.

^d Abnormal findings of sensory coordination noted on follow-up were: stage II - tendon reflex, 1; stage IIIb - muscle tone, 2.

^e Abnormal findings of cerebellum function noted on admission were: stage II - gait and balance, 7; and stage IIIa - gait and balance, 4. Abnormal findings of cerebellum function noted on follow-up were: stage

II - gait and balance, 5, and stage IIIb - gait and balance, position, and vibration, 2.

Table 2. Residual Cognitive and/or Motor Disorders Detected Among 9 of 63 Children with EV71 BE

Age at onset,y	Gender	Stage	Time Followed,y	Cognitive and motor disorders
1.6	F	II	2.2	WPPSI-R < 2SD
3.4	M	II	1.8	WPPSI-R < 2SD, Cerebellar dysfunction
2.4	F	II	1.8	WPPSI-R < 2SD
1.4	M	II	2.6	M-ABC < 5 th percentile, Cerebellar dysfunction
1.7	M	II	2.6	M-ABC < 5 th percentile, New cranial nerve II palsy, Poor sensory coordination, Cerebellar dysfunction
2.9	M	II	2.6	Cerebellar dysfunction
2.5	M	II	1.7	Cerebellar dysfunction
1.9	M	IIIb	3.8	Abnormal attention, movement, respiration, feeding, defecation and urination, Cranial nerve palsies in I,V and VIII, Poor position and vibratory sensation, Cerebellar dysfunction
0.7	M	IIIb	3.0	Abnormal attention, movement, respiration, feeding, defecation and urination, Cranial nerve palsies in I,V and VIII, Poor position and vibratory sensation ,Cerebellar

Copyright 2009 National Cheng Kung University

Synthesis of Mesoporous Silica in Helical Fibers, Vesicle-Like, Film Morphologies by Using Ternary Surfactant System as Organic Template

Hong-Ping Lin

Department of Chemistry, National Cheng Kung University, Tainan, Taiwan 701

Email: hplin@mail.ncku.edu.tw

Langmuir, 2007, 23, 4115-4119 and 2006, 22, 6-9.

In nature, numerous spectacular architectures result from the self-assembly of small organic and inorganic building blocks at low concentration into larger macromolecular structures. Recently, much effort has been devoted to synthesize organic-inorganic hybrids with amazing morphologies in order to design and control on the selective preparation of complicated chemical architectures. To mimic silicification in diatoms, using surfactant systems with properties similar to those of phospholipids and highly diluted silica solution as inorganic precursors are desired. Based on the surfactant chemistry, mixture of oppositely charged single-tailed cationic and anionic surfactants produce a very rich variety of aggregate microstructures (e.g., rodlike micelles, vesicles and lamellar) even at high dilution, which can serve both as model biological membranes and as novel organic templates of the mesostructured silica in different remarkable morphologies. Because the surfactant-silica assembly is a form of self-assembly with covalent modification, the morphology is particularly dependent on factors related to reaction kinetics and template behavior, such as the reaction temperature, water content, and pH value of the silica solution. With a well control on the silica condensation rate and surfactant composition, tailoring on the morphology of the mesoporous silica could be achieved.



It is well known that the mesostructural behavior and charge density of cationic and anionic surfactants is dependent on the anionic/cationic surfactant ratio. As the ratio increases to 1.0, phase transformation from rod micelles → vesicles → lamellar phase gradually occurs. These mesostructural surfactants can be used as template or co-template to generate the mesoporous silica in desired form.

At SDS/C₁₆TMAB (C₁₆TMAB: cetyltrimethylammonium bromide; SDS: sodium dodecylsulfate) weight ratio of 0.135, mesoporous silica helical fibers were obtained from slow silicification of C₁₆TMAB-SDS binary-surfactant mixture in a highly-diluted silica solution at pH ≈ 1.5. From low-magnification SEM images, it is clear that the yield of the mesoporous silica helical fiber is high (> 95 %) and the length ranges from tens to few hundred of micrometers (Figure 1). When observing at higher magnification, we can clearly see that the shapes of the helical mesoporous silicas are different including single-helix fibers, double-helix fibers, and triple-helix fibers. The pore size distributions of these samples are sharp and centered at about 3.0–4.0 nm. The BET surface area is around 700–800 m² g⁻¹.

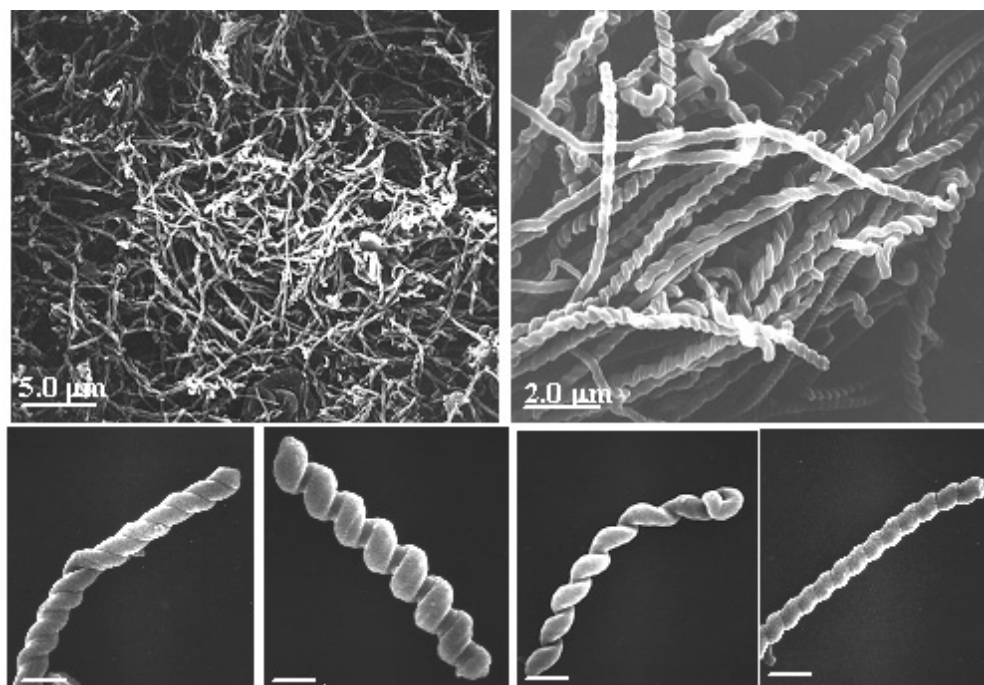


Figure 1. SEM images at different magnifications of various shapes of mesoporous silica helical fibers synthesized with C_{16} TMAB/SDS template (composition: 1.0 g : 0.135 g in weight ratio) at pH = 1.5.

In addition to acting as mesostructural template, the C_{16} TMAB-SDS binary-surfactant can also combine with neutral surfactant to form novel template. Hollow silica spheres with mesostructured shells were prepared with a vesicle template of C_{16} TMAB-SDS-Pluronic P123 ($EO_{20}PO_{70}EO_{20}$) at SDS/ C_{16} TMAB ratio of 0.6–0.8 following a fast silicification in dilute silicate solution at pH \approx 5.0. The mesostructure of the shell is disordered and mesopore size is about 5.5–7.5 nm (Figure 2). A bi-template model, in which the C_{16} TMA⁺–DS⁻ form the stable bilayer vesicle structure and the P123 copolymers anchored on C_{16} TMA⁺–DS⁻ vesicle act as the template for the mesoporous silica, was proposed to explain the formation of the hollow silica spheres with mesostructured shells. This bi-template model can be applied extensively to prepare the hollow silica spheres with mesostructured shells with different diameters and pore sizes by using other C_n TMA⁺-SDS- EO_m PO_nEO_n ternary-surfactant mixtures.

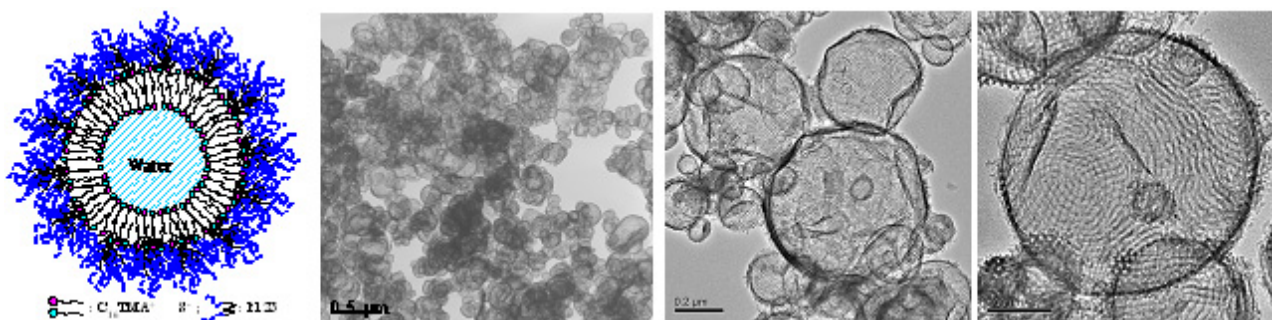


Figure 2. A schematic diagram of the bi-template model for the hollow silica spheres with mesostructured shell. TEM images at different magnifications of the hollow silica spheres with mesostructured shell prepared with P123- C_{16} TMAB-SDS ternary surfactants as template.

At the ionic surfactant ratio of SDS/ C_{16} TMAB \approx 1.67, mesoporous silica film with perpendicular nanochannels can be synthesized by using a ternary surfactant mixture of C_{16} TMAB, SDS and P123 as

template and silicate solution as inorganic source under neutral condition ($\text{pH} \approx 6.0$). At high-magnification SEM image, one can clearly see that the mesoporous silica film consists of 2D-hexagonally ordered holes facing up (Figure 2). On the edge (upper corner), one can see exposed nanochannels vertical to the film. TEM image reveals clearly the hexagonal-arrayed nanochannels of the film, and the pore size is about 7.0 nm. We proposed a ternary-surfactant template, somewhat idealized, for the formation of the mesostructured film(\perp) as depicted in Figure 3. Because of the strong specific interaction between C_{16}TMAB and SDS, they form bilayer structures and interact only weakly with the other components. However, the hydrophobic interaction between the pseudo-zwitterionic bilayer and P123 is apparently strong enough to let the P123 micelles intercalate between the bilayers. The excess of anionic SDS over cationic surfactant in the composition probably leads to the slightly negatively charged bilayers which would not allow a separate phase of $\text{C}_{16}\text{TMAB} + \text{SDS}$ from the ternary surfactant mixture. Under the neutral pH condition, the neutral P123 interacts strongly with a condensing sodium silicate mainly by hydrogen-bonding to form a hexagonal mesostructure. The silicate ions are negatively charged and they do not have a tendency to be attracted to the slightly negatively charged bilayer also. Thus, the free standing mesoporous silica film with perpendicular nanochannels was created.

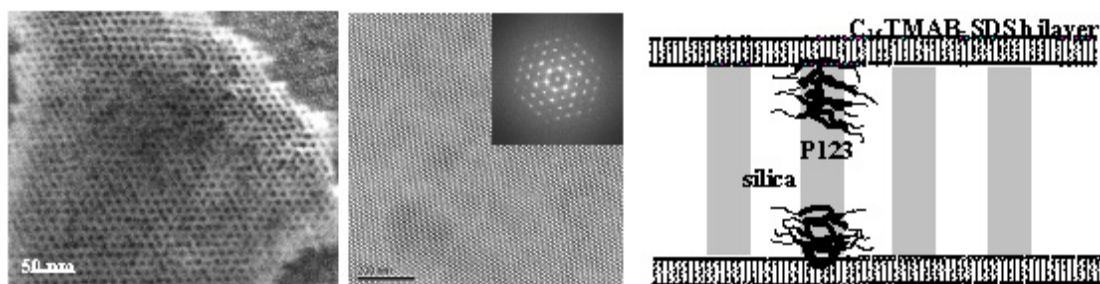


Figure 3 SEM and TEM images of the calcined mesoporous silica film synthesized from $\text{C}_{16}\text{TMAB}/\text{SDS}/\text{P123} = 0.75/1.0/0.70\text{-H}_2\text{O}$ -sodium silicate at $\text{pH} \approx 6.0$ and $T = 40^\circ \text{C}$. A bi-template model for the formation of mesoporous silica film with vertical nanochannels. The C_{16}TMAB -SDS cationic and anionic surfactants form a bilayer membrane structure and P123/silicate intercalates vertically as a 2D hexagonal structure.

From these works, creating mesoporous silicas in helical, vesicle-like or film morphologies is feasible, and future developments require our combining the knowledge gained from mesostructured silicas and the self-organization of surfactants system. Owing to the large pore size and high porosity, these mesoporous silica could be used as nano-template, the helical morphologies and well-ordered mesostructure are preserved in the resulted carbons. This should open up a new direction for the controlled synthesis and practical use of mesoporous materials for advanced applications such as chiral heterogeneous catalysis, sensors, adsorption, and separation. The ultimate goal is not only to mimic silicification in nature but also to go a step further and be able to preprogram mesoporous materials to produce a specific architecture with defined functionality.

Facilitating interactions through structured Web-based bulletin boards: A quasi-experimental study on promoting learners' critical thinking skills

Ya-Ting Yang ^{a,*}, Timothy Newby ^b, Robert Bill ^c

^a Institute of Education & Centre for Teacher Education, National Cheng Kung University

^b College of Education, Purdue University, USA

^c School of Veterinary Medicine, Purdue University, USA

Email: yangyt@mail.ncku.edu.tw

Published in Computers & Education, DOI: 10.1016/j.compedu.2007.04.006 [SSCI]

1. Introduction

John Dewey stated that the central purpose of education is learning to think. As part of education, learners need to develop and learn to effectively apply critical thinking (CT) skills to their academic studies, to the complex problems that they will face in their professions, and to the critical choices they will be forced to make as a result of the information explosion and other rapid technological changes. In general, CT has been defined as "reasonable, reflective thinking that is focused on deciding what to believe or do." Research has suggested that face-to-face verbal interaction, which includes rational dialogue and

questioning among learners and the instructor, accelerates the acquisition of knowledge and skills while fostering CT development. Unfortunately, in distance education, learners are separated by distance and/or time from their instructor and peers; thus, learner/instructor as well as learner/learner interactions can be significantly hindered. However, with advances in technology in the World Wide Web (WWW) and computer-mediated communication (CMC), researchers can now explore new ways to make distance education a truly interactive experience and, by extension, improve the development of CT skills through the use of distance education modalities. Thus, the goal of this study was to examine the impact of structured online discussions on the improvement of learners' CT skills in different phases of learning. Learners' attitudes toward learning and enhancing CT skills via a structured WBB (Web-Based Bulletin Board) were also investigated. Based on the above goal, a quasi-experimental design was employed to test the following two research hypotheses:

1. Learners who participate in structured WBB discussions will demonstrate CT skills at higher levels than learners who participate in unstructured WBB discussions.
2. Learners who participate in structured WBB discussions will show more positive attitudes toward learning via WBBs than learners who participate in unstructured WBB discussions.

2. Method



2.1. Participants and independent variable

The participants were 23 distance learners (see Table 1) enrolled in the same online course (with three sections) in an undergraduate veterinary distance learning course at a large US university. The independent variable, WBB discussions, was divided into two levels: unstructured and structured.

- **Unstructured WBB discussions (Treatment I):** Similar to email, which many instructors use as an educational tool for communication/feedback in their instruction, the unstructured WBB discussions referred to Web-based discussions where a threaded WWW discussion forum was provided in which learners could ask questions, interact with each other, and obtain feedback from their peers or their instructor, but where no discussion topics were posted.
- **Structured WBB discussions (Treatments II and III):** The structured WBB discussions consisted of four posted discussion activities that provide learners with guidance in asking CT questions and evaluating their understanding of the course material. For example, during the CT modeling, the instructor demonstrated and prompted the use of thought-provoking questions such as: What is my point of view on the issue? Is there supporting evidence for my conclusions? Are those reasons adequate? By what reasoning did you come to that conclusion? Learners were required to contribute their ideas and thoughts to each exercise and were encouraged to think critically about the course content and the questions asked by their instructor and peers. Those within Treatment II also had the instructor model CT questioning during the second half of the semester (for two discussion activities), while within Treatment III, the CT questioning was modeled during the first half of the semester (for two discussion activities).

The impact of structured versus unstructured discussion was examined through a comparison of the quality of responses from participants in Treatment I with the quality of responses from participants in the other two treatments. Moreover, a comparison of Treatment II with Treatment III allowed for the examination of the effect of the instructor's CT modeling at different points of time as well as its long-term impact.

Table 1. Experimental settings

	n	1st half of the semester	2nd half of the semester
Treatment I	7	• <u>Unstructured WBB discussions</u>	• <u>Unstructured WBB discussions</u>
Treatment II	11	• <u>Structured WBB discussions</u>	• <u>Structured WBB discussions</u> • Teaching and modeling of CT questioning
Treatment III	5	• <u>Structured WBB discussions</u> • Teaching and modeling of CT questioning	• <u>Structured WBB discussions</u>

2.2. Dependent variables

The two dependent variables were the learners' levels of CT skills and their attitudes toward learning via WBBs (see Table 2). Learners' levels of CT skills were measured via the California Critical Thinking Skills Test (CCTST) (Facione, 1990, 1992) as well as the Interaction Analysis Model (see Table 3) (Gunawardena, Lowe, & Anderson, 1997).

Table 2. Attitude survey

Attitude toward learning via WBBs		Attitude toward learning via WBBs	
1	I would like to use a WBB in the distance learning courses since it may be easier to ask questions and receive feedback from my peers than without using it.	7	I would like to use a WBB in the distance learning courses since the instructor might be able to better observe and enhance my critical thinking skills.
2	I would like to use a WBB in the distance learning courses since it may be easier to share my opinions/viewpoints with my peers and the instructor than without using it.	8	Using emerging communication technologies, such as WBBs, is important for veterinary technicians to share information, opinions, questions, and possible solutions with others in the profession.
3	I felt that the WBB allowed me to better compare and contrast my opinions/viewpoints with those of my peers in the course.	9	I felt that the WBB helped me become more productive in learning.
4	I felt that the WBB allowed me to better examine and justify my own opinions/viewpoints in the course.	10	I felt that the WBB increased the efficiency of my education.
5	I felt that I was more able to negotiate and integrate the different opinions/viewpoints raised by my peers in the online discussions in the course.	11	I felt that the WBB increased the quality of my education.
6	I would like to use a WBB in the distance learning courses since it may be easier to socialize and connect with my peers.	12	Overall, I think that WBBs are of little use in education.

Table 3. Interaction Analysis Model

Phase I: Sharing/comparing of information	
A. A statement of observation or opinion	[IA]
B. A statement of agreement from one or more other participants	[IB]
C. Corroborating examples provided by one or more participants	[IC]
D. Asking and answering questions to clarify details of statements	[ID]
E. Definition, description, or identification of a problem	[IE]
Phase II: The discovery and exploration of dissonance or inconsistency among ideas, concepts, or statements	
A. Identifying and stating areas of disagreement	[IIA]
B. Asking and answering questions to clarify the source or extent of disagreement	[IIB]
C. Restating the participant's position, and possibly advancing arguments or consideration in its support by references to the participant's experience, literature, formal data collected, or proposal of relevant metaphor or analogy to illustrate point of view	[IIC]
Phase III: Negotiation of meaning/co-construction of knowledge	
A. Negotiation or clarification of the meaning of terms	[IIIA]
B. Negotiation of the relative weight to be assigned to types of argument	[IIIB]
C. Identification of areas of agreement or overlap among conflicting concepts	[IIIC]
D. Proposal and negotiation of new statements embodying compromise, co-construction	[IIID]
E. Proposal of integrating or accommodating metaphors or analogies	[IIIE]
Phase IV: Testing and modification of proposed synthesis or co-construction	
A. Testing the proposed synthesis against "received fact" as shared by the participants and/or their culture	[IVA]
B. Testing against existing cognitive schema	[IVB]
C. Testing against personal experience	[IVC]
D. Testing against formal data collected	[IVD]
E. Testing against contradictory testimony in the literature	[IVE]
Phase V: Agreement statements/applications of newly-constructed meaning	
A. Summarization of agreements	[VA]
B. Applications of new knowledge	[VB]
C. Metacognitive statements by the participants illustrating their understanding that their knowledge or ways of thinking (cognitive schema) have changed as a result of the conference interaction.	[VC]

3. Data Analysis

Both quantitative and qualitative methods of data analysis were used in this study.

•For the quantitative data, a 2-way mixed design ANOVA was performed to identify whether differences between the results of the CCTST and the participants' attitudes toward learning via WBBs existed

among the three research groups.

- From a qualitative perspective, learner responses were categorized using the Interaction Analysis Model and analyzed using chi-square tests. Two raters—the instructor and the researcher—discussed, negotiated, and then together parsed the discussion transcripts into units of analysis. They then independently rated each unit across category of interactions. The following examples are used to explain how each unit of the online postings was coded. For example, if Learner A started a new discussion, the coding was [IA]. If Learner B evaluated Learner A's message and replied by stating a contradictory viewpoint, it was coded [IIA]. Based on Miles and Huberman's (1994) formula, the inter-rater reliabilities for the online discussion analyses ranged from 90.79% to 100%.

4. Results and discussion

The results of the data analyses showed both positive and negative findings in the testing of the research hypotheses. The main findings included:

(1). According to the CCTST scores, the learners who joined in structured WBB discussions (Treatments II and III) significantly improved their CT skills after the instructor facilitated discussion activities to help bring about more productive conversations via the WBB.

(2). From an analysis of the quality of learners' online discourse to reveal the "process" of CT, learners who participated in a structured WBB discussion (Treatments II and III) demonstrated CT skills at a higher level than learners who participated in an unstructured WBB discussion (Treatment I). In addition, increased levels of interaction positively impacted the levels of CT within this structured WBB discussion environment. However, if WBBs are employed as an educational tool (similar to email) for learners to use in voluntarily interacting with their peers and instructor for feedback (Treatment I), they might not devote enough time and effort to actually develop the needed CT.

(3). In a structured WBB discussion environment, the sequence of the study procedure alternated between Treatments II and III conditions with the instructor's modeling at different points in the semester. The results indicated that with the same training time, if the instructor started to model and challenge learners' CT skills at the beginning of the online discussion (Treatment III) rather than in the middle of the semester (Treatment II), learners seemed to be more motivated to participate, and the discussion tended to be more dynamic and interactive. Furthermore, learners maintained their CT skills after the instructor facilitated CT questioning (Treatment III).

(4). From the attitude survey (see Table 2), the findings (see Figure 1) suggest that the experimental groups felt significantly more positive toward the use of WBBs in helping them learn better because the WBBs allowed them to ask questions and receive feedback from their peers more easily, to better share and compare viewpoints with their peers, and to better examine and justify their own opinions. In addition, the WBBs enabled learners to better negotiate and integrate the different opinions expressed by their peers and enabled the instructor to better observe and enhance the CT skills in the structured online discussion. Thus, after critically discussing the course materials on the structured WBB, the experimental groups had more positive attitudes than did the comparison group toward the use of WBBs for increasing the productivity, efficiency, and quality of their learning.

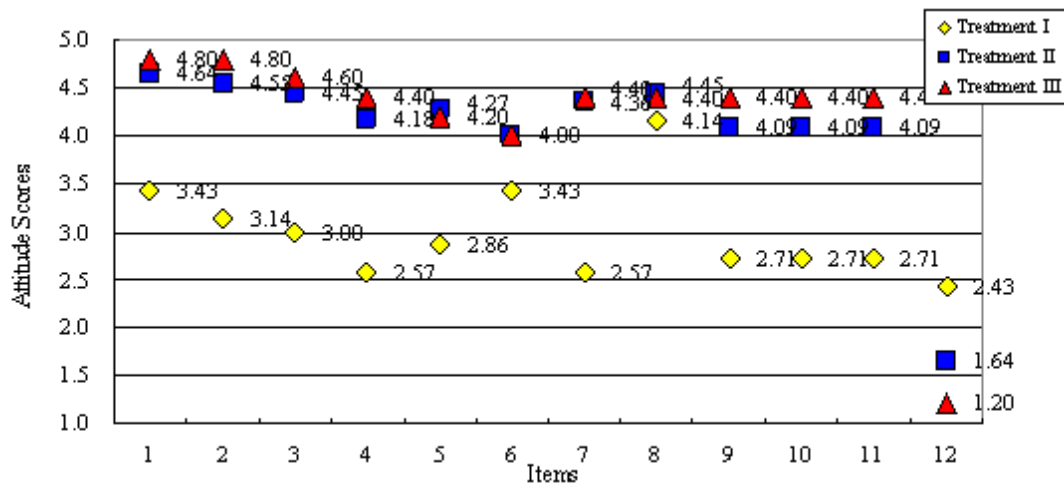


Fig. 1. Item-by-item means of post-course attitudes toward learning via WBBs.

5. Conclusion

Critical thinking is an important issue in higher education, and educators have continued to focus on the development of CT in learners. Structured WBB discussion has recently been used to improve learners' CT skills; however, its effectiveness has not yet been examined experimentally. This study, using a quasi-experimental design, has been a first step toward ascertaining the effectiveness of structured WBB discussions in developing learners' CT. Two different methods have been used to examine learners' CT: (a) quantitative method: CCTST to investigate learners' changes in their general CT skills, and (b) qualitative method: Interaction Analysis Model to investigate learners' interaction patterns in different phases of the content-based class discussion. The combination of the two instruments allowed the authors to thoroughly study learners' CT on both macro and micro levels. Positive gains in learners' CT skills and attitudes provide empirical evidence that instructional designs incorporating WBB discussion and interaction can be effective and conducive to the development of CT.

References:

- Facione, P. A. (1990, 1992). *The California critical thinking skills test (CCTST): Form A (1990) and From B (1992)*. Millbrae, CA: California Academic Press.
- Gunawardena, C., Lowe, C., & Anderson, T. (1997). Analysis of global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17(4), 397-431.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks: Sage.