Assessment By Design: The Satisfaction Index

By

Christopher C. Ibeh, Marjorie Donovan, Oliver Hensley, James Otter
Pittsburg State University, Pittsburg, KS 66762

Abstract

One of the key components of CUES-AM (Consortium for Upgrading Educational Standards – Assessment Model) is the EKE (Essential Knowledge Elements) Protocol for rating of programs and course/instructional delivery. The CUES-AM protocol for rating of programs and course/instructional delivery uses such essential knowledge elements factors as efficacy, usefulness, comprehensiveness, validity, interest and difficulty to assess participants' satisfaction level based on program/course-specific, expertly pre-determined essential knowledge elements (EKEs). The EKE factors generated by participants are converted to the satisfaction index (I_s), with a true satisfaction index (I_{TS}) scale of 0.0 – 0.29 (very poor), 0.30 – 0.49 (poor), 0.50 – 0.69 (Fair), 0.70 – 0.79 (good), 0.80 – 0.89 (very good) and 0.9 – 1.0 (excellent). The satisfaction index, a new concept developed by the CUES group at Pittsburg State University captures the satisfaction level for a given group of participants with a particular program or course/instructional delivery. This paper discusses the use of the concept of satisfaction index to assess and rate the interdisciplinary materials research program and the plastics materials courses at Pittsburg State University (PSU).

Introduction

The satisfaction index, a new concept developed by this paper's authors; is a derivative of the EKE (Essential Knowledge Elements) protocol of the CUES-Assessment Model. CUES-AM is an integral part of epistecybernetics. Epistecybernetics, a new system's approach to knowledge governance and stewardship was originated by Hensley et al [(1)(2)(3)(4)(5)(6)]: The satisfaction index can be used to provide a quantitative assessment and evaluation of the satisfaction level of participants in a given program or course. A literature search especially of the consumer industry indicate that most satisfaction-based assessment surveys are qualitative[(8)(9)(10)] in nature. CUES-AM consists of the following innovative components and modules:

1. pre-test, post-test of each student to determine knowledge gain, ability to apply knowledge and student creative thinking from the different delivery systems,
2. EKE (essential knowledge element) Protocol for rating of activities, reports etc.,
3. EKE Protocol for rating of programs and course/instructional delivery,
4. discipline, subject/course-specific structure of knowledge,
5. ethics and life-long learning, and a
6. universal network/registry of epistecybernets and products.

This paper focuses on the EKE Protocol for rating of programs and course/instructional delivery, particularly its usage in the assessment and evaluation of the interdisciplinary materials research program and plastics materials courses at Pittsburg State University.

The EKE Protocol

The essential knowledge elements (EKE) protocol for rating of programs and course/ instructional delivery uses the rating form as per Table I. The form of Tables I, III and IV, as the case may be, is given and explained to the participant at the beginning of the semester or program. CUES-AM via the EKE form solicits input and active participation from the participant(s); this constitutes a form of quasi-empowerment, and bestows on the participant a level of limited partnership with the faculty or program administration. Empowerment and partnership imply responsibility for learning and understanding of the course or program materials. Participants are typically the focus of any program or course, and their satisfaction level is a good gauge of the program's success. In academia, some are of the "school of thought" that students are "products" whereas others feel that they are "clients". This paper is of the school of thought that students are both products and clients"[1][3][4]; the successful programs are the ones that are able to strike the right balance between "clientele and product" approaches. As "products" we expect our students to be of the highest possible quality but as "clients," we treat them appropriately including empowering them to be responsible for learning and understanding the subject/program material as delineated by the "essential knowledge elements" (EKEs). However, regardless of the approach or school of thought, assessment is an important part of academia and industry. "Products" have to be verified and certified as performance worthy and up to specifications. Industry and academia are "clientele"-driven; customer satisfaction is the basis for profitability and ultimate success.

EKEs specify what are important in a given program, subject or discipline. Specification of the EKEs is the first step in the participants' empowerment process, and also provides a framework for an appropriate and successful performance evaluation protocol. Tables I, III and IV show the major elements of the CUES-EKE Protocol for program and instructional delivery assessment. The first column of Tables I, III and IV has the expertly, pre-determined **Essential Knowledge Elements** (EKEs) for a particular program or course as per program/course content or outline of activities (Rows 1 through ∞).

An EKE represents a concept, idea or task whose understanding and mastery is essential for success in a discipline, course or program. EKEs are typically determined by the expert opinion of one or more educated members of the discipline, course or program. The second column (Table I; minimized in Tables III & IV) has the Total Exposures and Times, and is actually made up of six sub-columns, one for in-class lectures and presentations, the next four for outside-of-class activities such as C.B.I. and internet (C.B.I = computer based instructions), application sessions, discussion exposures and creative sessions, and the final sixth column is for total exposures or sum of the first five. Each sub-division of the Total Exposure and Times has two sub-columns, one for the number of exposures or encounter with a particular EKE and the other for the times in

Course #	Class	Date: 07/17/02
ETECH 795+		**PSU/NSF-REU/RET 2002 Program**

Class Start Time ________ – Class End Time ________	Instructional Delivery Systems by EKE's						EKE Assessment					
	Table I: SAMPLE EKE-BASED ASSESSMENT FORM (Essential Knowledge Elements)											
	Exposure Times						**EKE Factors**					
	In Class			**Outside of Class**								
EKEs Rows 1 - ∞	Lecture Sessions & Time	CBI Sessions Time & Internet	Application Sessions & Time	Discussion Exposures & Time	Creative Sessions & Time	Total Exposures & Time	Usefullness 0 to 10	Difficulty 0 to 10	Validity 0 to 10	Interest 0 to 10	Comprehensiveness	Efficacy 0 to 10
Recruitment/Selection					2 1	2 1	10	7	5	0	7	6

Table II: LEGEND OF CUES-EKE FACTORS FOR PROGRAM AND COURSE/INSTRUCTIONAL DELIVERY ASSESSMENT	
EKE FACTORS ▼	LEGEND
USEFULNESS	This factor assesses the ability of the participant to utilize information or element in future tasks or in life. Scale = 0 (not useful) to 10 (very useful)
DIFFICULTY	The EKE factor verifies the level of ease or difficulty of a given element or task as perceived by the participant. Scale = 0 (very easy to understand or accomplish) to 10 (very difficult)
VALIDITY	This EKE factor determines the perception of the participant as to the validity f or inclusion of this element or task in the program or course. Scale = 0 (not valid) to 10 (very valid)
EFFICACY	The efficacy factor verifies the participant's level of competency with a given EKE or task. Scale = 0 (no competency) to 10 (very competent).
COMPREHENSIVENESS	The comprehensiveness factor verifies the participant's perception as to the completeness of instructional delivery with regard to this element or task. Scale = 0 (not complete) to 10 (very complete)
INTEREST	This EKE factor determines the participant's level of personal interest with this element or task.. Scale = 0 (no interest) to 10 (high level of interest)

minutes spent for the corresponding exposure. The final six columns of Tables I, III and IV have the assessment criteria or EKE factors such as **usefulness**, **difficulty**, **validity**, **efficacy**, **comprehensiveness** and **interest**.

The Satisfaction Index (I_s)

The level of satisfaction of the participants is measured using the satisfaction index, a new concept recently developed by the PSU-CUES group for the analyses of the results of this study. The satisfaction index (I_s) is derived from the EKE factors via the equation:

$\mathbf{I_{TS}} = \mathbf{I_S} + \mathbf{I_D}$ ……$\subseteq$ 1.0 ………… Eq. 1.0

Where:

$\mathbf{I_{TS}}$ is the true satisfaction index; it ranges in value from 0, minimal satisfaction to 1.0 maximum (super) satisfaction. $\mathbf{I_{TS}}$ can be determined per EKE or per "group" or sub-group.

$\mathbf{I_S}$ is the satisfaction index; it is the average value of the five EKE factors ($\mathbf{E_F}$) other than Difficulty, divided by a factor of ten. That is:

$\mathbf{I_S} = (\Sigma \mathbf{E_F}) / (5)(10)$ ……………….. Eq. 2.0

$\mathbf{I_D}$ is the difficulty index. $\mathbf{I_D} = 0.2[(\mathbf{D_F} - 5) / 10] = 0.02(D_F - 5)$ ………. Eq. 3.0

D_F is the **average** EKE factor for difficulty for a given group or sub-group. This value increases true satisfaction ($\mathbf{I_{TS}}$) for high difficulty ratings but reduces satisfaction level for low difficulty ratings, as per equation 1.0. The value 5.0 of Equation 3 is the mid (difficulty) rating value, and 0.2 is the satisfaction correction constant.

True Satisfaction Index ($\mathbf{I_{TS}}$) Rating Scale

$0.0 \subseteq \mathbf{I_{TS}} \subseteq 1.0$ (values above 1.0 $\cong$ 1.0)

$\mathbf{I_{TS}}$ = 0.90 - 1.0 = Excellent or super satisfaction rating
= 0.80 – 0.89 = Very good

= 0.70 – 0.79 = Good

= 0.50 – 0.69 = Fair

= 0.30 – 0.49 = Poor

= 0.0 – 0.29 = Very poor

Table III: **ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) FOR THERMOPLASTIC RESINS COURSE, Fall 2002**

ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) ↓	EKE FACTORS					
	Usefullness 0 to 10	**Difficulty 0 to 10**	**Comprehensivness 0 to 10**	**Interest 0 to 10**	**Validity 0 to 10**	**Efficacy 0 to 10**
Introduction	6.6	2.0	6.0	5.2	7.6	7.9
Overview of Plastics Industry	8.6	3.7	7.4	6.8	8.3	7.7
Chronology of the Plastics Industry	8.6	3.6	8.0	6.8	8.3	7.9
Basic Structures	7.3	2.7	7.0	6.8	7.6	7.7
Chemical Bonding in Plastics Resins	7.0	3.4	6.2	6.4	7.7	7.6
Structural Units	8.1	4.4	8.2	8.2	8.1	9.0
Polymers	8.0	5.1	8.4	8.8	8.6	9.0
Copolymers	9.1	5.4	7.4	7.8	7.7	8.6
Shapes & Sizes of Polymers	7.3	4.1	6.6	6.4	6.7	7.6
Differences Between Thermoplastics & Thermosets	7.3	3.7	6.4	6.6	6.9	7.4
Molecular Weight	8.3	6.6	7.6	7.6	8.1	8.1
Polydispersity	8.9	5.9	7.4	6.2	9.0	8.0
Molecular Weight Distribution (MWD)	7.9	5.9	8.0	6.4	9.0	8.1
Average Molecular Weight	8.1	5.7	8.0	6.8	8.9	8.3
Polymerization Reactions	8.0	6.4	7.4	7.4	8.9	7.6
Polymerization Processes	7.6	6.6	8.2	8.6	8.7	7.3
Bulk Polymerization	8.3	7.3	8.0	8.0	8.4	7.4
Solution	7.9	6.7	8.4	7.6	9.0	7.9
Emulsion	8.4	7.1	8.6	7.6	9.1	8.0
Suspension Polymerization	7.0	7.1	6.8	7.6	8.1	7.3

Table III (CONTD.): **ESSENTIAL KNOWLEDGE ELEMENTS FOR THERMOPLASTIC RESINS COURSE, Fall 2002**						
	EKE FACTORS					
ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) ↓	**Usefullness 0 to 10**	**Difficulty 0 to 10**	**Comprehensivness 0 to 10**	**Intrest 0 to 10**	**Validity 0 to 10**	**Efficacy 0 to 10**
Crystallinity	8.3	6.3	6.2	7.0	7.6	7.7
Plasticization & Annealing	8.7	6.4	6.8	8.4	8.7	7.6
Morphology	5.1	3.6	4.0	4.4	5.4	3.1
Categories of Thermoplastics	8.20	6.80	8.70	6.50	8.10	7.90
Thermoplastic Families						
Polyolefins	8.7	7.1	8.6	7.0	8.4	8.3
Polyvinyls	8.7	7.0	8.6	6.6	9.0	8.1
Polystyrenes	8.9	8.0	8.4	7.2	8.0	8.9
Polyacrylics	7.6	8.3	7.8	6.0	7.9	8.0
Polyesters	8.1	8.1	8.2	7.4	8.3	8.1
Polyamides	8.6	8.0	7.2	6.2	8.1	8.1
Polyacetals	8.1	8.7	7.6	7.0	7.9	7.7
Polycarbonates	8.6	8.0	8.4	7.2	7.7	8.3
Polyphenylene Sulfides	8.7	7.4	8.8	8.0	7.0	6.6
Polyphenylene Oxides	7.1	7.4	6.2	6.2	6.9	6.0
Polysulfones	7.3	7.1	7.4	7.2	7.1	6.6
High Temperature Polyimides	5.9	6.3	7.6	6.6	5.1	3.6
Cellulosics	3.1	4.7	4.6	4.6	3.9	1.3
LCP's	7.4	6.7	6.2	7.4	7.0	6.6
Crosslinked Thermoplastics	6.3	5.9	3.8	6.6	5.6	5.9
Miscellaneous	5.6	4.4	3.8	3.4	4.6	3.7

Table III (CONTINUED.): **ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) FOR THERMOPLASTIC RESINS COURSE, Fall 2002**						
ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) ↓	EKE FACTORS					
	Usefullness 0 to 10	**Difficulty 0 to 10**	**Comprehensivness 0 to 10**	**Intrest 0 to 10**	**Validity 0 to 10**	**Efficacy 0 to 10**
Laboratory Section						
Tensile Strength Testing	8.9	7.1	9.4	7.4	8.6	9.0
Impact Strength Test	9.0	6.7	8.4	7.2	8.1	7.9
Melt Flow Index	9.0	7.6	8.6	8.0	7.4	7.7
Torsional Test	3.9	2.4	3.2	3.8	4.0	3.4
Plastisol	2.4	1.6	1.6	1.0	3.9	3.4
Ultrasonic Welding	4.6	3.7	5.6	5.2	4.4	5.1
DSC-Thermal Transitions	9.0	7.1	7.8	8.4	8.6	8.7
Computerized Materials. Selection	9.0	6.6	8.4	7.2	8.4	9.1
PVC Plasticization	2.1	1.6	3.0	3.6	2.6	2.0
Blending	7.7	6.4	6.6	4.8	6.3	6.3
Moisture Analysis	2.1	2.1	3.8	3.6	2.1	1.9
Multi-directional Impact testing	3.3	2.6	4.6	5.2	4.3	4.1
Flexural Testing	6.6	4.7	4.4	3.8	4.9	5.0

Results

Tables III and IV have the average EKE factors responses for the 2002 Thermoplastic Resins Course and 2003 PSU-REU/RET program respectively. The total exposure time components have been minimized for this study. These EKE factors are used to determine the difficulty, satisfaction and true satisfaction indices as per equations 1.0 to 3.0. The difficulty (I_D), satisfaction (I_S) and true satisfaction (I_{TS}) indices are presented on Tables V and VI. Plots of these indices are shown on Graphs I and II. On both graphs, Series 1 is for the difficulty index (I_D), Series 2 is for the satisfaction index (I_S) and Series 3 is for the true satisfaction index (I_{TS}). However, both graphs are

Table IV: PSU/NSF-REU/RET 2003 PPROGRAM

2003 REU/RET Program EKEs ↓	**Usefullness 0 to 10**	**Intrests 0 to 10**	**Comprehensivness 0 to 10**	**Difficulty 0 to 10**	**Validity 0 to 10**	**Efficacy 0 to 10**
Recruitment/ Selection	**6.7**	**7.0**	**7.7**	**5.0**	**8.3**	**6.7**
Program Orentation	**3.3**	**2.0**	**4.0**	**3.3**	**4.0**	**3.3**
Weekly Seminars	**4.7**	**4.7**	**4.0**	**4.7**	**4**	**4.7**
Ethics Program	**8.23**	**8.7**	**8.1**	**4.6**	**9.0**	**8.8**
Ethics Topic	9.0	9.0	8.3	2.7	9.3	9.0
Ethics Panel	8.0	9.0	7.3	3.3	8.7	8.7
Ethics Paper	7.7	8.3	8.7	7.7	9.0	8.7
Research Program	**9.5**	**8.7**	**9.7**	**7.8**	**9.1**	**8.8**
Research Topic	8.7	8.7	9.3	8.3	9.3	8.7
Access To Lab	10	8.7	9.7	8.3	8.7	8.7
Access To Advisor	10	8.7	10	7.0	9.3	10
On Site Lab Presentation (07/18)	**4**	**3**	**5**	**8**	**4**	**3.3**
Report Writing	**5.3**	**6**	**5.3**	**6**	**6.7**	**6.7**
Field Trips	**5.1**	**5.8**	**5.5**	**2.3**	**4.9**	**5.4**
Able Corp. MO	5.3	5.3	5.7	2.3	5.3	5.0
JayHawk Chem., KS	4.7	5.0	4.7	2.7	4.3	5.3
3M Corp, MO	5.3	5.7	5.0	2.3	5.0	5.3
Safety	2.0	2.7	2.7	0.7	1.7	2.0
Big Brutus	8.3	8.7	8.7	3.3	8.3	8.0
Fort Scott Garrison	5.3	8.3	6.3	3.3	4.3	7.0
Kustom Signals, KS	7.7	8.0	7.0	3.7	7.3	7.0
Water Treatment Plant	2.7	2.7	2.7	1.3	2.7	2.7
Energy &Materials Mgmt Course	**5.2**	**4.5**	**5.7**	**6.8**	**4.5**	**5.2**
Energy Trends	3.3	3.7	5.0	9.7	3.0	4.3
BasiLaws of Energy	6.0	6.0	5.7	7.7	6.3	5.0
EnergyConservation	6.3	4.0	6.3	6.3	6.3	6.3
Energy Presentations	6.0	7.3	6.3	7.7	7.0	7.0
Hydrogen Economy	7.3	7.3	8.3	7.0	7.3	7.3
CompuHEX Design	2.3	4.7	6.7	9.0	3.7	3.3
3M Presentation	4.0	5.3	4.0	4.7	4.7	4.7
WepPages	5.3	6.0	5.3	5.3	6.0	5.3
Life Cycle Analysis	6.7	8.0	6.3	4.3	7.0	7.7
Picnics	**7.3**	**7.3**	**7.3**	**5.0**	**4.7**	**7.3**
C.W.Symposium	**7.3**	**8.0**	**8.3**	**7.0**	**8.0**	**8.0**

Table V.1: SATISFACTION INDICES OF ACTIVITY GROUPS FOR THE THERMOPLASTIC RESINS COURSE, FALL 2002						
ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) ↓	Satisfaction Indices					
	E_F	**D_F**	**I_D**	**I_S**	**I_{TS}**	
1. Introduction	**6.70**	**2.0**	**-0.06**	**0.670**	**0.610**	
2. Overview of Plastics Industry	**7.80**	**3.70**	**-0.026**	**0.780**	**0.754**	
3. Chronology of the Plastics Industry	**7.92**	**3.60**	**-0.028**	**0.792**	**0.764**	
4. Basic Structures	**7.30**	**2.70**	**-0.046**	**0.730**	**0.724**	
5. Chemical Bonding in Plastics Resins	**6.98**	**3.4**	**-0.032**	**0.698**	**0.670**	
6. Structural Units	**8.32**	**4.4**	**-0.012**	**0.832**	**0.820**	**0.724**
7. Polymers	**8.60**	**5.1**	**0.002**	**0.860**	**0.862**	
8. Copolymers	**8.12**	**5.4**	**0.008**	**0.812**	**0.820**	
9. Shapes & Sizes of Polymers	**6.92**	**4.1**	**-0.18**	**0.692**	**0.674**	
10. Differences Between Thermoplastics & Thermosets	**6.92**	**3.7**	**-0.026**	**0.692**	**0.670**	
12. Molecular Weight	**7.94**	**6.6**	**0.032**	**0.794**	**0.826**	
13. Polydispersity	**7.90**	**5.9**	**0.018**	**0.790**	**0.808**	
14.Molecular Weight Distribution (MWD)	**7.90**	**5.9**	**0.018**	**0.790**	**0.808**	
15. Average Molecular Weight	**8.02**	**5.7**	**0.014**	**0.802**	**0.816**	
16. Polymerization Reactions	**7.86**	**6.4**	**0.028**	**0.786**	**0.814**	
17. Polymerization Processes	**8.08**	**6.6**	**0.032**	**0.808**	**0.840**	
18. Bulk Polymerization	**8.02**	**7.3**	**0.046**	**0.802**	**0.848**	
19. Solution	**8.16**	**6.7**	**0.034**	**0.816**	**0.850**	
20. Emulsion	**8.34**	**7.1**	**0.042**	**0.834**	**0.876**	
21. Suspension Polymerization	**7.36**	**7.1**	**0.042**	**0.736**	**0.778**	**0.810**

Table V.2: SATISFACTION INDICES OF ACTIVITY GROUPS FOR THE THERMOPLASTIC RESINS COURSE, FALL 2002

	Satisfaction Indices					
ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) ↓	E_F	D_F	I_D	I_S	I_{TS}	
22. Crystallinity	**7.36**	**6.30**	**0.026**	**0.736**	**0.762**	
23. Plasticization & Annealing	**8.04**	**6.40**	**0.028**	**0.804**	**0.832**	
24. Morphology	**4.40**	**3.60**	**-0.028**	**0.44**	**0.412**	
25. Categories of Thermoplastics	**7.82**	**6.80**	**0.036**	**0.782**	**0.818**	
Thermoplastic Families						
26. Polyolefins	**8.2**	**7.1**	**0.042**	**0.820**	**0.862**	
27. Polyvinyls	**8.2**	**7.0**	**0.04**	**0.820**	**0.860**	
28. Polystyrenes	**8.28**	**8.0**	**0.06**	**0.828**	**0.890**	
29. Polyacrylics	**7.42**	**8.3**	**0.17**	**0.742**	**0.912**	
30. Polyesters	**8.02**	**8.1**	**0.062**	**0.802**	**0.864**	
31. Polyamides	**7.64**	**8.0**	**0.060**	**0.764**	**0.824**	
32. Polyacetals	**7.70**	**8.7**	**0.074**	**0.770**	**0.844**	
33. Polycarbonates	**8.04**	**8.0**	**0.060**	**0.804**	**0.864**	
34. Polyphenylene Sulfides	**7.82**	**7.4**	**0.048**	**0.782**	**0.830**	
35. Polyphenylene Oxides	**6.48**	**7.4**	**0.048**	**0.648**	**0.700**	
36. Polysulfones	**7.12**	**7.1**	**0.042**	**0.712**	**0.754**	
37. LCPs	**6.92**	**6.7**	**0.034**	**0.692**	**0.726**	0.828
38. High Temperature Polyimides	**5.26**	**6.3**	**0.026**	**0.526**	**0.552**	
39. Cellulosics	3.5	4.7	-0.006	0.35	0.344	
40. Crosslinked Thermoplastics	**5.64**	**5.9**	**0.018**	**0.564**	**0.582**	
41. Miscellaneous	**4.22**	**4.4**	**-0.012**	**0.422**	**0.410**	0.472

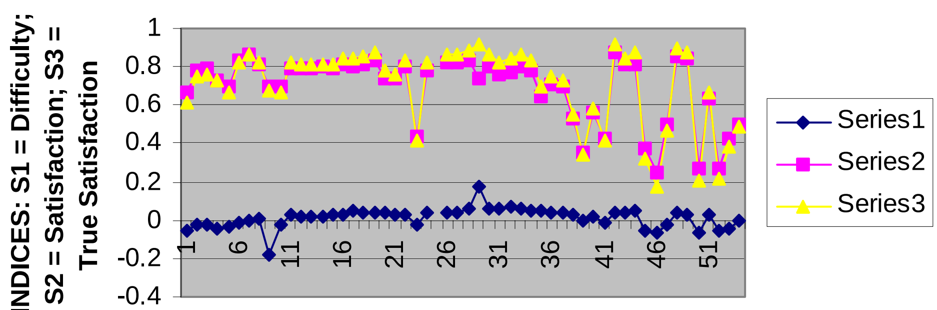
Table V.3: SATISFACTION INDICES OF ACTIVITY GROUPS FOR THE THERMOPLASTIC RESINS COURSE, FALL 2002						
ESSENTIAL KNOWLEDGE ELEMENTS (EKEs) ↓	EKE FACTORS					
	E_F	**D_F**	**I_D**	**I_S**	**I_{TS}**	
Laboratory Section						
42. Tensile Strength Test	**8.70**	**7.10**	**0.042**	**0.870**	**0.912**	
43. Impact Strength Test	**8.12**	**6.7**	**0.034**	**0.812**	**0.846**	
44. Melt Flow Index	**8.14**	**7.6**	**0.052**	**0.814**	**0.870**	
45. Torsional Test	**3.70**	**2.4**	**-0.052**	**0.370**	**0.320**	
46. Plastisol	**2.46**	**1.6**	**-0.068**	**0.246**	**0.178**	
47. Ultrasonic Welding	**4.98**	**3.7**	**-0.026**	**0.498**	**0.472**	
48. DSC-Thermal Transitions	**8.50**	**7.1**	**0.042**	**0.850**	**0.892**	
49. Computerized Materials. Selection	**8.42**	**6.6**	**0.032**	**0.842**	**0.874**	
50. PVC Plasticization	**2.7**	**1.6**	**-0.068**	**0.270**	**0.202**	
51. Blending	**6.34**	**6.4**	**0.028**	**0.634**	**0.662**	
52. Moisture Analysis	**2.7**	**2.1**	**-0.058**	**0.270**	**0.212**	
53. Multi-directional Impact Testing	**4.3**	**2.6**	**-0.048**	**0.430**	**0.382**	
54. Flexural Testing	**4.94**	**4.7**	**-0.006**	**0.494**	**0.488**	

not completely identical; the abscissa or x-axis of Graph I represents the course timeline, and sequential profile of the EKE offerings whereas the abscissa of Graph II, represents the different program activities. Some of the REU/RET program activities run concurrent. The REU/RET research activities occurred through out the ten weeks duration of the 2003 summer program whereas the ethics activities occurred only during the first four weeks. The energy and materials management course occurred through out the ten weeks but only met once a week for three hours. Of course, the campus-wide symposium occurred on the last day of the program etc. However, both graphs depict the difficulty and satisfaction indices of the course and program participants respectively.

Table VI : SATISFACTION INDICES OF ACTIVITY GROUPS FOR THE 2003 PSU-REU/RET PROGRAM

Activity Groups ↓	Satisfaction Indices					
	E_F	D_F	I_D	I_S	I_{TS}	
1. Research Program	9.2	7.8	0.057	0.92	0.973	
2. Ethics Program	8.56	4.6	-0.008	0.86	0.848	
3. C-W Symposium	7.7	7.0	0.040	0.77	0.830	
4. Recruitment	7.28	5.0	0.0	0.73	0.730	
5. Picnics	6.80	5.0	0.0	0.68	0.700	
6. Report Writing	6.00	6.0	0.020	0.60	0.620	
7. Energy Course	5.70	6.8	0.036	0.57	0.574	
8. Field Trips	5.34	2.3	-0.054	0.53	0.480	
9. Weekly Seminars	4.42	4.7	-0.006	0.44	0.434	
10. On-Site Presentation	3.86	8.0	0.06	0.39	0.440	
11. Orientation	3.32	3.3	-0.034	0.33	0.300	

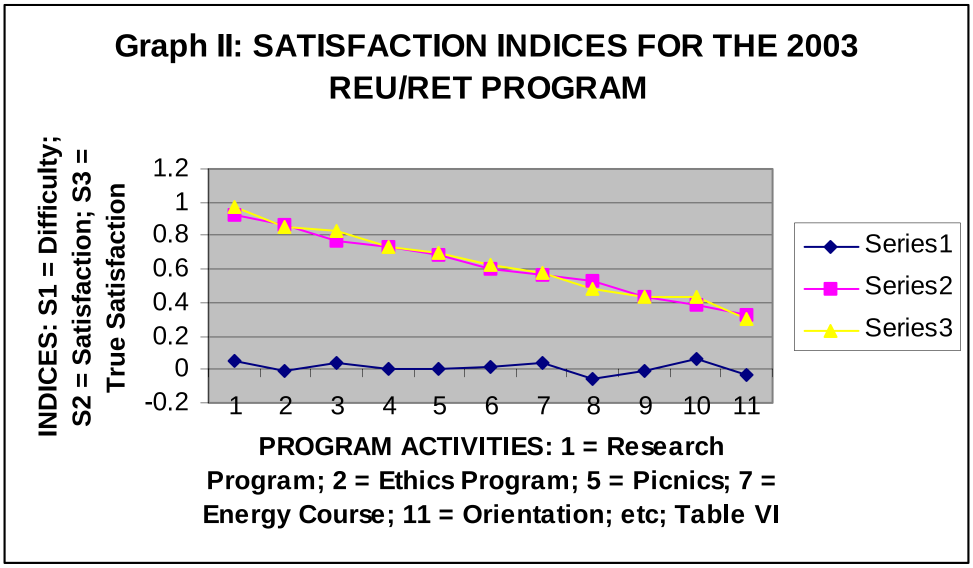
Graph I: SATISFACTION INDICES FOR THERMOPLASTIC RESINS COURSE, FALL 2002



COURSE TIMELINE: 1 = Introduction; 25 = Categories; 42 = Tensile Test, etc., Table V

Discussion of Results

A generic observation of Table V and Graph I reveals that the difficulty ratings of the participants for the introductory portion (segments 1 to 6) of the Fall 2002 Thermoplastic Resins course are relatively low. The difficulty indices for these segments of the course are negative indicating that the corresponding difficulty factors (D_F) are less than 5.0, the mid EKE Factor rating. Remarkably, these low difficulty ratings and indices do not necessarily translate to super satisfaction, as the true satisfaction index for this introductory segment is 0.724 or Good on the True Satisfaction Scale. The difficulty rating for the second or "polymer" segment of the course rises as depicted by the positive difficulty indices but so do the satisfaction indices. This segment received a low to high "Very Good" true satisfaction rating, with an average rating of 0.810. The third segment of the course that deals with crystallinity, the basis of strength of thermoplastics, received high difficulty ratings but with Good to Very Good true satisfaction ratings. The overall low ratings for the morphology EKE of this segment symbolizes the lack of emphasis of this element in the course. The fourth segment of the course, the thermoplastic families' segment, the main stay of the course, received Good to Excellent true satisfaction ratings despite of the relatively high difficulty ratings. The students and faculty are in agreement that this is the focus of the course. The later EKEs of this segment such as the polyimides, cellulosics and crosslinked thermoplastics elements received overall low ratings because they were barely or not covered in the course during this semester due to time constraints.



Graph I indicates that the results for the laboratory section depicts some apparent instabilities. Graph I shows two very distinct rating levels for the laboratory segment, excellent and poor. The tensile strength, impact strength, melt flow, DSC-thermal transition and computerized materials selection experiments received Very Good to Excellent true satisfaction ratings whereas the plasticization, moisture analysis, torsional, ultrasonic welding, plastisol and multi-directional impact experiments received poor ratings. These experiments received poor ratings because they were not performed due to equipment malfunction. This course typically has back-up experiments that are not listed on the CUES-EKE rating form such as the computerized Torque Rheometry experiment for blending and compounding, the Macbeth 2000 Spectrophotometer, and Material Identification tests etc. The students responses on these experiments should serve to validate and benchmark their overall responses and the EKE rating protocol.

For the REU/RET program, Table VI and Graph II reveal that the participants rated the research component most highly followed by the ethics and the campus-wide symposium components respectively. One would expect that the recruitment and selection component should receive very good ratings considering that its effect resulted in the participants' acceptance into the program. The relatively average EKE factors ratings of 6.7 for usefulness, 7.0 for interest, 7.7 for comprehensiveness, 5.0 for difficulty, 8.3 for validity and 6.7 for efficacy of the recruitment and selection component should serve as calibration for this assessment.

The research components (Table IV) of access to lab, access to research advisor and research topic received very favorable ratings; though they are considered difficult, with average difficulty EKE factor rating of 7.80, the participants consider it the focus of the program. However, research related activities such as on-site laboratory presentation and report writing did not do as well. On-site laboratory presentation was considered difficult with a rating of 8.0, and not useful (rating of 4) or of interest (rating of 3) and not of validity. The participants consider this and some other activities as "distractions"[7] from their research work. Report writing, a mainstay of the program was reluctantly rated valid but difficult; noteworthy is that it is rated less difficult than the ethics paper report. It is possible that the ethics paper (due date: July 10) provided writing experience for the research paper (August 01). The ethics program received much better ratings than the regular weekly seminars; the first four weeks of the program's weekly seminars are devoted to the ethics program. The presence of the ethics panel faculty members (Dr. Virginia Rider, bioethics, Dr. Michael Muoghalu, business ethics, Dr. Dilip Paul, environmental ethics, Dr. Gary McGrath, religion and ethics, Dr. Marjorie Donovan and Dr. Oliver Hensley, general ethics, Dr. Chris Ibeh, panel coordination) during the ethics discussions may account for the comfort level indicated by the high ratings. These observations have been quantified using the satisfaction index equations 1, 2 and 3, and the calculated values for true satisfaction ($\mathbf{I_{TS}}$), satisfaction ($\mathbf{I_S}$) and difficulty ($\mathbf{I_D}$) indices for the various categories of activities of the PSU-REU/RET program are as per Table VI.

Conclusions

CUES-AM is a valid model for program and course/instructional delivery assessment. CUES-EKE rating protocol makes it possible to receive input from program and course participants, the "clients and products." Responses from participants are valid because CUES-AM makes use of the average values of the responses.

The good to excellent true satisfaction ratings of the thermoplastic resins families' segment of the Thermoplastics Resins course, despite the accompanying relatively high difficulty ratings, indicate that the students and faculty are in agreement that this is the focus of the course. The introductory and prelude segments have been designed for effective instructional delivery and ease of learning.

The "apparent instabilities" of the laboratory section depicted on Graph II validates the capacity of CUES-AM for system monitoring and trouble shooting. The plastics engineering technology program at PSU is equipment-intensive; equipment maintenance and upgrading can be time and resource consuming. To account for these, course design requires that surplus number of experiments be available as back-up; it is standard operating procedure for this course to have at least thirteen viable experiments for each semester. Also, to meet the program's stated mission of producing graduates proficient and skilled to function effectively in the plastics industry and society in general, the program is continually upgrading its laboratories. In the past six months alone, the program has acquired five new equipment and instruments including a 160-Ton Engel Injection Molding Machine, a TA Instruments' DSC Q10, a Branson 910iw Ultrasonic Welding machine, a computerized Ceast 7025 Model Melt Flow Indexer, and upgraded the software for its Instron's Universal Testing Machine.

With respect to the PSU-REU/RET Summer 2003 program, the satisfaction index data of Table VI indicate that the research component has excellent rating with an $\mathbf{I}_{TS}$ value of 0.973 whereas the ethics (0.85) and symposium components are rated very good. The fair to good rating received by the course, report writing and picnic components, and the very poor to poor ratings for the orientation, on-site presentation, field trip and weekly seminar components may be an indication that the participants consider these as distractions from their research efforts. From the program management's perspective, these may be "distractions" but they are necessary components of the PSU-REU/RET program; the program strives to conform to NSF-DMR guidelines, and to provide the participants real world implication of research. Also, these activities provide some elements of the very much needed cohesiveness that is the backbone for success of the PSU-REU/RET program, an interdisciplinary materials research program. Fine-tuning, especially in the areas of orientation, site presentation and field trips will facilitate this cohesiveness..

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CHRISTOPHER C. IBEH

Dr. Christopher Ibeh serves as the Project Director-Designate and Principal Investigator for CUES-AMD, and is responsible for the overall project implementation and success. He is a professor of Plastics Engineering Technology at Pittsburg State University where he teaches courses entitled: thermoplastic resins, thermoset resins, heat transfer, thermodynamics, research topics in polymers and plastics, and advanced engineering materials. Professor Ibeh is the director of the NSF-sponsored, interdisciplinary REU/RET program at Pittsburg State University. He has a Doctorate from the Department of Chemical Engineering at Louisiana Tech University, Ruston, LA.

MARJORIE E. DONOVAN

Dr. M. Donovan is CUES-AMD Project Co-Director-Designate and Co-Principal Investigator. She holds an M.A. and a Ph.D. in sociology from University of California, Davis. She is an Associate Professor and the Director of the Sociology program at Pittsburg State University. Dr. Donovan's publications include three books and she is a member of the Ethics panel of the PSU/NSF-REU/RET program.

JAMES OTTER

Professor James Otter is the Chair and a graduate faculty in the Department of Engineering Technology at Pittsburg State University. He is also a member of the PSU-CUES Group, and participates in the organization and conduction of CUES-AM workshops. Jim has an M.B.A from Pittsburg State University where he teaches graduate courses in Value Engineering and Construction Management.

OLIVER D. HENSLEY

Dr. Oliver Hensley is the former dean of Graduate Studies & Research at Pittsburg State University. He is the **originator of the epistecybernetic model**, CUES (Consortium for Upgrading Educational Standards). He holds MA and Ph.D degrees in Education from Southern Illinois University. Dr. Hensley volunteers his time during the summer months to mentor and advise the PSU/NSF-REU/RET participants.