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**A UX MODEL FOR THE EVALUATION OF LEARNERS'
EXPERIENCE ON LMS PLATFORMS OVER TIME**

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**DOCTOR OF PHILOSOPHY
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Abstrak

Walaupun pengalaman pengguna (UX) adalah dinamik dan berkembang dari semasa ke semasa, kajian terdahulu melaporkan bahawa model pengalaman pelajar yang dibangunkan setakat ini hanyalah untuk penilaian statik pengalaman pelajar. Setakat ini, tiada model yang dibangunkan untuk penilaian sumatif dinamik UX bagi platform LMS dari semasa ke semasa. Objektif kajian ini adalah untuk membina model UX yang akan digunakan untuk menilai pengalaman pelajar tentang LMS dari semasa ke semasa. Kajian ini mengkaji literatur yang berkaitan dengan matlamat untuk mengkonseptualisasikan model teori. Rangka kerja Stimuli-Organism-Response (SOR) telah digunakan untuk memodelkan proses kejuruteraan pengalaman. Untuk mengesahkan model, 6 pakar UX telah terlibat. Model ini juga telah disahkan menggunakan reka bentuk kuasi-eksperimen yang melibatkan 900 orang pelajar. Penilaian dilakukan dalam empat titik masa, sekali seminggu selama empat minggu. Melalui semakan yang dijalankan, model UX konseptual telah dibangunkan untuk penilaian pengalaman pelajar dengan reka bentuk LMS dari semasa ke semasa. Hasil pengesahan model menunjukkan bahawa pakar bersetuju yang model itu mencukupi untuk penilaian pengalaman pelajar terhadap LMS. Keputusan pengesahan model menunjukkan bahawa model adalah sangat signifikan secara statistik dari semasa ke semasa (Minggu1: $\chi^2(276) = 27319.339$, Minggu2: $\chi^2(276) = 23419.626$, Minggu3: $\chi^2(276) = 18941.900$, Minggu (276) = $18941.900) = 27580.397$, $p=000<0.01$). Setiap kualiti reka bentuk mempunyai kesan positif yang kuat terhadap keadaan kognitif, sensorimotor dan afektif pelajar masing-masing. Tambahan pula, setiap satu daripada tiga keadaan organisma: kognitif, sensorimotor dan afektif, mempunyai pengaruh positif yang kuat terhadap keseluruhan pengalaman pembelajaran pelajar. Keputusan ini menunjukkan bahawa proses kejuruteraan pengalaman telah berjaya. Kajian ini mengisi jurang yang ketara dalam pengetahuan dengan menyumbang model UX yang baharu untuk penilaian pengalaman pelajar pada platform LMS dari semasa ke semasa. Pengamal jaminan kualiti UX juga boleh menggunakan model dalam pengesahan dan pengesahan pengalaman pelajar dari semasa ke semasa.

Kata kunci: Kesan reka bentuk, Pengalaman pembelajaran, Keadaan organisma pelajar, Pengalaman pengguna, Model UX

Abstract

Although user experience (UX) is dynamic and evolves over time, prior research reported that the learners' experience models developed so far were only for the static evaluation of learners' experiences. So far, no model has been developed for the dynamic summative evaluation of the UX of LMS platforms over time. The objective of this study is to build a UX model that will be used to evaluate learners' experience on LMS over time. The study reviewed relevant literature with the goal of conceptualizing a theoretical model. The Stimuli-Organism-Response (SOR) framework was deployed to model the experience engineering process. To verify the model, 6 UX experts were involved. The model was also validated using a quasi-experimental design involving 900 students. The evaluation was conducted in four time points, once a week for four weeks. From the review, a conceptual UX model was developed for the evaluation of learners' experience with LMS design over time. The outcome of the model verification shows that the experts agreed that the model is adequate for the evaluation of learners' experience on LMS. The results of the model validation indicate that the model was highly statistically significant over time (Week1: $\chi^2(276) = 27319.339$, Week2: $\chi^2(276) = 23419.626$, Week3: $\chi^2(276) = 18941.900$, Week4: $\chi^2(276) = 27580.397$, $p=000<0.01$). Each design quality had strong positive effects on the learners' cognitive, sensorimotor and affective states respectively. Furthermore, each of the three organismic states: cognitive, sensorimotor, and affective, had strong positive influence on learners' overall learning experience. These results imply that the experience engineering process was successful. The study fills a significant gap in knowledge by contributing a novel UX model for the evaluation of learners' experience on LMS platforms over time. UX quality assurance practitioners can also utilize the model in the verification and validation of learner experience over time.

Keywords: Design effects, Learning experience, Learners' organismic states, User experience, UX model

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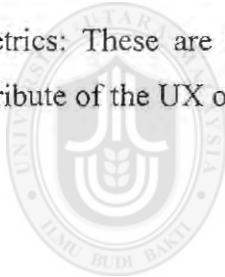


Glossary of Terms

The following consist of the glossary of terms used in this study:

- i. Model: This is a graphical representation of real-life phenomena. The structure is made up of measurable constructs that are related to each other. These measurable constructs (latent and/or manifest) include dimensions and their accompanying related quality criteria.
- ii. Dimensions: These are measurable constructs associated with a model that serve as a collection of other constructs that are related to each other and that are also related to the model's main construct. In other words, dimensions are the different aspects or facets of a construct.
- iii. Criteria: These are measurable design qualities or constructs that are elements of the dimensions that make up the model. These qualities contribute to or influence the model's dimensions.
- iv. Quality factors: Quality factors are design or quality elements that influence the user/learning experience of users of learning management systems.
- v. User Experience (UX): This is the totality of a user's feelings, perceptions, dispositions, behaviors, motivations, moods, needs, expectations, persuasions, passions, sentiments, reflections, desired or derived values, sensory gratifications, preferences, beliefs, attitudes and emotional reactions and responses that result from his or her actual and/ or anticipated encounter or interaction with or ownership of an interactive technological artifact within a specified time and context of interaction.
- vi. Learner Experience: This is the user experience of learners using a learning management system as their virtual learning environment.

- vii. Virtual learning environment is a web-based platform much like a classroom that enables learners to learn online.
- viii. Learning management system (LMS) is a virtual learning environment where teachers upload learning contents for students to learn with and where learners interact with their teachers, interact, communicate and collaborate with each other in the learning process.
- ix. Interaction: This is the process of users' engaging with or using a piece of technological artifact like the learning management system.
- x. Evaluation: This is the process of assessing the quality of the user experience (UX) of users/learners of an interactive learning management system.
- xi. Metrics: These are subjective measures used in evaluating each quality attribute of the UX of the LMS evaluation model.



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List of Abbreviations

1. AMOS: Analysis of Moment Structures
2. LMS: Learning Management System
3. LX: Learner Experience
4. ISO: International Standardization Organization
5. SEM: Structural Equation Modeling
6. SOR: Stimuli-Organism-Response
7. SPSS: Statistical Package for Social Sciences
8. ISRR: Interaction, Stimulation, Reflection, Reaction
9. UX: User Experience
10. VLE: Virtual Learning Environment

CHAPTER ONE

INTRODUCTION

1.1 Chapter Introduction

This chapter introduces the thesis and addresses the background to the study. It provides the preamble to key concepts in the study and filters out the research problem. The motivation for the research was also indicated. The chapter stated the research problem in clear terms and the necessary research questions that follow as well as the accompanying research objectives and the scope of the study.

1.2 Learning Management Systems

Following the rapid growth of the Internet, the teaching and learning domains have been revolutionized from a conventional classroom platform to an electronic or mobile platform. A number of learning management systems (LMSs) such as Edmodo, Moodle and Blackboard Apps etc. (Cavus & Zabadi, 2014; Joko, 2016; Sucipto et al., 2017; Prasetya & Taroreh, 2018; Joko, 2018) are employed to support and aid virtual or online learning. These apps support teachers to deploy teaching materials to students, conduct online tests and post assignments to students. Students on the other hand can download and learn with these materials anytime, anywhere (Jusoh et al., 2019). Ann (2018) reported that by 2022, the size of e-learning industry will amount to 243 billion USD with a compound growth rate of 5% annually from 2017 to 2022.

The understanding of UX is a first step to the user-centered design approach (Kraleva et al., 2019) for the development of educational applications to be accessed by a

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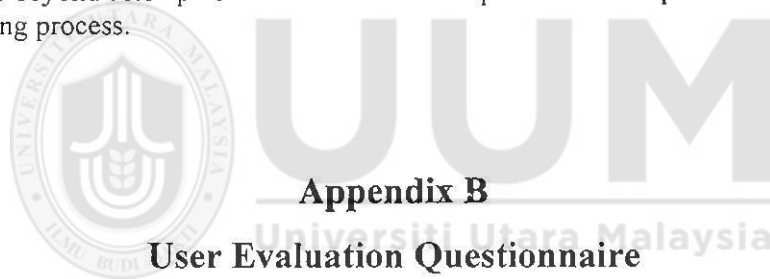
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Appendix A Interaction Tasks

The interaction tasks for the study are:

- i) Login
- ii) Download a lecture note
- iii) Upload a finished assignment
- iv) Send a message to a course mate who is online and interact with him/her
- v) Send a message to the course lecturer who is online and interact with him/her

Note: The interaction tasks are meant to be guides. However, the learners were given the freedom to go beyond these prescribed tasks and to explore the LMS platform as they so wish in their learning process.



Appendix B User Evaluation Questionnaire

Select/ tick (✓) the option that best describe your feeling and experience.

SD=Strongly Disagree; D=Disagree; N=Neutral; A=Agree; SA=Strongly Agree

Demographics	Matric No.:						
Sex: M <input type="checkbox"/> F <input type="checkbox"/>	Age: 15 – 20 <input type="checkbox"/> 21 – 25 <input type="checkbox"/> 26 – 30 <input type="checkbox"/> 31 – 35 <input type="checkbox"/> 36 – 40 <input type="checkbox"/> Above 40						
	What device(s) do you interact with? Laptop <input type="checkbox"/> Smartphone <input type="checkbox"/>						
Dimensions	Criteria	Items	SD	D	N	A	SA
Cognitive	Usability	LMS is easy to use and learn with					
		LMS is simple to use and learn with					
		LMS is easily accessible to me					
	Learnability	LMS is easy to learn and to learn with					
	Understandability	LMS is easy to understand					
	Ubiquity	LMS enables me to use and learn anywhere and anytime					
	Rememberability	I can easily recall what I learn with LMS					
		I can easily retain in my memory what I learn in LMS					
Safety	LMS is safe to use and learn with						
	LMS is secured for use and learning						

	Trust	LMS protects my privacy							
		LMS is credible							
		LMS is transparent							
		LMS is dependable and reliable							
	Epistemic	LMS offers me the information and knowledge I need							
		The knowledge I get from LMS is meaningful							
Sensorimotor	Interactivity	I am in control while using and learning with LMS							
		LMS responds well to me while I use it to learn							
	Engageability	My attention is focused while I am interacting and learning with LMS							
		I am totally absorbed and involved in my learning interaction and activities in LMS							
	Ludicity	LMS is very lively to use and learn with							
		LMS enables me to play while learning							
	Sociability	LMS enables me to communicate with my fellow students and teachers							
		LMS enables me to collaborate in learning with my fellow students							
Affective	Inspiring	Interacting and learning with LMS inspires me							
	Exciting	Interacting and learning with LMS is exciting to me							
	Interesting	Interacting and learning with LMS is interesting to me							
	Attractive	LMS is attractive to me							
		LMS is visually appealing to me							
	Novel	LMS is new to me							
		LMS is very creative and innovative							
	Pleasurable	LMS give me pleasure and fun							
	Challenging	I have a challenging feeling while using/ learning with LMS							
	Fascinating	Interacting and learning with LMS is fascinating to me							
Cognitive	Personal	LMS is personal to me, identified with me and is customized to meet my needs for self-learning							
		Using and learning with LMS is easy							
Sensorimotor		I learn a lot of new things on my own with LMS							
		I am fully engaged with LMS and/or with other users of LMS							
Affective		LMS makes me feel happy while using/learning with it							
		LMS gives me joy while using/learning with it							
		I have the feeling of enjoyment and pleasure using/ learning with LMS							
		Using LMS makes me feel well							
		I love using/ learning with LMS							

	Using/ learning with LMS inspires hope in me					
	Using/ learning with LMS makes me curious and eager to learn					
	Using/learning with LMS gives me the feeling of adventure					
	The use of LMS delights and satisfies me					
	LMS makes me to be passionate about and committed to learning					
	Each time I use/learn with LMS, I usually have a feeling of surprise and 'wow'.					
	I usually discover new things whenever I use/learn with LMS					
	LMS gives me confident to learn					
UX	Overall, I feel that I had an enriching experience on the LMS platform					
	Overall, I feel that I had a pleasant experience on the LMS platform					
	Overall, I feel that I had a great and memorable experience on the LMS platform					

Appendix C

Expert Review/Model Verification Guide

AN EXPERT VERIFICATION FORM FOR THE UX EVALUATION MODEL FOR LEARNING MANAGEMENT SYSTEMS (LMSs)

The main purpose of this verification is to substantiate that the model and its components as well as other entities within the model possess satisfactory range of accuracy, completeness and consistent. Moreover, this verification also determines whether the model has been built in an orderly approach. Therefore, having read the review documents provided to you, kindly use your expertise, experience and creativity to verify the items in both section B and C which are UX evaluation dimensions, and associated quality attributes used to measure the originality and acceptability of the model respectively. Section A is expert profile. This document will take you twenty (20) to thirty (30) minutes to answer. Please, kindly attach a copy of your CV after completing this verification form for the purpose of proper documentation of this research.

Section A: Expert Profile

Name	
Institution	
Position	<input type="checkbox"/> Professor <input type="checkbox"/> Assoc. Professor <input type="checkbox"/> Senior Lecturer <input type="checkbox"/> Lecturer <input type="checkbox"/> Others (Please specify)
Field of Specialization	
Experience (in years)	

Research Interest	
Email	
Phone Number	

Section B: The purpose of this section is to verify the efficiency and relevancy of the dimension and quality attributes defined in the model. In addition, the section will determine the consistency of flow and correlation of the UX evaluation dimensions and quality attributes. Therefore, the section contains a list of UX dimensions and related quality attributes for the UX evaluation of interactive software system. Please, kindly verify and tick YES or NO on each of the following attributes associated with a dimension in the model and provide suggestion where applicable on the item.

UX Dimensions	Criteria	Are the Criteria related to the Dimensions?		
		Yes	No	Suggestions
Cognitive	Usability			
	Learnability			
	Understandability			
	Ubiquity			
	Rememberability			
	Safety			
	Trust			
Sensorimotor	Epistemic			
	Interactivity			
	Engageability			
	Ludicity			
Affective	Sociability			
	Inspiring			
	Exciting			
	Interesting			
	Attractive			
	Novel			
	Pleasurable			
	Challenging			
	Fascinating			
	Personal			

Additional Suggestions/Comments (if any)

.....

.....

.....

Section C: Questionnaire: This section contains seventeen (17) model qualities: consistency, completeness, comprehensiveness, understandability, ease-of-use, tailorability, flexibility, verifiability, validity, usefulness, decision support, relevancy, organization, practicality, overall satisfaction about the model, etc. These qualities measure the originality, completeness and acceptability of the developed UX evaluation model for Learning Management Systems (LMSs). Please, kindly verify each of these qualities about the developed UX evaluation model.

Instruction: There are two (2) options on each item which are *Agree* and *Disagree*, please tick the appropriate scale for each item. Provide suggestions where applicable.

S/No	Model Qualities	Agree	Disagree
Consistency			
1	The level of details provided in the model such as UX dimensions, associated criteria with the accompanying instruments are consistent.		
2	Each criterion provided in the model relates to its corresponding dimension.		
3	The dimensions and associated criteria presented in the model are consistent and measurable in interactive software systems context.		
	Suggestions:		
Completeness			
4	The model is complete and appropriate to support UX evaluation of learning management systems.		
	Suggestions:		
Comprehensiveness			
5	The model is comprehensive and holistic enough to support UX evaluation of learning management systems.		
	Suggestions:		
Understandability			
6	The model is readable, and easy to understand, clearly defined and unambiguous.		
7	All the measurements in the model are well presented and easy to understand by both practitioners and researchers.		
8	The model defines the flow of assessment process clearly		
	Suggestions:		
Ease-of-Use			
9	As a practitioner, the model is simple and easy to interpret and does not require much mental effort to learn and use.		
10	The measurements in the model reflect how easy it is to implement the model.		
11	The model is easy to use and do not require much time to use		
	Suggestions:		
Tailorability			
12	The model is easy to adapt and provide opportunity for improvement in learning from experience.		
13	The model has the capacity for amendment (add/remove) to cope with new technological advancement and user need.		
	Suggestions:		
Flexibility			
14	The model is flexible and can allow continuous feedback from the users.		
	Suggestions:		
Verifiability			
15	The level of details provided in this questionnaire allowed me to give a fair assessment of the strengths and weaknesses of the new model for UX evaluation of learning management systems.		
	Suggestions:		
Validity			
16	The dimensions and associated criteria are measuring what they are supposed to measure		
	Suggestions:		
Usefulness			
17	The model is useful for the evaluation of the UX of learning management systems		
18	The model is useful to the research community, UX practitioners and software developing industry.		
	Suggestions:		
Decision Support			
19	The model is appropriate for valid decision making		
	Suggestions:		
Relevancy			
20	The model is relevant to learning management systems		
	Suggestions:		
Organization			

21	The model is well organized and structured		
	Suggestions:		
Practicality			
22	The model can be implemented in the real world environment		
	Suggestions:		
Personalization			
23	The model supports independent, personalized, self-regulated and learner-centered learning		
	Suggestions:		
Overall Satisfaction/Impression			
24	I am satisfied with the dimensions of the model		
25	I am satisfied with the criteria associated with the dimensions		
26	I am satisfied with the metrics and associated measures for this UX evaluation model		
27	I am satisfied with the entire model		
	Suggestions:		



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Appendix D

Letter of Nomination for Expert Reviewer

Dear Prof./ Assoc. Prof./Dr./Sir,

My name is Emmanuel O.C. Mkpojiogu, a PhD in Computer Science research candidate specializing in User Experience Engineering at Universiti Utara Malaysia. I humbly wish to nominate you and request for your convenient time to be one of the expert reviewers for the verification of a newly developed model for my research. The verification is one of the objectives of the research and determines the originality and validity of the model. The model is aimed at the evaluation of learning management systems (LMSs). There are needs to verify the model in order to substantiate that all the UX dimensions, criteria and measures defined possess a satisfactory range of accuracy, validity and consistency. The model is expected to support the evaluation of LMSs.

Please, if you accept my nomination, the developed model, verification questions and the list of dimensions and associated criteria with the measurement instruments for the model will be sent to you as soon as possible. The guiding verification questions will give you convenient platform of putting your expertise, experience and creativity into use. I will surely appreciate any assistance you would offer me, although you are under no obligation to do so. All information supplied will be treated in confidence and anonymity, and will be used only for the purpose of the research.

Please, feel free to contact my Supervisor, if necessary, via his email or phone numbers:

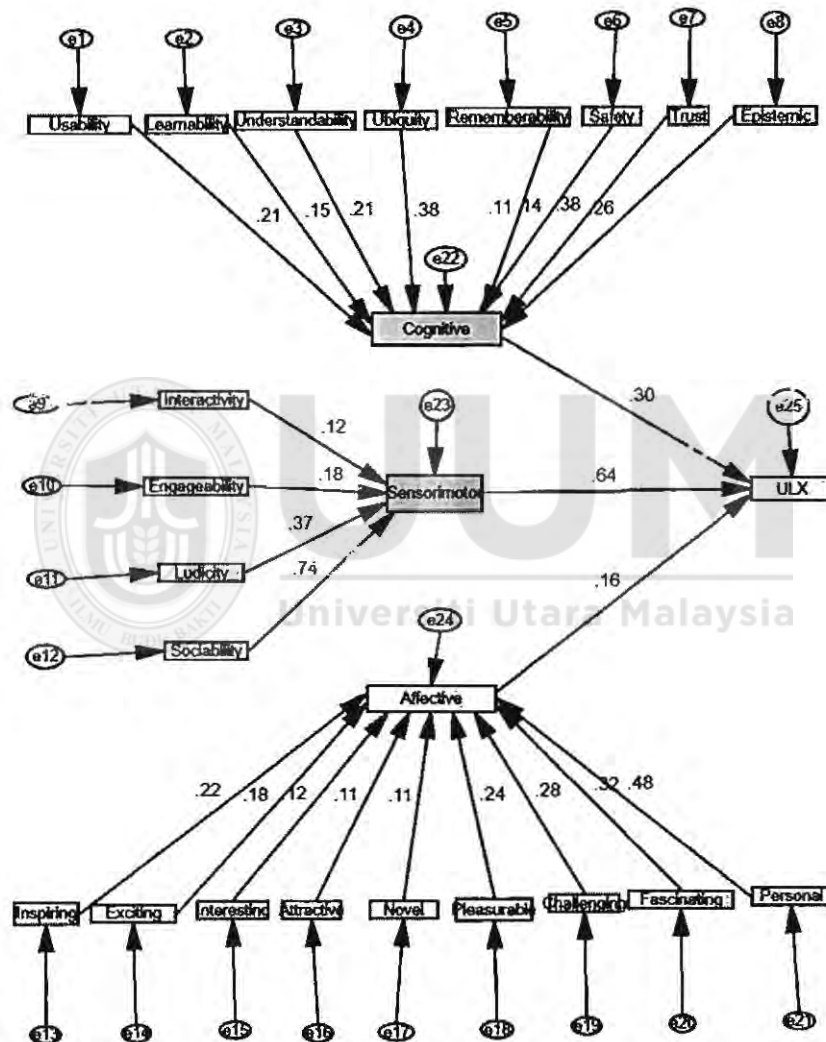
Assoc. Prof. Dr. Azham Hussain,
Email: azham.h@uum.edu.my
Office phone: +6049284609
Mobile: +60126446977

Thank you for your time and anticipated cooperation.

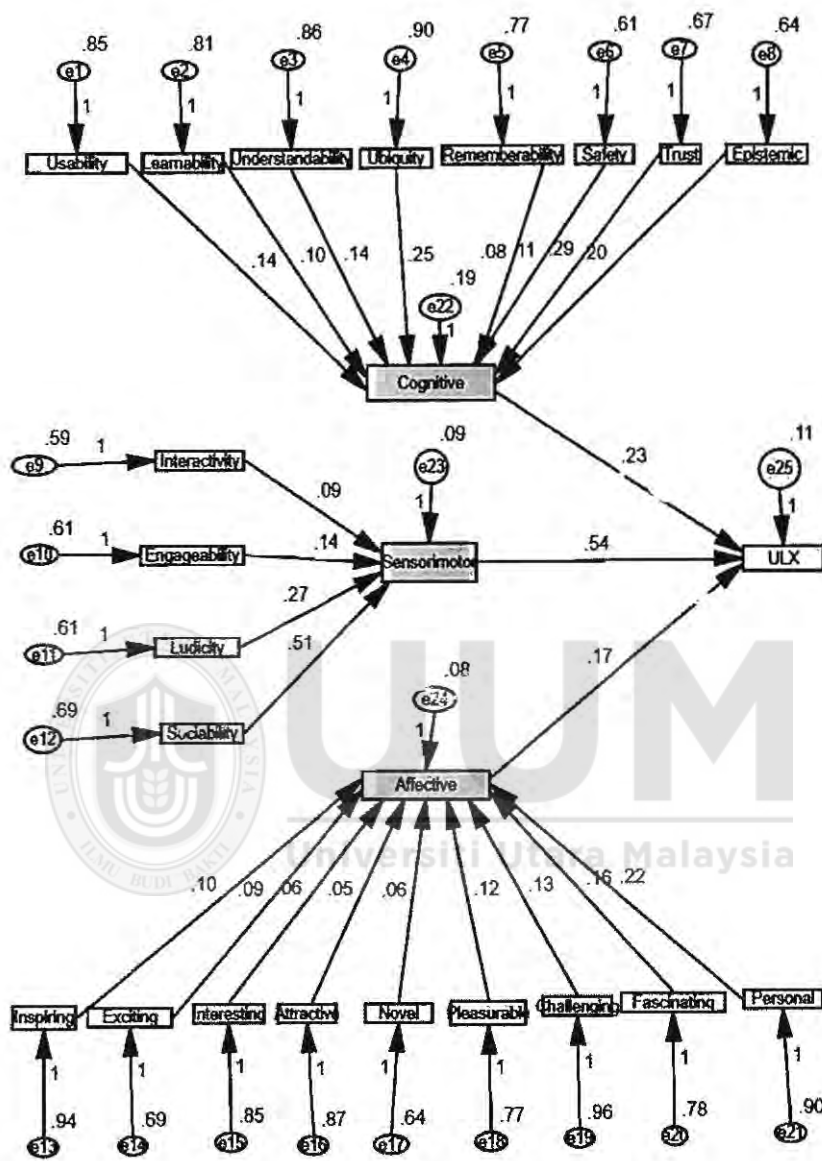
Emmanuel Mkpojiogu
PhD Candidate
Email: emelnuel@hotmail.com
Phone: +2348145855481

Appendix E

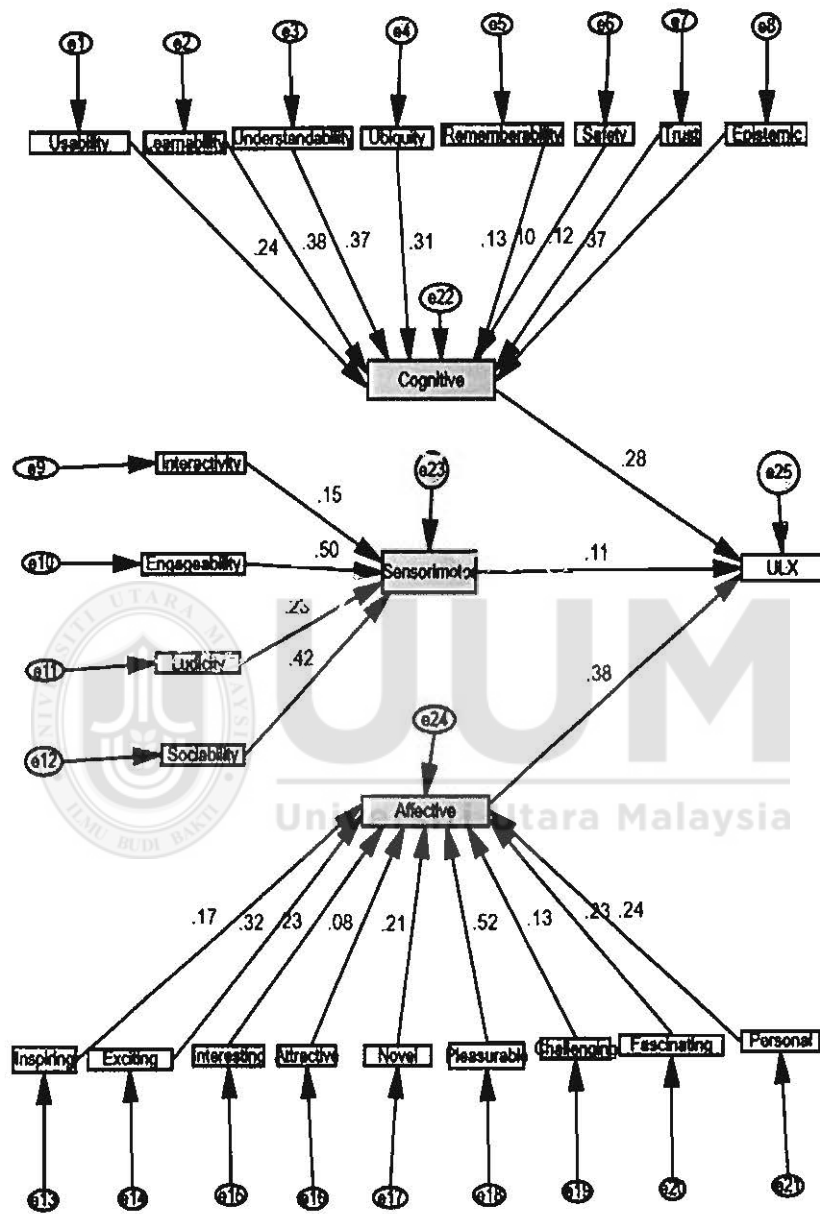
SEM Models by Weeks



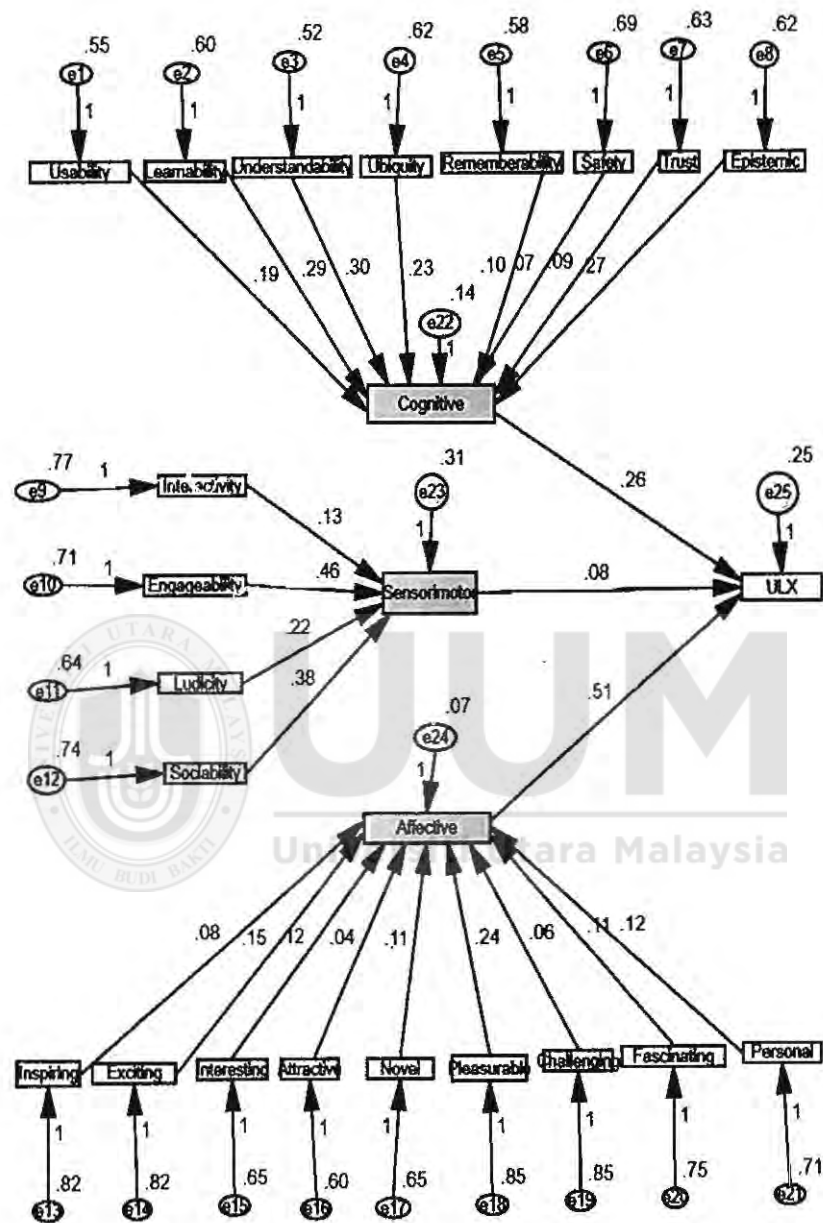
Week 1 Model with Standardized Estimates



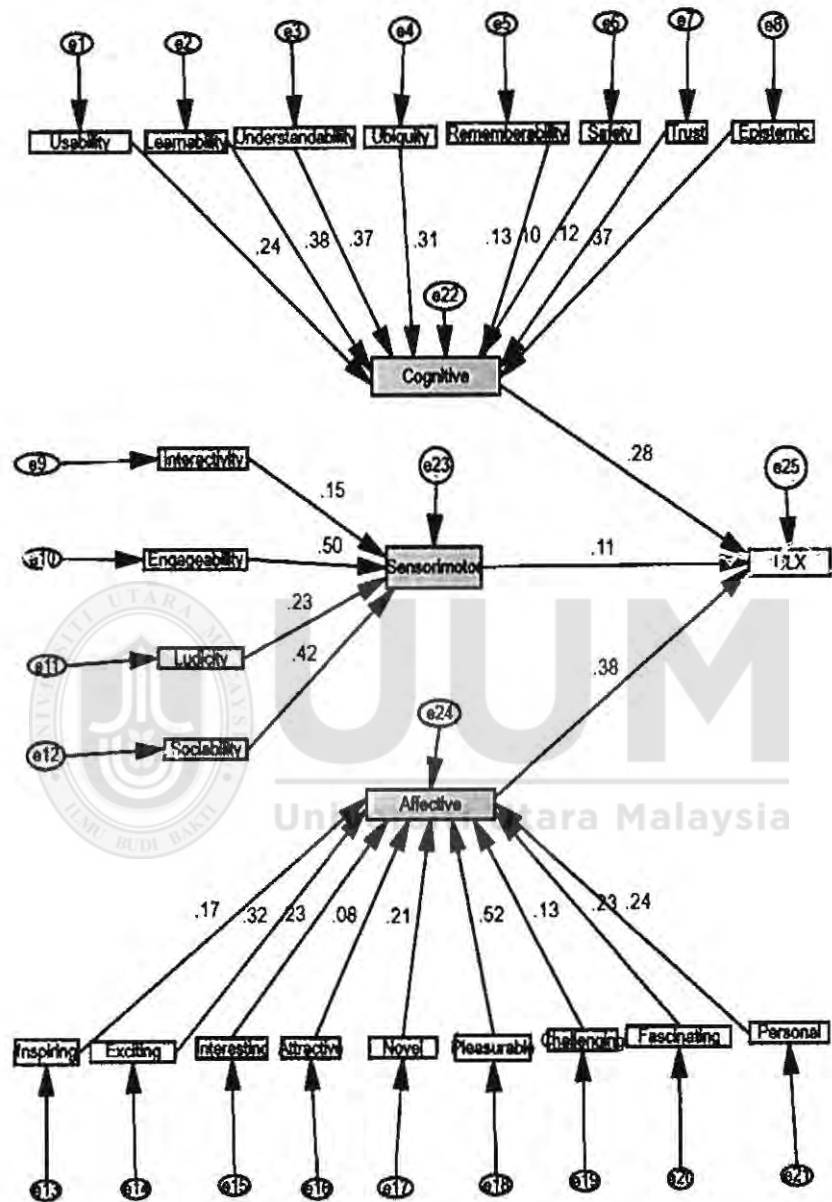
Week 1 Model with Unstandardized Estimates



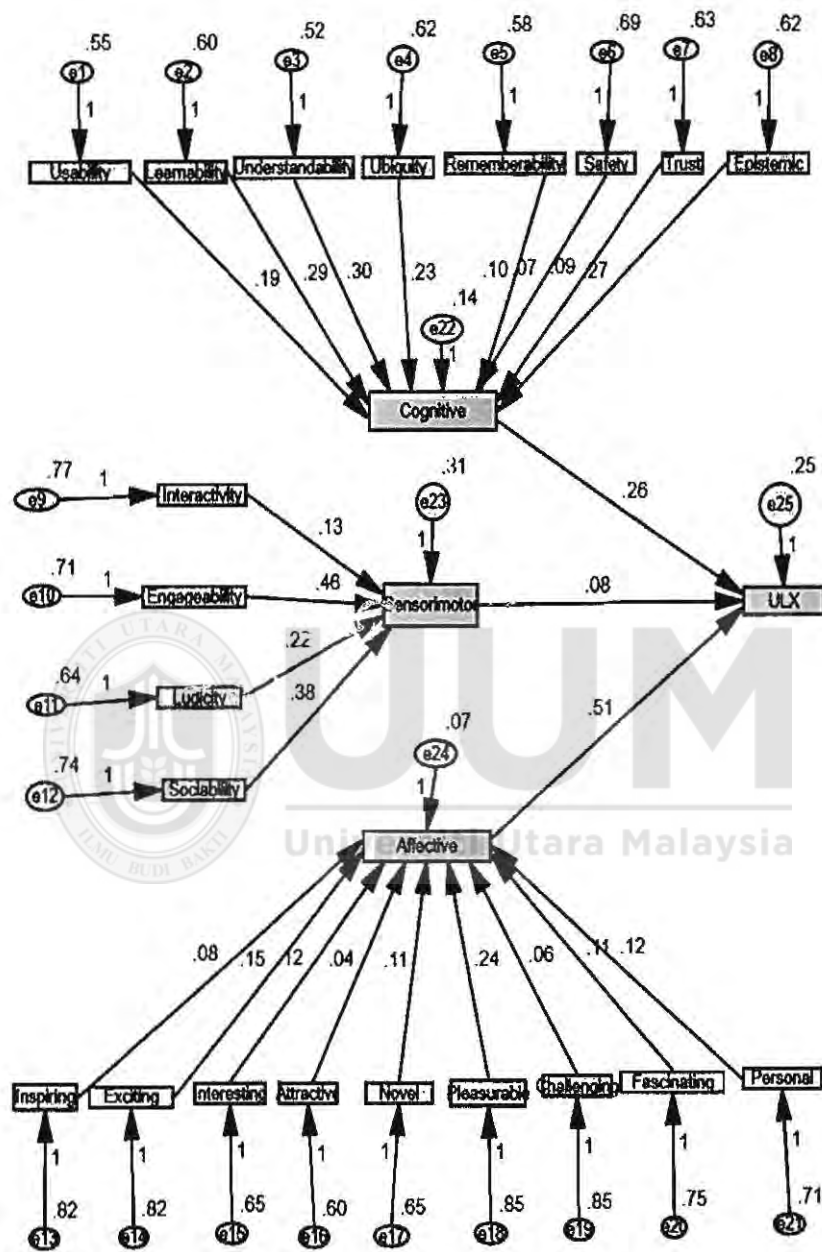
Week 2 Model with Standardized Estimates



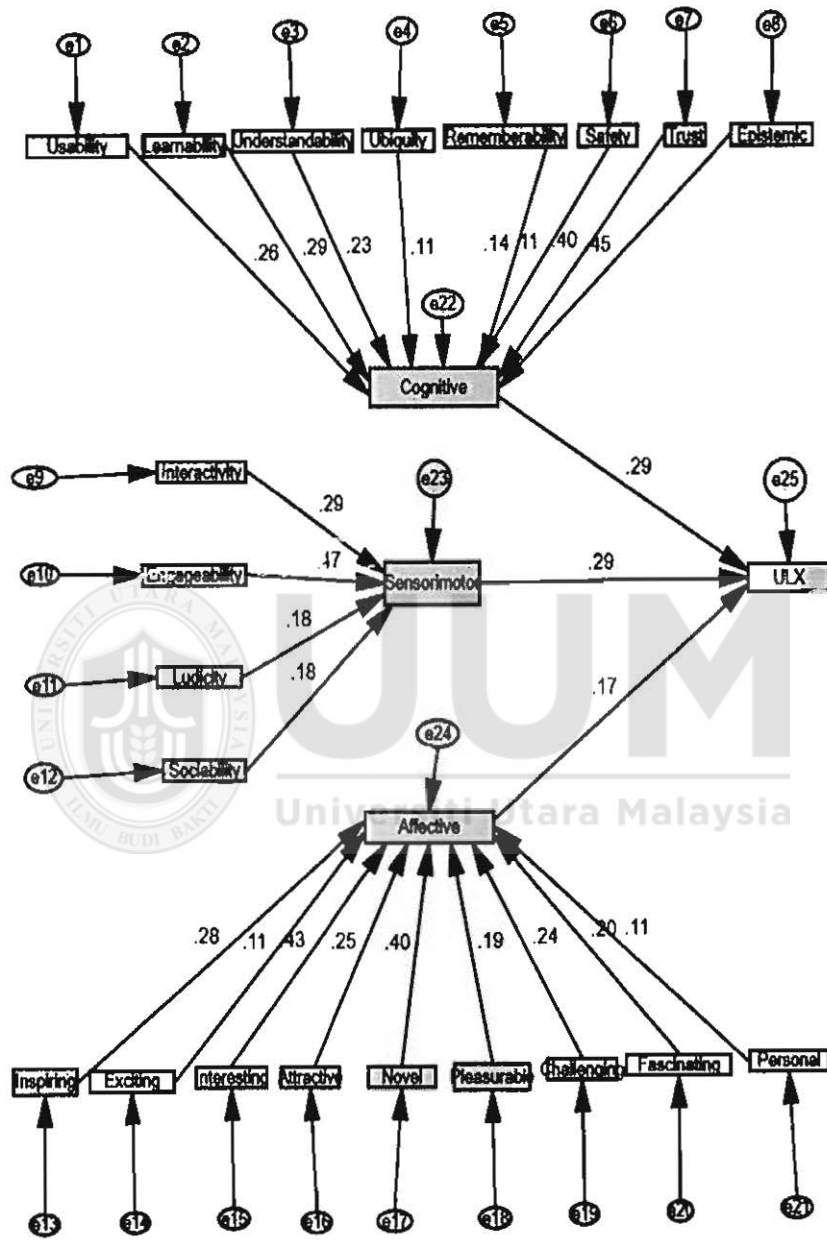
Week 2 Model with Unstandardized Estimates



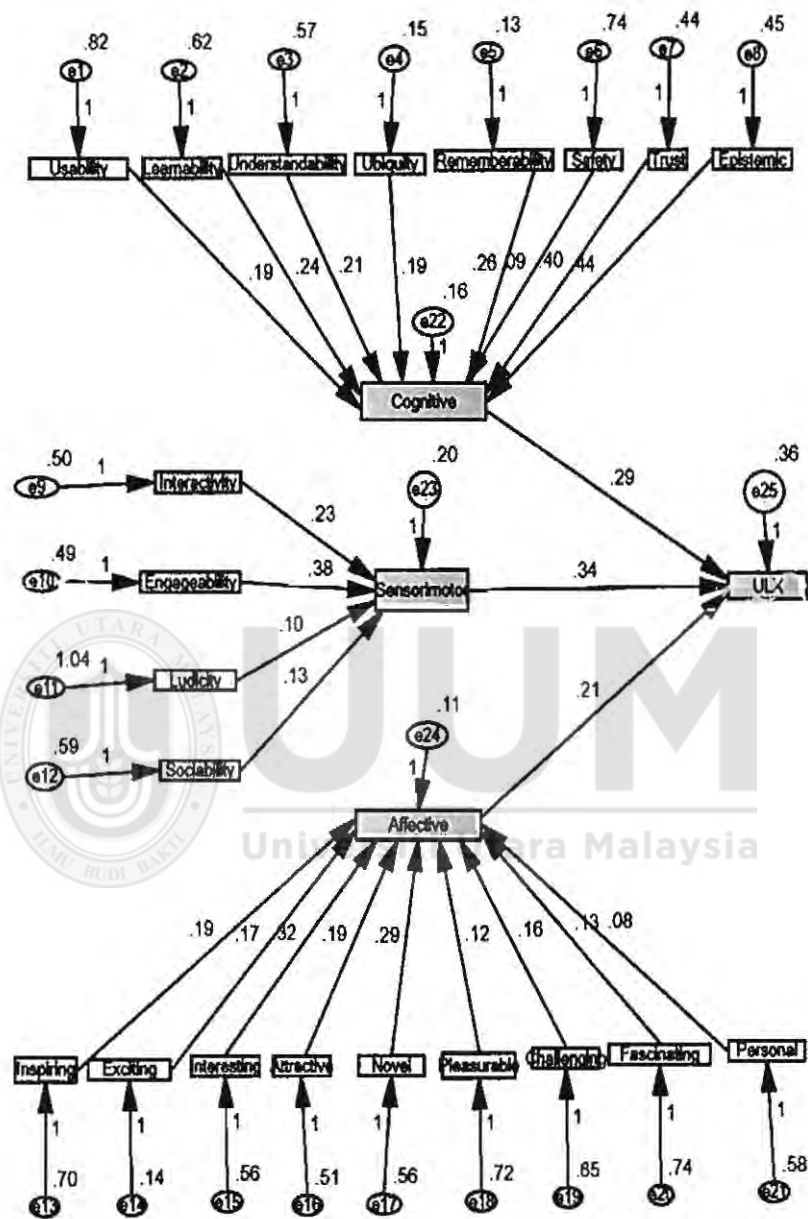
Week 3 Model with Standardized Estimates



Week 3 Model with Unstandardized Estimates



Week 4 Model with Standardized Estimates



Week 4 Model with Unstandardized Estimates

Appendix F

Models and Estimates by Weeks

Week 1 Model and Estimates

Number of distinct sample moments:	325
Number of distinct parameters to be estimated:	49
Degrees of freedom (325 - 49):	276

Chi-square = 27319.339
Degrees of freedom = 276
Probability level = .000

Model			Estimates				
			Stand.	Unstand.	S.E.	C.R.	P
Cognitive	<---	Usability	.213	.142	.016	9.102	***
Cognitive	<---	Learnability	.153	.104	.016	6.512	***
Cognitive	<---	Understandability	.212	.141	.016	9.038	***
Cognitive	<---	Ubiquity	.380	.247	.015	16.233	***
Cognitive	<---	Rememberability	.112	.078	.016	4.766	***
Cognitive	<---	Safety	.141	.111	.018	6.030	***
Cognitive	<---	Trust	.382	.288	.018	16.291	***
Cognitive	<---	Epistemic	.263	.202	.018	11.241	***
Affective	<---	Inspiring	.219	.100	.010	10.253	***
Affective	<---	Exciting	.177	.094	.011	8.267	***
Affective	<---	Interesting	.117	.056	.010	5.481	***
Affective	<---	Attractive	.112	.053	.010	5.254	***
Affective	<---	Novel	.115	.063	.012	5.369	***
Affective	<---	Pleasurable	.235	.118	.011	11.025	***
Affective	<---	Challenging	.285	.128	.010	13.323	***
Affective	<---	Fascinating	.317	.158	.011	14.839	***
Affective	<---	Personal	.484	.224	.010	22.668	***
Sensorimotor	<---	Engageability	.183	.136	.013	10.454	***
Sensorimotor	<---	Interactivity	.122	.092	.013	6.993	***
Sensorimotor	<---	Ludicity	.369	.272	.013	21.111	***
Sensorimotor	<---	Sociability	.736	.514	.012	42.150	***
ULX	<---	Cognitive	.296	.235	.018	12.804	***
ULX	<---	Affective	.156	.173	.026	6.747	***
ULX	<---	Sensorimotor	.638	.538	.019	27.617	***

***=p=0.000<0.01

Week 2 Model and Estimates

Number of distinct sample moments:	325
Number of distinct parameters to be estimated:	49
Degrees of freedom (325 - 49):	276

Chi-square = 23419.626
Degrees of freedom = 276
Probability level = .000

Model			Estimates				
			Stand.	Unstand.	S.E.	C.R.	P
Cognitive	<---	Usability	.238	.189	.017	11.343	***
Cognitive	<---	Learnability	.377	.287	.016	18.017	***
Cognitive	<---	Understandability	.370	.303	.017	17.662	***
Cognitive	<---	Ubiquity	.306	.229	.016	14.598	***
Cognitive	<---	Safety	.096	.069	.015	4.605	***
Cognitive	<---	Trust	.124	.092	.016	5.896	***
Cognitive	<---	Epistemic	.366	.274	.016	17.487	***
Affective	<---	Inspiring	.169	.079	.010	8.291	***
Affective	<---	Exciting	.323	.150	.010	15.797	***
Affective	<---	Interesting	.227	.118	.011	11.088	***
Affective	<---	Attractive	.081	.044	.011	3.960	***
Affective	<---	Novel	.209	.110	.011	10.229	***
Affective	<---	Pleasurable	.515	.236	.009	25.208	***
Affective	<---	Challenging	.125	.057	.009	6.124	***
Affective	<---	Fascinating	.226	.110	.010	11.078	***
Affective	<---	Personal	.240	.120	.010	11.741	***
Sensorimotor	<---	Engageability	.496	.459	.022	20.885	***
Sensorimotor	<---	Interactivity	.146	.130	.021	6.142	***
Sensorimotor	<---	Ludicity	.228	.223	.023	9.591	***
Sensorimotor	<---	Sociability	.417	.378	.022	17.574	***
Cognitive	<---	Rememberability	.131	.102	.016	6.263	***
ULX	<---	Cognitive	.275	.265	.028	9.405	***
ULX	<---	Affective	.377	.510	.040	12.886	***
ULX	<---	Sensorimotor	.115	.084	.021	3.923	***

***=p=0.000<0.01

Week 3 Model and Estimates

Number of distinct sample moments:	325
Number of distinct parameters to be estimated:	49
Degrees of freedom (325 - 49):	276

Chi-square = 18941.900
Degrees of freedom = 276
Probability level = .000

Model			Estimates				
			Stand.	Unstand.	S.E.	C.R.	P
Cognitive	<---	Usability	.211	.128	.013	9.557	***
Cognitive	<---	Learnability	.345	.197	.013	15.625	***
Cognitive	<---	Understandability	.321	.192	.013	14.526	***
Cognitive	<---	Ubiquity	.238	.433	.040	10.766	***
Cognitive	<---	Safety	.251	.174	.015	11.388	***
Cognitive	<---	Trust	.065	.028	.010	2.966	.003
Cognitive	<---	Epistemic	.362	.246	.015	16.420	***
Affective	<---	Inspiring	.257	.129	.012	11.002	***
Affective	<---	Exciting	.094	.032	.008	4.010	***
Affective	<---	Interesting	.337	.174	.012	14.445	***
Affective	<---	Attractive	.163	.078	.011	6.990	***
Affective	<---	Novel	.107	.051	.011	4.583	***
Affective	<---	Pleasurable	.351	.175	.012	15.030	***
Affective	<---	Challenging	.094	.041	.010	4.048	***
Affective	<---	Fascinating	.201	.112	.013	8.610	***
Affective	<---	Personal	.336	.167	.012	14.411	***
Sensorimotor	<---	Engageability	.149	.111	.018	6.124	***
Sensorimotor	<---	Interactivity	.452	.355	.019	18.608	***
Sensorimotor	<---	Ludicity	.451	.323	.017	18.558	***
Sensorimotor	<---	Sociability	.200	.147	.018	8.255	***
Cognitive	<---	Rememberability	.203	.145	.016	9.182	***
ULX	<---	Cognitive	.300	.269	.023	11.635	***
ULX	<---	Affective	.261	.282	.028	10.128	***
ULX	<---	Sensorimotor	.496	.405	.021	19.254	***

***=p=0.000<0.01; p=0.003<0.01

Week 4 Model and Estimates

Number of distinct sample moments:	325
Number of distinct parameters to be estimated:	49
Degrees of freedom (325 - 49):	276

Chi-square = 27580.397

Degrees of freedom = 276

Probability level = .000

Model			Estimates				
			Stand.	Unstand.	S.E.	C.R.	P
Cognitive	<---	Usability	.264	.192	.015	12.850	***
Cognitive	<---	Learnability	.290	.243	.017	14.125	***
Cognitive	<---	Understandability	.235	.205	.018	11.439	***
Cognitive	<---	Ubiquity	.112	.193	.035	5.441	***
Cognitive	<---	Safety	.114	.087	.016	5.567	***
Cognitive	<---	Trust	.402	.401	.020	19.567	***
Cognitive	<---	Epistemic	.453	.443	.020	22.077	***
Affective	<---	Inspiring	.283	.186	.013	14.253	***
Affective	<---	Exciting	.114	.169	.029	5.732	***
Affective	<---	Interesting	.425	.319	.015	21.911	***
Affective	<---	Attractive	.248	.191	.015	12.524	***
Affective	<---	Novel	.399	.293	.015	20.116	***
Affective	<---	Pleasurable	.189	.122	.013	9.543	***
Affective	<---	Challenging	.236	.160	.013	11.899	***
Affective	<---	Fascinating	.197	.125	.013	9.913	***
Affective	<---	Personal	.113	.081	.014	5.674	***
Sensorimotor	<---	Engageability	.466	.377	.022	17.491	***
Sensorimotor	<---	Interactivity	.288	.229	.021	10.808	***
Sensorimotor	<---	Ludicity	.178	.099	.015	6.690	***
Sensorimotor	<---	Sociability	.175	.129	.020	6.575	***
Cognitive	<---	Rememberability	.144	.258	.037	7.010	***
ULX	<---	Cognitive	.286	.290	.030	9.582	***
ULX	<---	Affective	.174	.212	.036	5.833	***
ULX	<---	Sensorimotor	.290	.342	.035	9.696	***

***=p<0.000<0.01

Appendix G

Factor Analysis by Weeks

Factor Analysis – Week 1

Items	Usability	Learnability	Understandability	Ubiquity	Rememberability	Safety	Trust	Epistemic
Q1	.873							

Q2	.831							
Q3	.782							
Q4		.756						
Q5			.816					
Q6				.811				
Q7					.806			
Q8					.763			
Q9						.798		
Q10						.774		
Q11						.817		
Q12							.813	
Q13							.795	
Q14							.857	
Q15								.833
Q16								.807

Items	Interactivity	Engageability	Ludicity	Sociability
Q17	.790			
Q18	.833			
Q19		.753		
Q20		.775		
Q21			.795	
Q22			.613	
Q23				.839
Q24				.759

Items	Inspiring	Exciting	Interesting	Attractive	Novel	Pleasurable	Challenging	Fascinating	Personal
Q25	.855								
Q26		.867							
Q27			.881						
Q28				.825					
Q29				.817					
Q30					.572				
Q31					.762				
Q32						.846			
Q33							.748		
Q34								.773	
Q35									.844

Items	Cognitive	Sensorimotor	Affective	ULX
Q36	.761			
Q37	.695			
Q38		.827		
Q39			.840	
Q40			.807	
Q41			.834	
Q42			.721	
Q43			.886	
Q44			.828	
Q45			.866	
Q46			.761	
Q47			.767	

Q48			.853	
Q49			.852	
Q50			.843	
Q51			.751	
Q52				.729
Q53				.843
Q54				.899

Factor Analysis ---Week 2

Items	Usability	Learnability	Understandability	Ubiquity	Rememberability	Safety	Trust	Epistemic
Q1	.802							
Q2	.812							
Q3	.849							
Q4		.821						
Q5			.837					
Q6				.827				
Q7					.764			
Q8					.746			
Q9						.840		
Q10						.805		
Q11						.799		
Q12							.843	
Q13							.795	
Q14							.762	
Q15								.848
Q16								.863

Items	Interactivity	Engageability	Ludicity	Sociability
Q17	.814			
Q18	.902			
Q19		.711		
Q20		.816		
Q21			.737	
Q22			.764	
Q23				.785
Q24				.777

Items	Inspiring	Exciting	Interesting	Attractive	Novel	Pleasurable	Challenging	Fascinating	Personal
Q25	.818								
Q26		.736							
Q27			.811						
Q28				.760					
Q29				.644					
Q30					.574				
Q31					.840				
Q32						.804			
Q33							.689		
Q34								.762	
Q35									.786

Items	Cognitive	Sensorimotor	Affective	ULX
Q36	.722			
Q37	.806			
Q38		.763		
Q39			.814	
Q40			.821	
Q41			.752	
Q42			.814	
Q43			.815	
Q44			.739	
Q45			.812	
Q46			.830	
Q47			.774	
Q48			.751	
Q49			.751	
Q50			.754	
Q51			.774	
Q52				.722
Q53				.775
Q54				.779

Factor Analysis ---Week 3

Items	Usability	Learnability	Understandability	Ubiquity	Rememberability	Safety	Trust	Epistemic
Q1	.804							
Q2	.763							
Q3	.834							
Q4		.849						
Q5			.711					
Q6				.776				
Q7					.809			
Q8					.787			
Q9						.776		
Q10						.787		
Q11						.691		
Q12							.699	
Q13							.777	
Q14							.822	
Q15								.809
Q16								.830

Items	Interactivity	Engageability	Ludicity	Sociability
Q17	.766			
Q18	.722			
Q19		.765		
Q20		.723		
Q21			.805	
Q22			.675	
Q23				.758
Q24				.757

Items	Inspiring	Exciting	Interesting	Attractive	Novel	Pleasurable	Challenging	Fascinating	Personal
Q25	.689								

Q26		.800							
Q27			.707						
Q28				.686					
Q29				.763					
Q30					.740				
Q31					.831				
Q32						.771			
Q33							.754		
Q34								.762	
Q35									.788

Items	Cognitive	Sensorimotor	Affective	ULX
Q36	.803			
Q37	.732			
Q38		.729		
Q39			.737	
Q40			.849	
Q41			.777	
Q42			.832	
Q43			.814	
Q44			.741	
Q45			.770	
Q46			.653	
Q47			.813	
Q48			.786	
Q49			.814	
Q50			.794	
Q51			.856	
EQ52				.824
EQ53				.798
EQ54				.761

Factor Analysis ---Week 4

Items	Usability	Learnability	Understandability	Ubiquity	Rememberability	Safety	Trust	Epistemic
Q1	.656							
Q2	.849							
Q3	.857							
Q4		.823						
Q5			.734					
Q6				.812				
Q7					.754			
Q8					.827			
Q9						.833		
Q10						.808		
Q11						.754		
Q12							.849	
Q13							.811	
Q14							.861	
Q15								.817
Q16								.873

Items	Interactivity	Engageability	Ludicity	Sociability
Q17	.786			
Q18	.731			
Q19		.737		
Q20		.717		
Q21			.807	
Q22			.813	
Q23				.834
Q24				.763

Items	Inspiring	Exciting	Interesting	Attractive	Novel	Pleasurable	Challenging	Fascinating	Personal
Q25	.801								
Q26		.803							
Q27			.679						
Q28				.768					
Q29				.800					
Q30					.882				
Q31					.871				
Q32						.745			
Q33							.691		
Q34								.791	
Q35									.852

Items	Cognitive	Sensorimotor	Affective	ULX
Q36	.749			
Q37	.782			
Q38		.801		
Q39			.873	
Q40			.805	
Q41			.851	
Q42			.664	
Q43			.872	
Q44			.807	
Q45			.775	
Q46			.818	
Q47			.704	
Q48			.845	
Q49			.837	
Q50			.850	
Q51			.766	
Q52				.790
Q53				.868
Q54				.819

Appendix H

ANOVA Analysis for Time Differentials

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Usability	Between Groups	1316.557	3	438.852	615.522	.000

	Within Groups	2563.860	3596	.713		
	Total	3880.417	3599			
Learnability	Between Groups	1079.032	3	359.677	523.622	.000
	Within Groups	2470.101	3596	.687		
	Total	3549.133	3599			
Understandability	Between Groups	5.996	3	1.999	3.081	.026
	Within Groups	2333.175	3596	.649		
	Total	2339.172	3599			
Ubiquity	Between Groups	704.973	3	234.991	540.974	.000
	Within Groups	1562.047	3596	.434		
	Total	2267.020	3599			
Rememberability	Between Groups	187.312	3	62.437	128.964	.000
	Within Groups	1740.993	3596	.484		
	Total	1928.306	3599			
Safety	Between Groups	1239.402	3	413.134	652.418	.000
	Within Groups	2277.113	3596	.633		
	Total	3516.516	3599			
Trust	Between Groups	148.881	3	49.627	67.075	.000
	Within Groups	2660.577	3596	.740		
	Total	2809.458	3599			
Epistemic	Between Groups	9.176	3	3.042	5.477	.001
	Within Groups	1997.034	3596	.555		
	Total	2006.160	3599			

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Interactivity	Between Groups	905.502	3	301.834	521.539	.000
	Within Groups	2081.138	3596	.579		
	Total	2986.640	3599			
Engageability	Between Groups	20.687	3	6.896	11.929	.000
	Within Groups	2078.653	3596	.578		
	Total	2099.340	3599			
Ludicity	Between Groups	33.125	3	11.042	15.580	.000
	Within Groups	2548.520	3596	.709		
	Total	2581.644	3599			
Sociability	Between Groups	6.580	3	2.193	3.459	.016
	Within Groups	2280.169	3596	.634		
	Total	2286.750	3599			

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Inspiring	Between Groups	69.290	3	23.097	29.938	.000
	Within Groups	2774.300	3596	.771		
	Total	2843.590	3599			

Exciting	Between Groups	136.709	3	45.570	61.124	.000
	Within Groups	2680.904	3596	.746		
	Total	2817.613	3599			
Interesting	Between Groups	53.046	3	17.682	26.549	.000
	Within Groups	2394.927	3596	.666		
	Total	2447.972	3599			
Attractive	Between Groups	836.490	3	278.830	417.381	.000
	Within Groups	2402.297	3596	.668		
	Total	3238.786	3599			
Novel	Between Groups	1050.447	3	350.149	549.498	.000
	Within Groups	2291.428	3596	.637		
	Total	3341.874	3599			
Pleasurable	Between Groups	69.192	3	23.064	30.910	.000
	Within Groups	2683.206	3596	.746		
	Total	2752.398	3599			
Challenging	Between Groups	784.496	3	261.499	316.470	.000
	Within Groups	2971.367	3596	.826		
	Total	3755.862	3599			
Fascinating	Between Groups	23.204	3	7.735	11.105	.000
	Within Groups	2504.644	3596	.697		
	Total	2527.849	3599			
Personal	Between Groups	29.774	3	9.925	13.956	.000
	Within Groups	2557.192	3596	.711		
	Total	2586.966	3599			

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Cognitive	Between Groups	18.136	3	6.045	11.172	.000
	Within Groups	1945.808	3596	.541		
	Total	1963.945	3599			
Sensorimotor	Between Groups	29.323	3	9.774	16.314	.000
	Within Groups	2154.502	3596	.599		
	Total	2183.825	3599			
Affective	Between Groups	39.060	3	13.020	26.828	.000
	Within Groups	1745.204	3596	.485		
	Total	1784.264	3599			

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
ULX	Between Groups	14.952	3	4.984	8.384	.000
	Within Groups	2137.626	3596	.594		
	Total	2152.578	3599			

Appendix I

Pair-Wise Comparison with Bonferroni Method

Dependent Variable	(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.
Usability	Week 1	Week 2	-1.14556*	.03980	.000
		Week 3	.07778	.03980	.305
		Week 4	-1.19222*	.03980	.000
	Week 2	Week 1	1.14556*	.03980	.000
		Week 3	1.22333*	.03980	.000
		Week 4	-.04667	.03980	1.000
	Week 3	Week 1	-.07778	.03980	.305
		Week 2	-1.22333*	.03980	.000
		Week 4	-1.27000*	.03980	.000
	Week 4	Week 1	1.19222*	.03980	.000
		Week 2	.04667	.03980	1.000
		Week 3	1.27000*	.03980	.000
Learnability	Week 1	Week 2	.00778	.03907	1.000
		Week 3	-.08000	.03907	.244
		Week 4	1.23778*	.03907	.000
	Week 2	Week 1	-.00778	.03907	1.000
		Week 3	-.08778	.03907	.148
		Week 4	1.23000*	.03907	.000
	Week 3	Week 1	.08000	.03907	.244
		Week 2	.08778	.03907	.148
		Week 4	1.31778*	.03907	.000
	Week 4	Week 1	-1.23778*	.03907	.000
		Week 2	-1.23000*	.03907	.000
		Week 3	-1.31778*	.03907	.000
Understandability	Week 1	Week 2	.05833	.03797	.747
		Week 3	-.04444	.03797	1.000
		Week 4	-.03778	.03797	1.000
	Week 2	Week 1	-.05833	.03797	.747
		Week 3	-.10278*	.03797	.041
		Week 4	-.09611	.03797	.068
	Week 3	Week 1	.04444	.03797	1.000
		Week 2	.10278*	.03797	.041
		Week 4	.00667	.03797	1.000
	Week 4	Week 1	.03778	.03797	1.000
		Week 2	.09611	.03797	.068
		Week 3	-.00667	.03797	1.000
Ubiquity	Week 1	Week 2	1.24778*	.03107	.000
		Week 3	.55611*	.03107	.000
		Week 4	.55278*	.03107	.000
	Week 2	Week 1	-1.24778*	.03107	.000
		Week 3	-.69167*	.03107	.000
		Week 4	-.69500*	.03107	.000
	Week 3	Week 1	-.55611*	.03107	.000
		Week 2	.69167*	.03107	.000
		Week 4	-.00333	.03107	1.000
	Week 4	Week 1	-.55278*	.03107	.000
		Week 2	.69500*	.03107	.000
		Week 3	.00333	.03107	1.000
Rememberability	Week 1	Week 2	-.04778	.03280	.872
		Week 3	-.16222*	.03280	.000
		Week 4	.43889*	.03280	.000
	Week 2	Week 1	.04778	.03280	.872
		Week 3	-.11444*	.03280	.003

	Week 3	Week 4	.48667*	.03280	.000
		Week 1	.16222*	.03280	.000
		Week 2	.11444*	.03280	.003
		Week 4	.60111*	.03280	.000
	Week 4	Week 1	-.43889*	.03280	.000
		Week 2	-.48667*	.03280	.000
		Week 3	-.60111*	.03280	.000
		Week 4	-.144889*	.03751	.000
Safety	Week 1	Week 2	-.17889*	.03751	.000
		Week 3	-1.44889*	.03751	.000
		Week 4	-.12778*	.03751	.004
		Week 1	.17889*	.03751	.000
	Week 2	Week 3	-1.27000*	.03751	.000
		Week 4	.05111	.03751	1.000
		Week 1	1.44889*	.03751	.000
	Week 3	Week 2	1.27000*	.03751	.000
		Week 4	1.32111*	.03751	.000
	Week 4	Week 1	.12778*	.03751	.004
		Week 2	-.05111	.03751	1.000
		Week 3	-1.32111*	.03751	.000
Trust	Week 1	Week 2	.03630	.04055	1.000
		Week 3	.41963*	.04055	.000
		Week 4	-.12444*	.04055	.013
		Week 1	-.03630	.04055	1.000
	Week 2	Week 3	.38333*	.04055	.000
		Week 4	-.16074*	.04055	.000
		Week 1	-.41963*	.04055	.000
	Week 3	Week 2	-.38333*	.04055	.000
		Week 4	-.54407*	.04055	.000
	Week 4	Week 1	.12444*	.04055	.013
		Week 2	.16074*	.04055	.000
		Week 3	.54407*	.04055	.000
Epistemic	Week 1	Week 2	-.00111	.03513	1.000
		Week 3	-.09222	.03513	.052
		Week 4	-.10889*	.03513	.012
		Week 1	.00111	.03513	1.000
	Week 2	Week 3	-.09111	.03513	.057
		Week 4	-.10778*	.03513	.013
		Week 1	.09222	.03513	.052
	Week 3	Week 2	.09111	.03513	.057
		Week 4	-.01667	.03513	1.000
	Week 4	Week 1	.10889*	.03513	.012
		Week 2	.10778*	.03513	.013
		Week 3	.01667	.03513	1.000
Interactivity	Week 1	Week 2	1.12889*	.03586	.000
		Week 3	-.08222	.03586	.132
		Week 4	.00222	.03586	1.000
		Week 1	-1.12889*	.03586	.000
	Week 2	Week 3	-1.21111*	.03586	.000
		Week 4	-1.12667*	.03586	.000
		Week 1	.08222	.03586	.132
	Week 3	Week 2	1.21111*	.03586	.000
		Week 4	.08444	.03586	.112
	Week 4	Week 1	-.00222	.03586	1.000
		Week 2	1.12667*	.03586	.000
		Week 3	-.08444	.03586	.112
Engageability	Week 1	Week 2	.06278	.03584	.480
		Week 3	-.14000*	.03584	.001
		Week 4	-.06944	.03584	.317
		Week 1	-.06278	.03584	.480
	Week 2	Week 3	-.20278*	.03584	.000
		Week 4	-.13222*	.03584	.001

Ludicity	Week 3	Week 1	.14000*	.03584	.001
		Week 2	.20278*	.03584	.000
		Week 4	.07056	.03584	.294
		Week 4	.06944	.03584	.317
	Week 4	Week 1	.13222*	.03584	.001
		Week 2	-.07056	.03584	.294
		Week 3	.11222*	.03969	.028
		Week 4	-.01167	.03969	1.000
	Week 1	Week 1	-.15778*	.03969	.000
		Week 2	-.11222*	.03969	.028
		Week 3	-.12389*	.03969	.011
		Week 4	-.27000*	.03969	.000
Sociability	Week 2	Week 1	.01167	.03969	1.000
		Week 2	.12389*	.03969	.011
		Week 3	-.14611*	.03969	.001
		Week 4	.15778*	.03969	.000
	Week 3	Week 1	.27000*	.03969	.000
		Week 2	.14611*	.03969	.001
		Week 3	.03472	.03754	1.000
		Week 4	-.08250	.03754	.168
	Week 4	Week 1	-.00694	.03754	1.000
		Week 2	-.03472	.03754	1.000
		Week 3	-.11722*	.03754	.011
		Week 4	-.04167	.03754	1.000
Inspiring	Week 1	Week 1	.08250	.03754	.168
		Week 2	.11722*	.03754	.011
		Week 3	.07556	.03754	.265
		Week 4	.00694	.03754	1.000
	Week 2	Week 1	.04167	.03754	1.000
		Week 2	-.07556	.03754	.265
		Week 3	-.13667*	.04141	.006
		Week 4	-.28000*	.04141	.000
	Week 3	Week 1	-.36333*	.04141	.000
		Week 2	.13667*	.04141	.006
		Week 3	-.14333*	.04141	.003
		Week 4	-.22667*	.04141	.000
Exciting	Week 4	Week 1	.28000*	.04141	.000
		Week 2	.14333*	.04141	.003
		Week 3	-.08333	.04141	.265
		Week 4	.36333*	.04141	.000
	Week 1	Week 1	.22667*	.04141	.000
		Week 2	.08333	.04141	.265
		Week 3	-.07167	.04070	.470
		Week 4	.06611	.04070	.626
	Week 2	Week 1	.43389*	.04070	.000
		Week 2	.07167	.04070	.470
		Week 3	.13778*	.04070	.004
		Week 4	.50556*	.04070	.000
Interesting	Week 3	Week 1	-.06611	.04070	.626
		Week 2	-.13778*	.04070	.004
		Week 3	.36778*	.04070	.000
		Week 4	-.43389*	.04070	.000
	Week 4	Week 1	-.50556*	.04070	.000
		Week 2	-.36778*	.04070	.000
		Week 3	.04556	.03847	1.000
		Week 4	-.24111*	.03847	.000
	Week 1	Week 1	-.18889*	.03847	.000
		Week 2	-.04556	.03847	1.000
		Week 3	-.28667*	.03847	.000
		Week 4	-.23444*	.03847	.000
Interesting	Week 2	Week 1	.24111*	.03847	.000
		Week 2	.24111*	.03847	.000

Attractive	Week 4	Week 2	.28667*	.03847	.000
		Week 4	.05222	.03847	1.000
		Week 1	.18889*	.03847	.000
		Week 2	.23444*	.03847	.000
		Week 3	-.05222	.03847	1.000
	Week 1	Week 2	-1.08222*	.03853	.000
		Week 3	-1.15444*	.03853	.000
		Week 4	-1.09778*	.03853	.000
	Week 2	Week 1	1.08222*	.03853	.000
		Week 3	-.07222	.03853	.366
		Week 4	-.01556	.03853	1.000
	Week 3	Week 1	1.15444*	.03853	.000
		Week 2	.07222	.03853	.366
		Week 4	.05667	.03853	.849
Novel	Week 1	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 2	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 3	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
Pleasurable	Week 1	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 2	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 3	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
Challenging	Week 1	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 2	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 3	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
Fascinating	Week 1	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 2	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000
	Week 3	Week 1	1.09778*	.03853	.000
		Week 2	.01556	.03853	1.000
		Week 3	-.05667	.03853	.849
		Week 4	1.15444*	.03853	.000

Personal	Week 4	Week 4	-.04222	.03934	1.000
		Week 1	.12667*	.03934	.008
		Week 2	.20889*	.03934	.000
		Week 3	.04222	.03934	1.000
	Week 1	Week 2	-.08667	.03975	.176
		Week 3	-.23667*	.03975	.000
		Week 4	-.18444*	.03975	.000
	Week 2	Week 1	.08667	.03975	.176
		Week 3	-.15000*	.03975	.001
		Week 4	-.09778	.03975	.084
	Week 3	Week 1	.23667*	.03975	.000
		Week 2	.15000*	.03975	.001
		Week 4	.05222	.03975	1.000
	Week 4	Week 1	.18444*	.03975	.000
		Week 2	.09778	.03975	.084
		Week 3	-.05222	.03975	1.000
Cognitive	Week 1	Week 2	-.01222	.03468	1.000
		Week 3	-.12778*	.03468	.001
		Week 4	-.16333*	.03468	.000
	Week 2	Week 1	.01222	.03468	1.000
		Week 3	-.11556*	.03468	.005
		Week 4	-.15111*	.03468	.000
	Week 3	Week 1	.12778*	.03468	.001
		Week 2	.11556*	.03468	.005
		Week 4	-.03556	.03468	1.000
	Week 4	Week 1	.16333*	.03468	.000
		Week 2	.15111*	.03468	.000
		Week 3	.03556	.03468	1.000
Sensorimotor	Week 1	Week 2	.01111	.03649	1.000
		Week 3	-.13556*	.03649	.001
		Week 4	-.20167*	.03649	.000
	Week 2	Week 1	-.01111	.03649	1.000
		Week 3	-.14667*	.03649	.000
		Week 4	-.21278*	.03649	.000
	Week 3	Week 1	.13556*	.03649	.001
		Week 2	.14667*	.03649	.000
		Week 4	-.06611	.03649	.421
	Week 4	Week 1	.20167*	.03649	.000
		Week 2	.21278*	.03649	.000
		Week 3	.06611	.03649	.421
Affective	Week 1	Week 2	-.12248*	.03284	.001
		Week 3	-.21624*	.03284	.000
		Week 4	-.27573*	.03284	.000
	Week 2	Week 1	.12248*	.03284	.001
		Week 3	-.09376*	.03284	.026
		Week 4	-.15325*	.03284	.000
	Week 3	Week 1	.21624*	.03284	.000
		Week 2	.09376*	.03284	.026
		Week 4	-.05949	.03284	.421
	Week 4	Week 1	.27573*	.03284	.000
		Week 2	.15325*	.03284	.000
		Week 3	.05949	.03284	.421
ULX	Week 1	Week 2	.00815	.03635	1.000
		Week 3	-.12185*	.03635	.005
		Week 4	-.12741*	.03635	.003
	Week 2	Week 1	-.00815	.03635	1.000
		Week 3	-.13000*	.03635	.002
		Week 4	-.13556*	.03635	.001
	Week 3	Week 1	.12185*	.03635	.005
		Week 2	.13000*	.03635	.002
		Week 4	-.00556	.03635	1.000

	Week 4	Week 1	.12741*	.03635	.003
		Week 2	.13556*	.03635	.001
		Week 3	.00556	.03635	1.000

Appendix J

Descriptive Statistics by Weeks

Descriptive Statistics: Week 1				
	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Usability	900	2.3822	.03078	.92338
Learnability	900	3.5800	.03006	.90188
Understandability	900	3.6500	.03086	.92593
Ubiquity	900	3.5689	.03158	.94729
Rememberability	900	3.4711	.02921	.87624
Safety	900	2.2522	.02611	.78341
Trust	900	3.5563	.02722	.81660
Epistemic	900	3.5694	.02670	.80108
Interactivity	900	3.5856	.02560	.76812
Engageability	900	3.5400	.02598	.77936
Ludicity	900	3.4911	.02613	.78390
Sociability	900	3.5742	.02762	.82867
Inspiring	900	3.3400	.03230	.96890
Exciting	900	3.4839	.02770	.83114
Interesting	900	3.5067	.03079	.92365
Attractive	900	2.5033	.03107	.93206
Novel	900	3.4389	.02658	.79741
Pleasurable	900	3.4256	.02920	.87609
Challenging	900	3.3478	.03272	.98156
Fascinating	900	3.4922	.02943	.88300
Personal	900	3.3900	.03172	.95162
Cognitive	900	3.5194	.02644	.79305
Sensorimotor	900	3.5033	.02662	.79870
Affective	900	3.3631	.02501	.75021
ULX	900	3.4915	.02616	.78488
Valid N (listwise)	900			

a. Time = Week 1

Descriptive Statistics: Week 2				
	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Usability	900	3.5278	.02478	.74334
Learnability	900	3.5722	.02594	.77811
Understandability	900	3.5917	.02412	.72358
Ubiquity	900	2.3211	.02636	.79080
Rememberability	900	3.5189	.02537	.76104
Safety	900	2.4311	.02770	.83094
Trust	900	3.5200	.02638	.79126
Epistemic	900	3.5706	.02636	.79085
Interactivity	900	2.4567	.02923	.87691

Engageability	900	3.4772	.02816	.84492
Ludicity	900	3.3789	.02664	.79926
Sociability	900	3.5394	.02877	.86319
Inspiring	900	3.4767	.03021	.90636
Exciting	900	3.5556	.03017	.90495
Interesting	900	3.4611	.02695	.80849
Attractive	900	3.5856	.02576	.77281
Novel	900	3.4439	.02681	.80420
Pleasurable	900	3.4289	.03070	.92093
Challenging	900	2.4156	.03074	.92222
Fascinating	900	3.4100	.02890	.86696
Personal	900	3.4767	.02805	.84144
Cognitive	900	3.5317	.02566	.76988
Sensorimotor	900	3.4922	.02931	.87922
Affective	900	3.4856	.02295	.68859
ULX	900	3.4833	.02589	.77668
Valid N (listwise)	900			

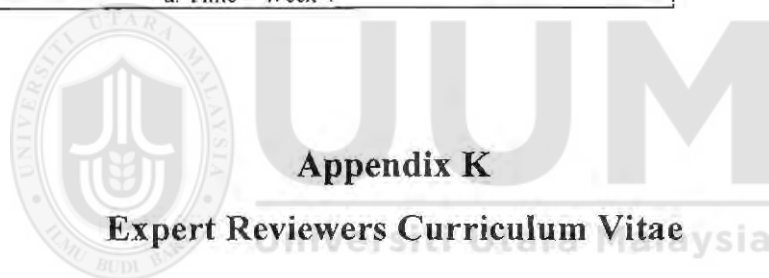
a. Time = Week 2

Descriptive Statistics: Week 3				
	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Usability	900	2.3044	.02637	.79107
Learnability	900	3.6600	.02808	.84240
Understandability	900	3.6944	.02680	.80399
Ubiquity	900	3.0128	.00880	.26389
Rememberability	900	3.6333	.02248	.67450
Safety	900	3.7011	.02318	.69529
Trust	900	3.1367	.03698	1.10926
Epistemic	900	3.6617	.02360	.70807
Interactivity	900	3.6678	.02241	.67216
Engageability	900	3.6800	.02368	.71051
Ludicity	900	3.5028	.02458	.73733
Sociability	900	3.6567	.02400	.71990
Inspiring	900	3.6200	.02645	.79349
Exciting	900	3.4178	.03853	1.15578
Interesting	900	3.7478	.02583	.77484
Attractive	900	3.6578	.02778	.83353
Novel	900	3.6656	.02804	.84132
Pleasurable	900	3.7011	.02674	.80225
Challenging	900	3.5489	.03054	.91633
Fascinating	900	3.5767	.02389	.71665
Personal	900	3.6267	.02683	.80499
Cognitive	900	3.6472	.02108	.63225
Sensorimotor	900	3.6389	.02284	.68525
Affective	900	3.5793	.02140	.64185
ULX	900	3.6133	.02272	.68160
Valid N (listwise)	900			

a. Time = Week 3

Descriptive Statistics: Week 4				
	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Usability	900	3.5744	.03020	.90605

Learnability	900	2.3422	.02623	.78685
Understandability	900	3.6878	.02513	.75376
Ubiquity	900	3.0161	.01270	.38102
Rememberability	900	3.0322	.01223	.36697
Safety	900	2.3800	.02878	.86332
Trust	900	3.6807	.02201	.66037
Epistemic	900	3.6783	.02243	.67295
Interactivity	900	3.5833	.02367	.71005
Engageability	900	3.6094	.02324	.69718
Ludicity	900	3.6489	.03396	1.01876
Sociability	900	3.5811	.02552	.76570
Inspiring	900	3.7033	.02781	.83432
Exciting	900	3.0500	.01232	.36951
Interesting	900	3.6956	.02487	.74620
Attractive	900	3.6011	.02384	.71516
Novel	900	2.2867	.02491	.74729
Pleasurable	900	3.7078	.02839	.85171
Challenging	900	3.5367	.02691	.80722
Fascinating	900	3.6189	.02870	.86089
Personal	900	3.5744	.02545	.76347
Cognitive	900	3.6828	.02456	.73691
Sensorimotor	900	3.7050	.02395	.71837
Affective	900	3.6388	.02339	.70165
ULX	900	3.6189	.02777	.83302
Valid N (listwise ^a)	900			
a. Time = Week 4				



Reviewer 1:

Full name: Kujala, Sari

Nationality: Finnish

Degrees awarded

- Title of docent: Human-Centered Design, Tampere University of Technology, 14.9.2011
- Title of docent: User-Centered Design, Helsinki University of Technology, 20.6.2006
- Ph.D., Helsinki University of Technology, Human-Computer Interaction, 10.6.2002
- Lic.Phil., University of Helsinki, Cognitive Science, 9.2.1999
- MA, University of Helsinki, Psychology, 28.4.1992

Other education and training, qualifications and skills

- TAHTO Leadership training, Tampere University of Technology, 2006-2007.
- COTCOS (Cooperative Technologies for Complex Work Settings) Summer School, Winston House, E. Sussex, July 2000

Current position

- Research Fellow, Aalto University, Department of Computer Science, 1.2.2014-

Previous work experience

- Visiting Researcher, UMIT – Private University for Health Sciences, Medical Informatics and Technology, Innsbruck, Austria, 18.11.-13.12.2019
- Postdoctoral Researcher, Aalto University, Department of Design, 2011-2014
- Professor of Psychology, Tampere University of Technology, 2006-2011
- Senior Researcher, Helsinki University of Technology, 2005-2006
- Acting Professor of Software Product Business, Helsinki University of Technology, 2004 (six months)
- Senior Researcher, Helsinki University of Technology, 2003-2004
- Researcher, Helsinki University of Technology, 1997-2003
- Family leave, 1995-1997
- Research Associate in the Usability Laboratory, Helsinki University of Technology, 1995
- Research Assistant, Department of Psychology, University of Helsinki, 1992-1994
- Part-time (50%) Researcher, Department of Psychology, University of Helsinki, 1992-1993

Research funding as well as leadership

- Major research funding as PI:
 - Deputy PI of the consortium, PI of the subproject of DigiIN – Towards socially inclusive digital society: transforming service culture, the Strategic Research Council of the Academy of Finland, 1.6.2019-31.8.2022, 606 280 €;
 - The eHealth subproject of COPE – Competent workforce for the future, the Strategic Research Council of the Academy of Finland, 1.4.2016-31.3.2019, 462 914 €;
 - DELUX - Delightful Long-Term UX: Creating Customer Loyalty, TEKES Finnish Funding Agency, Nokia, Fiskars, Suunto, Paf, 1.2.2011-31.5.2013, 588 522 €.
 - MUX - Mobile Camera UX, Nokia, 2010, 35 000 €;
 - SUXES - User Experience Evaluation for Supporting International Competitiveness, funded by TEKES Finnish Funding Agency for Innovation, Nokia, Suunto, Paf, 1.4.2009-31.3.2011, 416 000 €;
 - MySuunto, Suunto, 2009, 8100 €;
 - PROFCOM – Product Internationalization with Firm-Hosted Online Communities, TEKES, Nokia, Tekla, Sanoma, 1.3.2008 – 28.2.2011, 893 208 €;
 - VALU – Tools for Identifying Users' Needs and Values in Designing Successful Technology Products, TEKES Finnish Funding Agency for Innovation, TeliaSonera, Polar, Nokia, Etnoteam, Paf, Satama Interactive, 1.1.2007 - 31.12.2008, 310 734 €;
 - Project for developing teaching of human-centered design, Tampere University of Technology, 2007, 15 000 €;
- Leadership in research work:
 - Leader of an own research group 2006-2011 and PI in all the research projects mentioned in major research funding.

Awards, prizes and honours

- Software Business and Engineering Institute's science prize 2002

Other professional activities and achievements

- Opponent of doctoral thesis:

Daniela Wurhofer, University of Salzburg, Austria, 2018; Bennett Kankuzi, University of Eastern Finland, 2015; Päivi Sampola, University of Vaasa, August 2008.

- Pre-examination of doctoral theses: Monika Pölönen, University of Helsinki, 2010.
- Pre-examination of licentiate theses: Sari Walldén, University of Tampere, 2004.
- Evaluation of academic/scientific competence:
The position of Senior Lecturer in HCI with specialization towards human sciences, Kungliga Tekniska Högskolan, 2010;
Antti Oulasvirta, Adjunct professor of Cognitive Science, 2008;
Netta Iivari, Adjunct professor of User-Centered Participative Information System Design, 2008.
- Evaluation of project proposal for Dutch Ministry of Economic Affairs.
- Member of programme committee of ozCHI 2019, DIS Conference 2018, CHI Conference 2017, MobileHCI Conference 2006; 2010, NordiCHI Conference 2014, ECIS 2011, 2013, 2014, 2015
- Referee for scientific and scholarly journals: International Journal of Medical Informatics, 2019;
Computers in Human Behavior, 2019;
Finnish Journal of eHealth and eWelfare, 2018, 2019;
International Journal of Human-Computer Interaction, 2019;
Nurse Education in Practice, 2019;
International Journal of Human Factors and Ergonomics, 2017;
Interacting with Computers, 2009-2018;
Research in Engineering Design 2014-2018,
Behaviour & Information Technology, 2011-2017;
Applied Research in Quality of Life, 2017;
Human Technology 2015-2016;
Transactions on Affective Computing, 2016;
Personality & Creativity, 2016;
International Journal of Human-Computer Studies, 2015;
Research of Engineering Design, 2014-2015;
Information and Software Technology, 2014;
International Journal of Design, 2013;
Empirical Software Engineering, 2009;
Scandinavian Journal of Information Systems, 2008, 2009;
Information Systems Journal, 2007;
Journal of Information Technology Theory and Application (JITTA), 2006, 2009
- Invited keynote lectures:
Northwestern Polytechnical University and Shaanxi University of Science & Technology, China, 14.9.-15.9.2015

Scientific and societal impact of research

Total number of peer-reviewed publications: 69

- Google Scholar citation statistics: number of citations 3382, h-index 21, i10-index 39

I have been an active advocate of human and user perspective in software engineering and service design. In my research projects, I have collaborated, developed practices and collected research data with industrial companies, health-care providers, SoteDigi and Virtual Hospital developing eHealth services for self-management, and non-

governmental organizations. I have also been active speaker in a number of public events and disseminated research results in scientific and other articles, a blog post, a podcast, and social media.

I have also distributed research results by organizing an international summer school, a tutorial and workshops:

- Workshop at Medical Informatics of Europe Conference 2017: *Competence for IT-induced change in health care work practices*, together with Hyppönen, H. Ahonen, O., Scott, P., and Heponiemi T.
- Workshop at NordiCHI Conference 2012: *Temporal Aspects of User Experience: Models and Methods Beyond a Single Use Situations*, together with Michael Minge, Anna E. Pohlmeier and Marlene Vogel.
- International Summer School on Product User Experience, Tampere 2010
- Workshop at CHI'08: *Values, Value and Worth: Their Relationship to HCI?*, together with Gilmore, D., Cockton, G., Churchill, E., Henderson, A., and Hammontree, M.L.
- Tutorial at NordicCHI'2006: *Effective Field Studies for Gathering User Needs and Requirements*, together with Mia Lähteenmäki.
- Workshop at IEEE International Requirements Engineering Conference 2005: *The Interplay of Requirements Engineering and Project Management in Software Projects*, together with Hermann, A., Kauppinen, M., Lauesen, S., Paech, B. Robertson, J.

Positions of trust in society and other societal merits

A vice-chair of SIGCHI Finland, the Finnish association for people practicing in the field of human-computer interaction, 2019-

- A vice-member of the steering group, the Monitoring and assessment of social welfare and health care information system services (STePS 3.0) research project, 2019-
- A member of the steering group, the Digital work and stress research project, 2016-2019

Reviewer 2:

Name: William S. Albert, PhD

Address: 111 Pleasant Street, Newton, MA 02459

mitbert@gmail.com

617-953-2186

Nationality: USA

Education

- Ph.D., Geography, Boston University, Boston, MA, 1998
Dissertation: *The Role of Attention in Learning Spatial Relationships During Simulated Navigation*
- M.A., Geography, University of Washington, Seattle, WA, 1990
Thesis: *The Use of Behavioral Data in a Geographic Information System for Transportation Planning*
- B.A., Geography, University of Washington, Seattle, WA, 1988

Research Statistics (as of 12/28/19)

- ResearchGate:
 - ResearchGate score: 10.58
 - Total Research Interest: 673.5 (top 9%)
- Google Scholar:
 - 2,870 citations
 - h index = 12
 - i-10 index = 13

Professional Positions

Executive Director, User Experience Center (UXC), Bentley University, 2012 – Present

Director, Design and Usability Center (DUC), Bentley University, 2009 - 2012

- Responsible for running the daily operation of the UXC, including business development, project scoping, marketing, client relationships, and team management
- Routinely generate more than \$1M annually from commercial clients for UX research, design, and strategy services provided by UXC full-time staff and graduate students
- Conduct a wide variety of user research and design for clients, including usability testing, surveys, content strategy, information architecture, competitive benchmarking, biometrics/eye tracking, and design thinking
- Set annual business goals and long-term strategic direction for the UXC, coordinating with various departments across the university

Director of User Experience, Fidelity Investments, Marlborough, MA, 2007 – 2009

Principal Usability Specialist, Fidelity Investments, Marlborough, MA, 2002 – 2007

- Managed a team of user experience researchers supporting Fidelity Investments web applications used by more than 20 million investors in the US
- Championed user-centered design across the organization, brought together designers, information architects, business sponsors, product managers, and development partners on all major user research initiatives

Senior User Interface Researcher, Terra Lycos, Inc., Waltham, MA, 1999 – 2002

Research Positions

Post-Doctoral Research Associate, Cambridge Basic Research, Nissan Research & Development,

Cambridge, MA, 1998 – 1999

- Conducted research on the interface design of 3D map displays for automobile navigation systems using a driving simulator
- Examined how various types of map interfaces influence visual attention patterns and cognitive load while driving Post-Doctoral Research Fellow, Nissan Research Center, Electronics and Information Systems Research Laboratory, Yokosuka, Japan, 1997 - 1998
- This highly competitive fellowship was sponsored by the Japanese Government, designed to bring new Ph.D.'s to Japan to work on innovation and technology
- Directed a series of experiments to study visual attention patterns of drivers in a virtual environment Research Assistant, Department of Geography, Boston University, 1993 - 1997

Teaching Positions

- *Invited Instructor*, Department of Applied Psychology, Tsinghua University, Beijing, China, 2020

- Teaching one week course on usability testing in Fall, 2020 *Instructor*, UX Certificate Program, Bentley University, 2009 – Present
- Introduction to Measuring the User Experience (2010 - 2019)
- Introduction to Service Design and Journey Mapping (2014, 2016, 2017, 2019)
- *Adjunct Professor*, Graduate Program in Human Factors and Information Design, McCallum Graduate School of Business, Bentley University, 2008 – 2018
- Introduction to Measuring the User Experience (2008 - 2016)
- Research Methods in Human Factors in Information Design (2016, 2018)

Student Advising

- Supervised more than 80 Departmental Graduate Assistants who have worked in the Bentley University User Experience Center on user experience research and design projects
- Advised approximately 10 Graduate Research Assistants on various research studies, many leading to publications and professional/academic presentations

External Funding

- Responsible for generating more than \$10.6M in external funding in my role as Executive Director of the Bentley University User Experience Center since 2009
- Received funding from more than 100 companies around the world, focused primarily on financial services, healthcare, and retail organizations

Books

- [1] Tullis, T. & **Albert W.** (forthcoming). *Measuring the User Experience: Collecting, Analyzing and Presenting Usability Metrics (Third edition)*. Morgan Kaufmann Series in Interactive Technologies, Elsevier Publishers. Forthcoming in Fall, 2020
- [2] Tullis, T. & **Albert W.** (2013). *Measuring the User Experience: Collecting, Analyzing and Presenting Usability Metrics (Second edition)*. Morgan Kaufmann Series in Interactive Technologies, Elsevier Publishers (translated into: Mandarin and Japanese)
- [3] **Albert W.** , Tullis, T., & Tedesco, D. (2010). *Beyond the Usability Lab: Conducting Large-Scale User Experience Studies*. Morgan Kaufmann Series in Interactive Technologies, Elsevier Publishers (translated into Korean)
- [4] Tullis, T. & **Albert W.** (2008). *Measuring the User Experience: Collecting, Analyzing and Presenting Usability Metrics*. Morgan Kaufmann Series in Interactive Technologies, Elsevier Publishers (translated into Mandarin)

Publications

- [1] Ericson, J., **Albert, W.**, Bernard, B. & Brown, L. Impact of Redesigning End User License Agreements on Perceived Usability. To be submitted to *Law and Human Behavior*, January, 2020.
- [2] Ericson, J, **Albert, W.**, & Bernard, B. Breaking Website Design Conventions Increases Cognitive Load: Evidence from Mousetracking, *International Journal of Human-Computer Interaction* (provisionally accepted for publication)
- [3] Resnick, M. & **Albert, W.** (2016). The Influences of Design Esthetic, Site Relevancy and Task Relevancy on Attention to Banner Advertising, *Interacting with Computers*, 28(5), 680-694.
- [4] **Albert, W.** (2015). The Fox Guarding the Usability Lab, *Journal of Usability Studies*, 10(3), 96-99.
- [5] Resnick, M. & **Albert, W.** (2013). The Impact of Advertising Location and User Task on the Emergence of Banner Ad Blindness: An Eye Tracking Study. *International Journal of Human Computer Interaction*, 30(3), 206-219.

- [6] **Albert W & Liu A** (2012). The Effects of Map Orientation and Landmarks on Visual Attention While Using an In-Vehicle Navigation System. In: A G Gale, ID Brown, CM Haslegrave, SP Taylor (Eds), *Vision in Vehicles VIII*, Loughborough University, UK, 456-462.
- [7] **Albert, W. & Tedesco, D.** (2010). Reliability of Self-Reported Awareness Measures Using Eye Tracking Data. *Journal of Usability Studies*, 5(2), 50-64.
- [8] **Albert, W. & Thornton, I. M.** (2003). The Effects of Speed Changes on Route Learning in a Desktop Virtual Environment. *Springer-Verlag Lecture Notes in Artificial Intelligence*, Berlin.
- [9] **Albert, W.** (2002). Spatial Cognition 2002: Conference Summary Report. *Künstliche Intelligenz*, 4/02, 46.
- [10] **Albert, W., Rensink, R.A., Beusmans, J.B.** (1999). Learning Relative Directions Between Landmarks in a Desktop Virtual Environment. *Spatial Cognition and Computation*, 1(2), 131-144.
- [11] **Albert, W., Reinitz, M.T., Beusmans, J.B., & Gopal, S.** (1999). The Role of Attention in Spatial Learning During Simulated Route Navigation. *Environment & Planning A*, 31, 1459-1472.
- [12] **Albert, W., & Golledge, R.G.** (1999). The Use of Spatial Cognitive Abilities in Geographic Information Systems: The Map Overlay Operation. *Transactions in GIS*, 3(1), 6-20.
- [13] **Albert, W.** (1997) "The Role of Spatial Abilities in the Acquisition and Representation of Geographic Space". In *Geographic Information Research: Bridging the Atlantic*. Eds: M. Craglia and H. Couclelis, London: Taylor & Francis, pp. 320-334.
- [14] **Woodcock, C., Gopal, S., & Albert, W.** (1996). Evaluation of the Potential for Providing Secondary Labels in Vegetation Maps. *Photogrammetric Engineering and Remote Sensing*, 62(4), 393-399.

Conference Proceedings

- [1] **Resnick, M., Albert, W., Huang, Y** (2016). The Attention Grabbing Saliency of Viscerally Engaging Images, Published in the Proceedings of the Human Factors Ergonomics Society Annual Conference, Washington, DC, 2016.
- [2] **Burton, L., Albert, W., & Flynn, M.** (2014). A Comparison of the Performance of Webcam vs. Infrared Eye Tracking Technology, Published in the Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Chicago, IL, 2014.
- [3] **Albert, W., Gribbons, W, & Almadras, J.** (2009). Pre-Conscious Assessment of Trust: A Case Study of Financial and Health Care Web Sites, Published in the Proceedings of the Human Factors and Ergonomics Society Annual Meeting, San Antonio, TX, 2009.

Technical Reports

- [1] **Albert, W.** (1999). The Effects of Turn Instruction on Memory for Landmarks During Route Learning. *Cambridge Basic Research Technical Report*, 99-1, Cambridge, MA.
- [2] **Albert, W. & Thornton, I.M.** (1999). Traveling through Space and Time: Changes in Speed Do Not Affect Route Learning in a Virtual Environment. *Cambridge Basic Research Technical Report*, 99-6, Cambridge, MA.
- [3] **Albert, W., Reinitz, M.T., Beusmans, J.M., & Gopal, S.** (1997). The Role of Attention in Route Learning during Simulated Navigation. *Cambridge Basic Research Technical Report*, 97-4, Cambridge, MA.
- [4] **Albert, W., Beusmans, J.M., & Rensink, R.A.** (1997). The Effect of Spatio-Temporal Discontinuity on the Acquisition of Relative Direction Knowledge. *Cambridge Basic Research Technical Report*, 97-5, Cambridge, MA.

Presentations

- [1] **Albert, W.** (2020). Mine Emotional Metrics for Site Design, Internet Retailer Conference & Exhibition (IRCE), Chicago, IL, June, 2020
- [2] **Albert, W.** (2020). Is That Model Supposed to Look Like Me? A Case Study in Measuring Emotional Engagement, UX Insight 2020, Breda, The Netherlands, April, 2020
- [3] **Albert, W.** (2020). Is That Really Me? Measuring Emotional Engagement of Customers Using a Virtual Dressing Room in an e-Commerce Website, NextGen CX, Indian Wells, CA, March, 2020
- [4] **Albert, W. & Marriott, J.** (2019). Is That Really Me? Measuring Emotional Engagement Of Customers Using A Virtual Dressing Room In An E-commerce Website, ReCon, New York, NY, October, 2019
- [5] **Albert, W.** (2019). Exploring the Emotional User Experience, User Research London, London, UK, June, 2019
- [6] **Albert, W.** (2018). Exploring the Emotional User Experience, World Usability Congress, Graz, Austria, 2018
- [7] **Albert, W.** (2017). Moving Your UX Career to the Next Level, UX Hong Kong, Hong Kong, 2017. (Keynote)
- [8] **Resnick, M., Albert, W., Huang, Y** (2016). The Attention Grabbing Salience of Viscerally Engaging Images, Human Factors Ergonomic Society Annual Conference, Washington, DC, 2016.
- [9] **Albert, W.** (2016). You Can't Buy It If You Can't Find It, Conversion, Las Vegas, NV, 2016
- [10] **Albert, W.** (2016). How Sure Are We? The Predictive Power of Early UX Evaluation Methods on Live Site Performance, World IA Day Boston, 2016
- [11] **Albert, W.** (2015). Keys to a Successful UX Career, UX India, Bangalore, India, 2015 (Keynote)
- [12] **Albert, W.** (2015). Usability Testing: Lessons Learned and Looking to the Future, ErgoDesign, Recife, Brazil, 2015 (Keynote)
- [13] **Albert, W.** (2014). Measuring the User Experience, UX Strategy Forum Japan, Tokyo, Japan, 2014
- [14] **Albert, W.** (2014). The Role of Metrics in a UX Strategy: Leveraging the Power of UX Data to Create Better Designs and Drive Innovation, Convey UX, Seattle, WA, 2014
- [15] **Albert, W.** (2013). Top 10 Usability Challenges – and How to Solve Them. Internet Retailers Web Design and Usability, Orlando, FL, 2013
- [16] **Albert, W.** (2012). Essential Tools for Finding And Fixing Customer Experience Problems, Forrester Customer Experience Forum, New York and Los Angeles, 2012
- [17] **Albert, W.** (2012). How Quick Are We to Judge? A Case Study of Trust and Web Site Design, NYC Technology Council, New York City, 2012.
- [18] **Albert, W.** (2011). Are We usable? The State of User Experience Around the World (Panel), International Usability Professionals' Association Annual Conference, Atlanta, GA, 2011
- [19] **Albert, W.** (2011) . Usability of Personal Health Records: Current State and Moving Forward. HiMSS, Orlando, FL, 2011
- [20] **Hass, C., Engdahl, K., Albert, W., Setyawan, J., & Mateo, N.** (2010). Patient Preferences and Perceived Ease of Use in Inhaler Features: Genuair vs. Other Inhalers, CHEST 2010, Vancouver, Canada.
- [21] **Albert, W.** (2010). Shopping for Unmoderated Usability Testing Tools, UX Masterclass, Montreal, Canada, 2010
- [22] **Albert, W. & Tedesco, D.** (2010). Did You See that Thing? An Eye Tracking Study on the Reliability of Self-Reported Awareness Measures, Annual Conference of the Boston Chapter of the International Usability Professionals' Association, 2010

- [23] **Albert, W. & Dmitrieva, L.** (2009). Beyond the Usability Lab: Exploring Large Scale User Experience Research, Usability Marathon 2, Moscow, Russia, 2009 (remote presentation)
- [24] **Albert, W., Gribbons, W., & Almadas, J.** (2009). Pre-Conscious Assessment of Trust: A Case Study of Financial and Health Care Web Sites, Human Factors and Ergonomics Society 53 Annual Meeting, San Antonio, TX, 2009
- [25] **Albert, W.** (2009). Challenges in Large Scale Persona Projects (Panel), International Usability Professionals' Association Annual Conference, Portland, OR, 2009
- [26] **Albert, W.** (2009). Unmoderated Usability Testing: Experiences from the Field (Panel), International Usability Professionals' Association Annual Conference, Portland, OR, 2009
- [27] **Tullis, T. & Albert, W.** (2009). Tips and Techniques for Measuring the User Experience, Course to be presented at the ACM SIG/CHI Conference on Human Factors and Computing Systems, April 2009, Boston, MA
- [28] **Albert, W.** (2008). Subjective Ratings of Usability: Reliable or Ridiculous? (Panel), International Usability Professionals' Association Annual Conference, Baltimore, MD, 2008
- [29] **Albert, W. & Tullis, T.** (2008). Tips and Tricks for Measuring the User Experience. Mini-conference of the Boston Chapter of the Usability Professionals' Association, Waltham, MA, 2008
- [30] **Albert, W.** (2007). Looking into the Crystal Ball: The Future of Usability (Panel), International Usability Professionals' Association Annual Conference, Austin, TX, 2007
- [31] **Albert, W.** (2005). Do You Use (and Trust) Self-Reported Usability Measures? International Usability Professionals' Association Annual Conference, Montreal, Quebec, 2005
- [32] **Albert, W.** (2005). A Summative Approach to Discount Usability Testing. Mini-conference of the Boston Chapter of the Usability Professionals' Association, Natick, MA, 2004
- [33] **Albert, W.** (2003). Is this What You Expected? The Use of Expectation Measures in Usability Testing. Usability Professionals' Association Annual Conference, Scottsdale, AZ, 2003
- [34] **Albert, W.** (2002). Viewpoint-Dependent Representations During Spatial Orientation, MIT Center for Space Research, Man-Vehicle Laboratory, 2002
- [35] **Albert, W.** (2002). Do Web Users Really Look at Ads? A Case Study of Banner Ads and Eye-Tracking Technology, Usability Professionals' Association Annual Conference, Orlando, FL, 2002
- [36] **Albert, W. & Thornton, I.** (2002). The Effects of Speed Changes on Route Learning in a Desktop Virtual Environment, Spatial Cognition 2002, Lake Starnberg, Germany, 2002
- [37] **Albert, W.** (2001). Visual Attention Patterns of Web Users. Boston University School of Management, 2001
- [38] **Albert, W.** (1998). A Varenius workshop on Cognitive Models of Dynamic Geographic Phenomena and their Representations, University of Pittsburgh, 1998
- [39] **Albert, W.** (1998). The Role of Attention in Memory Conjunction Errors during Simulated Route Navigation. Annual Meeting of the Association of American Geographers, Boston, MA, 1998
- [40] **Albert, W.** (1997). Sex-Related Differences in the Use of Geographic Information Systems: The Map Overlay Operation, University Consortium for Geographic Information Science Summer Retreat, Bar Harbor, ME, 1997
- [41] **Albert, W.** (1997). The Effects of Spatio-temporal Disorder on the Acquisition of Relative Location Knowledge, Cognitive Mapping Symposium at the Annual Meeting of the Association of American Geographers, Fort Worth, TX, 1997
- [42] **Albert, W.** (1996). The Role of Attention in Learning Spatial Relationships during

- Navigation, Department of Psychology, University of California, Santa Barbara, CA, 1996
- [43] **Albert, W.** (1996). Accuracy and Distortions in Global Cognitive Maps, Annual Meeting of the Association of American Geographers, Charlotte, NC, 1996
 - [44] **Albert, W.** (1996). Assessing Undergraduate's Location Knowledge of the World and Factors in Individual Country Identification, Conference Proceedings of the Annual Meeting of the New England – St. Lawrence Valley Geographical Society, Ed: B. Middlekauff, Vol. 25, 1-9.
 - [45] **Albert, W.** (1995). Examining Cognitive Representations of Route and Survey Knowledge, International Young Scholars Summer Institute in Geographic Information, Wolfe's Neck, ME, July 1995
 - [46] **Albert, W.** (1995). The Role of Spatial Abilities in the Development of Route and Survey Knowledge, Annual Meeting of the Association of American Geographers, Chicago, IL, 1995
 - [47] **Albert, W.** (1994). Spatial Cognitive Considerations in Map Overlay Tasks, Annual Meeting of the Association of American Geographers, San Francisco, CA, 1994

Professional Workshops & Tutorials

- [1] **Albert, W. & Bhaskaran, V.** (2020). Driving Organizational Change through User Research, UX Insight 2020, Breda, The Netherlands, April, 2020
- [2] **Albert, W.** (2019). Measuring the User Experience, User Research London, London, UK, June, 2019
- [3] **Albert, W.** (2018). Measuring the User Experience, World Usability Congress, Graz, Austria, 2018
- [4] **Albert, W.** (2017). Measuring the User Experience, UX Hong Kong, 2017
- [5] **Albert, W.** (2015). Measuring the User Experience, UX India, Bangalore, India, 2015
- [6] **Albert, W.** (2013). Measuring the User Experience, UX Lisbon, 2013
- [7] **Albert, W.** (2012). Measuring the User Experience and Expanding (and Improving) your UX Toolkit, User Friendly China, Beijing, 2012
- [8] **Albert, W.** (2012). User Experience Metrics 101, LeanUX, Denver, 2012
- [9] **Albert, W.** (2012). Measuring the User Experience, Minnesota Chapter of the UPA, Minneapolis, 2012
- [10] **Albert, W.** (2012). Measuring the User Experience, New York City UPA, 2012
- [11] **Albert, W. & Tullis, T.** (2011). A Step-by-Step Guide to Online (Unmoderated) Usability Testing, Usability Professionals Association Annual Conference, Atlanta, 2011
- [12] **Albert, W. & Tullis, T.** (2008). Usability Metrics 101: Collecting, Analyzing, and Presenting Usability Data, Usability Professionals Association Annual Conference, Baltimore, June, 2008
- [13] **Albert, W. & Tullis, T.** (2007). Usability Metrics 101: Collecting, Analyzing, and Presenting Usability Data, Usability Professionals Association Annual Conference, Austin, June, 2007
- [14] **Albert, W. & Tullis, T.** (2006). "Usability Metrics: How to Measure Performance and Progress" (Usability Manager's Series, sponsored by the US General Services Administration), Washington, DC, 2006
- [15] **Albert, W. & Tullis, T.** (2005). Quantifying Web Usability, Nielsen Norman User Experience Conference, Boston and London, 2005

Editorial Service

- Co-Editor in Chief, Journal of Usability Studies, 2013 - Present
- Editorial board, Journal of Usability Studies, 2009 - 2013
- Adhoc reviewer for peer-reviewed journals:
 - International Journal of HCI
 - Journal of Business Research
 - Technical Communication

- Journal of Usability Studies
- Interaction with Computers
- Morgan Kaufmann Series in Interactive Technologies (Elsevier Publishers)
- Journal of Geography;
- Journal of Environmental Psychology
- Spatial Cognition and Computation

Awards and Fellowships

- Post-Doctoral Research Fellowship, Japan Key Technology Center, Japan Trust Fund, Tokyo, Japan, 1997
- Environmental Perception & Behavioral Geography Specialty Group Travel Award to attend the Cognitive Mapping Symposium, Fort Worth, TX, 1997
- Visiting Research Fellowship, National Center for Geographic Information & Analysis (funded by the National Science Foundation), University of California, Santa Barbara, CA, 1996
- Boston University Dean's Conference Travel Award, 1994 - 1996
- International Young Scholars Summer Institute in Geographic Information, Co-Sponsored by the National Science Foundation and European Science Foundation, Wolfe's Neck, ME, 1995

Professional Memberships

- Customer Experience Professionals Association (CXPA)
- ACM SIG/CHI
- Greater Boston SIG/CHI
- User Experience Professional Association (UXPA)
- Boston Chapter of the User Experience Professional Association
- Human Factors and Ergonomic Society (HFES)

Reviewer 3

NAME: NARAYANAN N KULATHU RAMAIYER

Director, Institute of Social Informatics and Technological Innovations, Universiti Malaysia Sarawak

NATIONALITY: Malaysian

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WEBSITE: <https://expert.unimas.my/profile/130>

EDUCATION AND ACADEMIC QUALIFICATIONS

Ph D in Computer Science, Graz University of Technology, Austria 2008

Master of Science in Computer Science, Universiti Sains Malaysia 1989

Bachelor of Computer Science, Universiti Sains Malaysia 1988

PROFESSIONAL CERTIFICATION

International TRIZ (MATRIZ) Level 3 Practitioner 2018

Malaysian TRIZ Level 3 Practitioner 2016

Malaysian TRIZ Level 1 Trainer 2016

HRDF Certified Trainer No. 5066, 2017-current

Malaysian TRIZ Instructor Level 2, 2019-current

Malaysian TRIZ Consultant, 2019-Current

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WORKING EXPERIENCE

Position	Period
Director, Centre for Social Innovation, Digital Sarawak COE	March 2018- current
Director, Institute of Social Informatics & Technological Innovations	March 2016- current
Professor, Faculty of Computer Science and Information Technology	Nov 2008- current
Visiting Professor, Graz University of Technology, Austria	Jul 2014-Sept 2014 Dec 2014- March 2015
Visiting Professor, Braunschweig University of Technology, Germany	Oct 2014-Nov 2014
Dean, Faculty of Computer Science & Information Technology	Oct 2008-Dec 2013
Adjunct Professor, Cape Peninsula University, South Africa	July 2007 – 2009
Associate Professor, Faculty of Computer Science and Information Technology	Oct 2000- Oct 2008
Dean, Faculty of Information Technology, Universiti Malaysia Sarawak	Nov 2001- Sept 2006
Head, Centre for Applied Learning & Multimedia, Universiti Malaysia Sarawak	Oct 1999- Oct 2001
Deputy Dean, Faculty of Computer Science and Information Technology (Postgraduate Studies), Universiti Malaysia Sarawak	July 1999-Sept 1999
Programme Head, UNIMAS Virtual Campus, Universiti Malaysia Sarawak	Nov 1997-June 1999
Programme Head of Computer Systems Technology & Computational Science, Universiti Malaysia Sarawak	March 1996 - Oct 1997
Lecturer, Universiti Malaysia Sarawak	Feb 1994 to Sept 2000
Senior Lecturer, International Computers Ltd (M)	Oct 1993-Jan 1994
Lecturer, International Computers Ltd (M)	Sept 1991-Sept 1993
Research Officer, AI Lab., Universiti Sains Malaysia	Sept 1989 - Aug 1991

AWARDS

- Silver Medal, Malaysian Technology Expo (MTE) Awards, “Co-Design Tool for Pusat Internet”, 2020
- Shortlisted for Times Higher Education Asia Technology Innovation of The Year, “Telecentre Program for Orang Asli”, Awards, 2019
- Academic Excellence Award (Anugerah Tokoh Akademik UNIMAS) , MAGU, April 2018
- UNIMAS Excellence Award (Anugerah Khas MAGU) , “eBario”, 2017
- Gold medal, TRIZ based co-design tool for Pusat Internet Centers, UNIMAS Innovation Awards (INTEX), July 2019
- The Third ASEAN Leadership Award on Rural Development and Poverty Eradication, “e-Bario”, Ministry of Rural and Regional Development (ASEAN) & Secretary General (ASEAN), 6th October 2017
- Silver Medal, Malaysian Technology Expo (MTE) Awards, “Ensemble and Hybrid Computational Intelligence”, February 2016
- Gold Medal - UNIMAS R&D Expo (INTEX) “Digitising and Preserving Oroo’ A secret signage language”. April 2015, UNIMAS.
- Gold Medal, Malaysian Technology Awards, “Integrated Organisational Learning Management Environment”, February 2014
- Silver Medal, Malaysian Technology Awards, “Indigenous Knowledge Governance Framework”, February 2014
- Asia Pacific APICT Merit Award, “eTORO-Indigenous Botanical KMS of Penans”, November 2013

- Silver Medal - PECIPTA 2013 (International Conference and Exposition On Invention of Institutions of Higher Learning). "eTORO-Indigenous Botanical KMS of Penans . Nov 2013, Kuala Lumpur
- Bronze Medal - PECIPTA 2013 (International Conference and Exposition On Invention of Institutions of Higher Learning). "Ecodemia: Integrated Organization Learning Management System", Nov 2013
- Gold Medal - UNIMAS R&D Expo. "eCourse Outline System for Institute of Higher Learning". 19 March 2013, Dewan Mutiara, Detar Putra, UNIMAS.
- Information Society Innovation Fund (ISIF Asia) Award, "eTORO-Indigenous Botanical KMS of Penans", 2013
- Highest National R&D grant award, UNIMAS Awards (MAGU), 2013
- Gold Medal, UNIMAS Research Awards, eTORO: Formalising Indigenous Knowledge Governance Framework, 2013
- Gold Medal, UNIMAS Research Awards, Integrated Organisational Learning Management Environment, 2013
- Penghargaan Harta Intelek UNIMAS 2012, Kategori HakCipta, Semantic Image Analysis Toolkit, September 2012
- Shortlisted for Anugerah Inovasi Nasional (National Innovation Award), Services Innovation, World Innovation Forum, KL, November 2012
- Anugerah Inovasi Naib Canselor (Vice Chancellor's Innovation Excellence Award) for Best Achievement in Quality Assurance, E-Course Outline, 2012
- Bronze Medal, PECIPTA R&D Expo, Semantic Clustering Workbench, 2011
- Silver Medal, UNIMAS Research Awards, Semantic Clustering Workbench, 2011
- Bronze Medal, UNIMAS Research Awards, Discovering Useful Concepts from Text, 2011
- Bronze Medal, UNIMAS Research Awards, Automated Construction of WordNet for Indigenous Language, 2011
- Pingat Perkhidmatan Setia (Loyalty Service Medal), UNIMAS, 2010
- Gold Medal, Commonwealth Association of Public Administration and Management (CAPAM) International Innovations Awards, Sydney, 2006
- Special Award, Swiss Government Special Award for Information Solution, Geneva, 2006
- Gold Medal, Intelligent Image Finder, Geneva, 2006
- Bronze Medal, IPTA R&D Expo, Image Finder, Content Based Image Retrieval, 2005
- Certificate of Merit, Contributions towards E-Learning in UNIMAS (2004)
- Excellent Service Medal, UNIMAS - (1998) (2002) (2003) (2004) (2006) (2007) (2010)
- Travel Grant award: Pacific Rim International Conference on AI, 19 July 1990

IP REGISTRATION (Patent/Copyright)

1. Organisational Learning Management Environment for IHL, UNIMAS Centre of Technology Transfer and Consultancy, 2013
2. Organisational eTORO: Formalizing Indigenous Knowledge Governance Framework, UNIMAS Centre of Technology Transfer and Consultancy, 2013
3. Semantic Image Analysis Toolkit, UNIMAS Centre of Technology Transfer and Consultancy, 2011
4. Extracting natural language description for making sense of images, UNIMAS Innovation, 2014
5. Indigenous Knowledge Governance Framework, UNIMAS Innovation, 2012

6. Trademark: e-Borneo Logo, UNIMAS Innovation, UNIMAS/IP/T2016(01), UNIMAS/IP/T2016(02) 2016
7. Development and Evaluation of Digital media Training 2.0 (DEDT 2.0) Program UNIMAS/IP/C2018(25) (Registration Number: LY2018004064) 2018
8. Development and Evaluation of Digital media Training (DEDT) Program UNIMAS/IP/C2018(24) (Registration Number: LY2018004062)
9. Lightweight Model for Self-Sustaining Community Based Co-Design Portal UNIMAS/IP/C2019(26) (Registration Number: LY2019006240)
10. Inventive Trigger Cards, 2018

ADMINISTRATIVE DUTIES AND OTHER RESPONSIBILITIES

International Level

- Advisory Board Member, UK Research and Innovation for Global Challenge Research Fund (UKRIGCRF), 2019-
- Senior Fellow, The Information Society Institute (TISI), 2011-2013
- Editor in Chief, Journal of Universal Computer Science, 2009-2015
- Ambassador, eSkills Summit South Africa 2009-2010
- Member, The Information Society Institute 2009-2011
- Director, Web Intelligence Consortium Malaysian Research Lab 2005-2013

National and State-Level

- Committee member, Saberkas Science, Technology and innovation, Sarawak State 2013-2016
- Panel member, Technical Evaluation Committee on Science and Techno Fund (ICT Cluster), MOSTI, 2012-2014
- Board of Computing Professional, Special Taskforce Member, (MOSTI) 2012-
- Team Leader of Taskforce on Computing in School, 2012-
- Deputy Chairman, National ICT Dean's Council (MADICT), 2012-
- Member of Expert Panel, National Science and Research Council, 2011-2014
- Board of Computing Professional, Protem Committee Member, (MOSTI) 2010-2014
- National IT Council Working Group, Expert Panel on Human Resource and Research, 2011-2014
- National IT Council Working Group, Expert Panel on Technology and Innovations Ecosystem, 2011-2014
- MQA Assessor PhD in Computer Science, Malaysian University of Science and Technology, 2011
- Committee Member of ICT Cluster, National Professors Council (MPN), 2010-2014
- Taskforce and Secretary, National ICT Human Resource, July 2009- current
- Steering Committee, National Citation Centre, 2009-current
- Member of National ICT Deans Council, (MADICT) (2003-2006) (2008-2014)
- MQA Assessor for Computer Science, 2008-current
- Advisor, MIMOS-UNIMAS, Semantic Technology Centre of Excellence, 2009
- Member of Expert Panel, MSc In Mobile Computing, University Technology Petronas. 2004
- Member of Assessor Panel for Quality Assurance Department of Ministry of Higher Education 2004, 2007-current
- Chairman of Industry Standards Committee for Information Technology ISCG Technical Committee 6, on Graphics and Multimedia, Department of Standards, Malaysia (2004-) [member since 2002]
- Member of National ICT Panel on Standardization of ICT Curriculum (2002-2004)

- Member of the Strategic Thrusts Implementations Committee , E-learning Working Group (1999-2001)
- Secretariat for the National Information Technology Council, E-learning Working Group (1998-1999)

University-level

- UNIMAS Lead, Malaysian Research and Educational Network (MYREN), 2012-2014
- Judge, UNIMAS Research Expo, 2012, March 2012
- Chairman, Taskforce of Webometrics, UNIMAS, 2011-2014
- Chairman, Expert Panel on Technology & Engineering, UNIMAS, 2011-2014
- Senior Fellow, Centre of Excellence on Rural Informatics, UNIMAS, 2009-
- Advisor, Strategic Planning Taskforce, UNIMAS, 2006-2008
- Member of Technical Committee for Information Services (TECIS), Universiti Malaysia Sarawak [member since 2000]
- Chairman of Technical Committee for Information Services (TECIS), Universiti Malaysia Sarawak (2003-2006)
- Chairman of Network Infrastructure Taskforce (2003-2004)
- Member of Expert Panel on Information Technology & Engineering, Unimas (2002-2006)
- Knowledge Systems Core Group Leader (2002-2006)
- Member of Senate & Dean's Council, University Malaysia Sarawak (2001-2006)
- Steering Committee Member of Testbed on Multimedia networking (TEMAN-2) project (2000-2001)
- Programme Coordinator, MSc in Advanced IT programme (1997-1999)
- Head of Virtual Campus Technical Team, Online Education Committee
- Pioneer Chairman, Computer Systems Technology Board of Studies 1996-1997
- Pioneer Chairman, Computational Science Programme Board of Studies 1996-1997

CONSULTANCY WORK

Projects:

1. Cornell University Global Citizenship & Sustainability Service Learning Programme, 2016-2019
2. Team member, Zika disease modelling, AIME, Inc. USA, 2016
3. Academic Advisor, Universiti Malaysia Terengganu, Postgraduate Programmes, 2014-2016
4. Academic Advisor, Universiti Utara Malaysia, Degree Programmes, 2014-2015
5. Academic Advisor, Mutiara Indonesia International Foundation, Jakarta, (2012-
6. Taylors University, Diploma and Foundations Programme, External Examiner (2012-)
7. MQA Auditor, Malaysian University of Science and Technology, MOHE, (2011-current)
8. SMS-SCORE HR Portal, by Sarawak Government (2009-2010)
9. MQA Auditor, Creative Multimedia PhD Program, MOHE, 2010
10. Knowledge Innovation Project, Shell Holland, Collaborator, (2008-2009)
11. Study of Danger of Web Search Engine, Consultant Researcher (2007)
12. ICT Blueprint for Sarawak, Sarawak Development Institute (2006-2007)
13. Evaluation Study of ICT Community Project, by Malaysian Communications and Multimedia Commission in Rumah King (2006)
14. K-Readiness Index for Sarawak (KRIS) Phase 2- Sarawak Development Institute, Technical Consultant (2006-2007)

15. Steering Committee member for GIS/GPS Systems Development for SALCRA, (2004- 2006)
16. K-Readiness Index for Sarawak (KRIS) – Sarawak Development Institute, Technical Consultant (2004-2005)
17. Multimedia Grant Scheme- Multimedia Development Corporation, Technical Consultant (2004)
18. Multimedia College Programme Management Committee, Advisor, Board of Studies (2004-current)
19. UNIMAS Permanent Campus Project, Internal IT Consultant (2000-2002)
20. Expert System for the Troubleshooting of Mobile Telephones (1989-90), Consultant

Member of Professional Bodies

- MyTriz Malaysian TRIZ Innovation Society, Committee Member (2011-current)
- TRIZ Level 2, Practitioner, MyTriz Malaysia
- Web Intelligence Consortium
- Japan International Co-operation Agency Alumni Society
- Malaysian National Computer Confederation
- Association for Computing Machine Professional
- Sarawak Development Institute ICT Committee Member
- Malaysian Research and Educational Network (MYREN) Research Committee

Technical Committees

Member of the Editorial Board: (Journal/Encyclopedia/Newsletter)

- Editorial Board Member, Journal of Universal Computer Science, Technological University Graz, 2006-current
- Reviewer, Journal of IT and Multimedia, Universiti Kebangsaan Malaysia (JITM) 2005
- International Advisory Board, Encyclopedia on Developing Regional Communities with ICT, 2004-current
- International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2004-current
- Editorial Board, UNIMAS Info SERV Newsletter, Issues 10-12, 2001-current
- International Advisory Board, Malaysian Journal of Distance Education, School of Distance Education, University Sains Malaysia. (2001- current)
- International Multidisciplinary Journal of Business & Society, Association of Business Scholars' Publication (2000-2002)

Member of the Technical Committee (Conference/Symposium/Workshops)

1. Programme Committee Member, International Conference on Computing, Communication and Network (ICCCN 2013), Chennai Institute of Technology, Chennai, India in association with IEEE & Computer Society of India, 15th - 17th March 2013
2. Programme Committee, JUCS 2012: VW JUCS 2012 Special Issue: Virtual Worlds for academic, organizational, and life-long learning, 2012
3. Programme Committee Member, AI Workshop, Kuching, Programme Committee, International Workshop on Collaboration and Intelligence in Blended Learning (CIBL-2012) September 3-4, 2012
4. Technical Programme Committee, DFmA 2012 Distributed Frameworks and Applications, Universiti Sains Malaysia, Penang, Malaysia from 5 - 6 July 2012.
5. Technical Programme Committee Member, MUSIC2012
6. Technical Advisory Board, "Recent Trends in Application of Mechanical, Electrical, Electronics and Computer Communication" on April 12th-13th 2012, Tirunelveli, India

7. Programme Committee Member, ICIMT 2011, 3rd International Conference on Information and Multimedia Technology (ICIMT 2011) December 2011
8. General Chair, The 4th IEEE International Conference on Cyber, Physical, and Social Computing <http://cpscom.org/> Dalian, China, October 19, 2011
9. Executive Chair, The International Workshop on Internationalization of Products and Systems, IWIPS 2011,
10. Advisor, Conference on IT in Asia, Kuching, 2011
11. ICBL2011 is the fourth international ICBL conference and took place on November 2-4, 2011, 11 - 14 July 2011 in Kuching, Malaysia
12. International Committee, International Conference on Engineering and Applied Science, Beijing, China, July 24-27, 2012 <http://www.iceas2012.org>
13. Programme Committee, Member, The First International Conference on Creative Content Technologies, Athens, Greece, 2009
14. Programme Committee, Member, The First International Conference on Advanced Cognitive Technologies and Applications, Athens, Greece, 2009
15. Technical Committee Member, Inaugural International Conference on Virtualization and Cloud Computing, Singapore, 2009
16. Programme Committee, I-Know 09, Graz, Austria September 2009
17. International Conference on Interactive Computer-Aided Learning, Villach, Austria, September 2009
18. Programme Committee, ICAET AI Conference, Kuala Lumpur, 2009
19. Programme Committee, Conference on IT in Asia, Kuching, 2009
20. Programme Committee, Virtual Worlds for academic, organizational, and life-long learning ViWO 2009, Amman, Jordan, April 2009
21. Programme Committee, Malaysian Indonesian Joint Symposium on Language Technology, MALINDO, 2009
22. Technical Committee Member of Franco-Malaysia Conference on Multimedia, DFMA 08, Penang, Malaysia, 2008
23. Technical Committee Member, Knowledge Management International Conference, KMICE June 2008,
24. Programme Committee, Malaysian Indonesian Joint Symposium on Language Technology, MALINDO, 2007
25. Technical Committee Member of Franco-Malaysia Conference on Multimedia, DFMA 07, Besancon, France, 2007
26. Member of Advisory Committee, Third International Conference on Artificial Intelligence and Applications in Engineering and Technology ICAIET 2006, November 2006
27. Programme Committee Member, International Conference on Web Engineering, California, USA July 2006
28. Technical Committee Member of Franco-Malaysia Conference on Multimedia, Penang, Malaysia, May 2006
29. Malaysian Software engineering Conference, (MYSEC'05) December 2005
30. Programme Committee Member 6th MIMOS Annual Technical Symposium on ICT and Microelectronics, November 2005. Programme Committee Member, International Conference on Web Engineering, Sydney, Australia August 2005
32. Technical Committee Member of Franco-Malaysia Conference on Multimedia, Besancon, France, February 2005
33. International Technical Committee Member for the Special Session on Advances in Intelligent Data Processing Techniques and Applications at the 8th International Conference on Knowledge-Based Intelligent Information & Engineering Systems (KES2004)

34. Technical Programme Committee Member, 5th International ItiRA Information Technology in Regional Areas Conference 2003, Caloundra, Queensland Australia 15 - 17 December 2003
35. Programme Committee Member 4th MIMOS Annual Technical Symposium, 2002.
36. Programme Committee Member, Conference on Information Technology in Asia: "Advanced ICT for the new Millennium", Kuching, 2001
37. Programme Chair, Symposium on Online Education, Kuala Lumpur 2001 (SOLE2001)
38. Programme Committee Member, Conference on Information Technology in Asia: Information Equality for the next millennium, Kuching, 1999
39. Programme Committee Member, International Conference on Computers in Education ICCE 99, Taiwan, 1999
40. Programme Committee Member, International Conference on Computers in Education ICCE 98, Beijing, 1998
41. Programme Committee Member, International Conference on Computers in Education ICCE 97, Kuching, 1997

Conference / Workshops Organisation

1. Organizing Chair, e-Borneo Knowledge fair (eBKF) 2019
2. Organizing Chair, e-Borneo Knowledge fair (eBKF) 2017
3. Advisor, Conference on Information Technology in Asia: "Human Centered Computing", Kuching, 2009
4. Advisor, Conference on Information Technology in Asia: "Social Computing", Kuching, 2007
5. Programme /Chair, International Symposium on ICT for Rural Development, Kuching 2006
6. Organizing Chairman, Conference on Information Technology in Asia: "Ubiquitous and Pervasive Computing", Kuching, 2005
7. Organizing Chairman, Conference on Information Technology in Asia: "Transforming Knowledge into Insight", Kuching, 2003
8. Co-organizer, Advanced GIS Workshop, Kuching 6-7 March 2003
9. Workshop Co-Chair, Conference on Information Technology in Asia, Kuching, 2001
10. Workshop Chair, Conference on Information Technology in Asia, Kuching, 1999

Community Service and Social Activities

1. State Coordinator, Sri Sathya Sai Baba Central Council, 2009-2015
2. Education in Human Values Teachers Training, Team Leader, 2002-2018
3. Human Values Programme, Trainer, 1995-current
4. Silver Medal, Veteran Futsal, UNIMAS Sports Carnival, 2011
5. Global Conference on Computing Ethics, Organizing Committee, Feb 2012

Publications

Published Work (in Impact and Indexed Journals)

1. van Gevelt, T., Abok, H., Bennett, M. M., Fam, S. D., George, F., Kulathuramaiyer, N., & Zaman, T. (2019). Indigenous perceptions of climate anomalies in Malaysian Borneo. *Global Environmental Change*, 58, 101974. [ISI impact factor 10.74]
2. Pariyar, A., Kulathuramaiyer, N., Abdullah, B. J., & KeeMan, C. (2019). Contextualizing Learning for Rural Community using Library-in-a-Box: Experience from Penan Community. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 8 (8).
3. Pariyar, A., Kulathuramaiyer, N. (2019) Community Engagement to Gender Differentiated Impacts of Climate Change in Social Media. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 8 (8).

4. Tabassum, G., Kulathuramaiyer, N., Harris, R., & Yeo, A. W. (2019). The indirect and intangible impacts of a telecentre on a rural community. *The Electronic Journal of Information Systems in Developing Countries*, e12087.
5. Iboi, H., Chua, S., Ranaivo-Malançon, B., & Kulathuramaiyer, N. (2017). Performance of Opinion Summarization towards Extractive Summarization. *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, 9(2-10), 57-64.
6. Kulathuramaiyer, N., How Social Networks will change Research, IPSI BgD Transactions, IPSI BgD Transactions on Internet Research (TIR), Vol 12. No. 1, pp. 15-20, January 2016
7. Mehmood, R., Maurer, H., Kulathuramaiyer, N., A new look at the geography of the World, IPSI BgD Transactions, IPSI BgD Transactions on Internet Research (TIR), Vol 12. No. 1, pp. 21-30, January 2016
8. Atoum, I., Bong, C. H., & Kulathuramaiyer, N. (2015). Building a Pilot Software Quality-in-Use Benchmark Dataset. *arXiv preprint arXiv:1509.05736*.
9. Zaman, T., Kulathuramaiyer, N., Yeo, A. W., & Falak, H. (2015). Modelling indigenous knowledge creation as a living system. *International Journal of Knowledge Management Studies*, 6(2), 136-150.
10. Kulathuramaiyer, N., Maurer, H., (2015) A Survey of Communication and Collaborative Web Technologies, Journal of Computing and Information Technology - CIT 23, Special Issue on Emerging Web Technology and Applications, 1-18
11. Javed, A., Chai, W. Y., Alenezi, A. R., & Kulathuramaiyer, N. (2015). Fully Automatic Detections of Abnormalities of Brain MR Images by utilizing Spatial Information and Mathematical Morphological Operators. *Appl. Math.* 9(1), 213-222.
12. Atoum, I., Bong, C. H., & Kulathuramaiyer, N. (2014). Towards Resolving Software Quality-in-Use Measurement Challenges. *Journal of Emerging Trends in Computing and Information Sciences*, 5(11), 877-885.
13. Kulathuramaiyer, N., Maurer, H., & Mehmood, R. (2014). Some Aspects of the Reliability of Information on the Web. *Journal of Universal Computer Science*, 20(9), 1284-1303. [Impact Factor, 0.5]
14. Javed, A., Chai, W. Y., Alenezi, A. R., & Kulathuramaiyer, N. (2014). Enhancement of Magnetic Resonance Images Using Soft Computing Based Segmentation. *International Journal of Machine Learning & Computing*, 4(1).
15. Zaman, T., Yeo, A. W., & Kulathuramaiyer, N. (2014). Knowledge Management in Nonprofit Settings: A Case Study of Indigenous Knowledge Management. *International Journal of Public Administration in the Digital Age (IJPADA)*, 1(4), 44-51.
16. Javed, A., Alenezi, A.R., Wang, Y.C., Kulathuramaiyer, N., Diagnosis System for the Detection of Abnormal Tissues from Brain MRI, Life Science Journal, Volume 10, Issue 2, MARS LAND Press USA. 2013.
17. Javed, A., Wang, Y.C., Kulathuramaiyer, N., Javed, M.S., Alenezi, A.R., Automate Segmentation of Brain MR Images by Combining Contourlet Transform and K-Means Clustering Techniques, Journal of Theoretical & Applied Information Technology (JATIT), volume 54 issue 1, 2013. <http://www.jatit.org/volumes/Vol54No1/11Vol54No1.pdf>
18. Zaman, T., Yeo, A. W., Kulathuramaiyer, N., Augmenting Indigenous Knowledge Management with Information and Communication Technology. *International Journal of Services Technology and Management*. 2013
19. Zaman, T., Yeo, A. W., Kulathuramaiyer, N., Indigenous Knowledge Management in the Kelabit community in Eastern Malaysia: insights and reflections for contemporary KM design. *International Journal of Sociotechnology and Knowledge Development*, 2013.

20. Hiong, S. N., Kulathuramaiyer, N., & Labadin, J. 2012. Towards structure-based paraphrase detection using discourse parser. *Journal of Information Retrieval and Knowledge Management* 2:96-103.
21. Zaman, T., Kulathuramaiyer, N., & Yeo, A. W. , Balanced Scorecard for performance measurement and strategic planning of indigenous knowledge management. *Knowledge Management for Development Journal*, 7(3), 317-326. 2011 doi: 10.1080/19474199.2011.652140117
22. Lim, P.C, Kulathuramaiyer, N., D.N.F, Awg. Iskandar, Semantic Clustering-A Brief Overview, *Journal of Image Processing*, Vol. 4, No 6, 2011
23. Afzal, M.T., Balke, W.-T., Maurer, H., Kulathuramaiyer, N., Rule based Autonomous Citation Mining With TIERL, *Journal of Digital Information Management*, Vol. 8, No. 10, pp. 196-204, 2010 <http://www.dirf.org/jdim/v8i3.asp>
24. Abdelhamid, A., Wang, H.H., Kulathuramaiyer, N., Spiral Bit-string Representation of Color for Image Retrieval, *International Arab Journal of IT*, Vol. 7, No 3., pp. 223-230, 2010 [ISI Impact] <http://www.ccis2k.org/iajit/PDF/vol.7,no.3/654.pdf>
25. Kulathuramaiyer, N., Zaka, B., Integrated Multimodal Copy-Paste Checking, *Journal of Software*, Vol. 4, No. 6, Academy Publisher, pp. 521-528, 2009 <http://www.academpublisher.com/ojs/index.php/js/article/viewFile/0406521528/1082>
26. Khan, S., Kulathuramaiyer, N., Maurer, H., Application of Mashup for a Digital Journal, *Journal of Universal Computer Science*, Vol. 14, No. 10, pp. 1695-1716, 2008 http://www.jucs.org/jucs_14_10/applications_of_mash_ups [ISI impact factor 0.48]
27. Kulathuramaiyer, N., Maurer, H., Addressing Copy-Paste with ICARE, *Journal of Research in Innovative Teaching*, Vol. 1, No. 1, National University, CA, USA, pp. 1-24, 2008 http://www.nu.edu/assets/resources/pageResources/Journal_of_Research_March081.pdf
28. Afzal, M.T., Kulathuramaiyer, N., Maurer, H., Creating Links into the Future, *Journal of Universal Computer Science*, Vol. 13, No. 9, pp. 1234-1245, 2007 http://www.jucs.org/jucs_13_9/creating_links_into_the [ISI impact factor 0.48]
29. Kulathuramaiyer N., Maurer, H., Fighting Plagiarism and IPR Violation: Why is so Important ?, *Learned Publishing*, Vol. 20. No. 4, pp. 13-19, 2007 [ISI impact factor 0.5] <http://www.ingentaconnect.com/content/alpsp/lp/2007/00000020/00000004/art00003>
30. Kulathuramaiyer N., "Mashups: emerging application Development paradigm for a Digital Journal", *Journal of Universal Computer Science*, Vol. 13 No. 4 pp. 531-543, 2007 [ISI impact factor 0.48] http://www.jucs.org/jucs_13_4/mashups_emerging_application_development
31. Kulathuramaiyer N., Balke, W.T. Restricting the View and Connecting the Dots - Dangers of a Web Search Engine Monopoly, *Journal of Universal Computer Science*, Vol. 12, No. 12, pp. 1731-1740, 2006 [ISI impact factor 0.48] http://www.jucs.org/jucs_12_12/restricting_the_view_and

Published Works (Book Chapters)

1. Pariyar, A., Kulathuramaiyer, N. (2020) Towards Participatory MOOCs in Traxler J., (Eds.) "Critical Mobile Pedagogy: Cases of Inclusion, Development, and Empowerment." To be published by Routledge
2. Hiong, S. N., Ranaivo-Malançon, B., Kulathuramaiyer, N., & Labadin, J., 2015. Inducing a Semantically Rich Nested Event Model. *SoMeT 2014, Communications in Computer and Information Science (CCIS) 513 Book Series*. Springer Link.
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Google Scholar H-Index	: 11

Publications:

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Awards

- Education Leadership Award, Asia's Education Leadership Award, 2019.
- 251 Fabulous Professors, World Education Congress, 2019
- 100 Most Dedicated Professors, World Education Congress, 2018
- Best Professor in Multimedia Technology, The Golden Globe Tigers Awards, 2018 • Education Leadership Award, Asia's Education Leadership Award, 2018.
- ITEX Gold Awards: 2016, 2012
- ITEX Silver Awards: 2014, 2012, 2018
- PECIPTA Silver Awards: 2015
- PECIPTA Bronze Award: 2017
- MTE Best Awards: 2013
- MTE Gold Awards: 2013
- MTE Silver Awards: 2012
- Excellence Service Awards: 2003, 2005, 2013

Professional Membership

- 2018 – current, Professional Technologist, Malaysia Board of Technologist.
- Lifetime, Member, MyHCI-UX
- 2014 – 2017, member, IRCA QMS 2008 Auditor Association
- 2014 – 2015, Member, Scientific Papers.org
- lifetime membership – Internet Society Malaysia Chapter
- 2010 – current, Member, Internet Society Global

Reviewer 5

Nationality: Nigerian

CV Not Available (Anonymity)

Reviewer 6

Engr. Prof. Anthony N. Nzeako

Dean, Faculty of Engineering

Veritas University, Abuja

Nationality: Nigerian

Educational Institutions Attended

- Catholic University, Nijmegen, The Netherlands (1971-1976)
- Twente University of Technology, Enschede, The Netherlands (1969-1971)
- Leningrad Polytechnic Institute, Leningrad, USSR (1963-1969)

- Federal Emergency Science School, Onikan, Lagos, Nigeria (1961-1963)
- P & T Technical School, Oshodi, Lagos, Nigeria (1960-61)
- Holy Family College, Abak, Akwa-Ibom State, Nigeria (1955-59)

Academic Qualification

- Ph. D. (1976): Systems Engineering, Catholic University, Nijmegen, The Netherlands
- M. Sc. (1969): Electrical Engineering (Automation & Telemechanics Option): Leningrad Polytechnic Institute, (former) Leningrad, USSR.
- GCE A Level (London) (1963): Three Papers (Maths, Maths, Physics) Passed at a Sitting
- WAEC (Grade I) (1959)

Professional Qualification

- Chartered Engineer (COREN R. 5026), 1992.

Membership of many National & International Professional Bodies, including:

- Nigerian Society of Engineers (NSE)
- Institute of Electrical and Electronic Engineers (IEEE)
- International Association for Continuing Engineering Education (IACEE)
- American Society for Engineering Education (ASEE)

Working Experience

- Professor, Dept. of Computer Science/Mathematics, Novena University, Ogume, Delta State, Nigeria (Jan. 2016 – July, 2018)
- Professor, Department of Electrical/Electronic Engineering, Cross River University of Technology, Calabar, Cross River State, Nigeria (Jan. 2010 – Dec. 2015)
- Visiting Scholar, Dept. of Computer Engineering, University of Ghana, Legon, Accra, Ghana (2012/2013)
- Professor of Electronic Engineering, UNN (1992-2009)
- Senior Lecturer, Dept. of Electronic Engineering, UNN (1982-1992)
- Lecturer I, Dept. of Electrical/Electronic Engineering, UNN (1976-1981)

Administrative Experience

- Dean, Faculty of Engineering, Cross River University of Technology, Calabar, Cross River State, Nigeria (Jan. 2011 – Dec. 2015)
- Head, Department of Electrical/Electronic Engineering, Cross River University of Technology, Calabar, Cross River State, Nigeria (Jan. 2010 – Dec. 2010)
- Dean, Faculty of Engineering, University of Nigeria, Nsukka [UNN]. (2002-2004)
- Associate Dean, Faculty of Engineering, UNN (1990-1992)
- Head, Dept. of Electronic Engineering, UNN (2004/5)
- Acting Head, Dept. of Electronic Engineering, UNN (1986-1989)
- Founding Director, Computer Communications Centre, UNN (1992-2000)
- Founding Coordinator, UNN-TU Delft Linkage (2005-2010); TU Delft is Delft University of Technology in the Netherlands

Publications

- Journal Articles: Author and Co-Author of well over 150 journal articles in diverse disciplines in reputable national and international journals.

Most Recent Publications

1. Ani, Vincent Anayochukwu and Nzeako, Anthony Ndubueze (2013). "Potentials of Optimized Hybrid System in Powering Off-Grid MacroBase Transmitter Stations Site". *International Journal of Renewable Energy Research (IJRER)* Vol. 3, No. 4.
2. Ani, Vincent Anayochukwu and Nzeako, Anthony Ndubueze (2012). "Energy Optimization at GSM base Station Sites Located in Rural Areas". *International Journal of Energy Optimization and Engineering (IJEEO)* Vol. 1, No. 3. DOI: 10.4018/ijeoe.2012070101 Publisher IGI Global
3. Ani, Vincent Anayochukwu, Nzeako Anthony Ndubueze and Obianuko Jonathan Chigbo (2012). "Energy Optimization at Data centers in Two Different Locations of Nigeria". *International Journal of Energy Engineering* 2012; Vol. 2 No. 4: (151-164) DOI: 10.5923/j.ijee.20120204.07 Scientific & Academic Publishing (SAP).
4. Ani, Vincent Anayochukwu and Nzeako, Anthony Ndubueze (2012). "The potential of Stand-Alone PV/Wind hybrid Energy System for Power Supply to Remote Rural Areas in Nigeria". *International journal for clean environment* 13(
5. Mamilus A. Ahaneku, Anthony N. Nzeako, Udora N. Nwawelu (2015). "Investigation of Electromagnetic Radiations by GSM Base stations in Nigeria for Compliance Testing", *Advances in Physics Theories and Applications*, Vol. 47, Pp.10-17, 2015. www.iiste.org
6. Mamilus A. Ahaneku, Anthony N. Nzeako, Udora N. Nwawelu (2014). "Assessment of Radiation Variations with Distance in the Vicinity of GSM Base Stations". *International Journal of Scientific and Engineering Research*. Vol. 5, Issue 4. April, 2014.
7. Ahaneku, M. A; Nzeako, A.N (2012): "GSM Base Station Radiation Level: A case Study of University of Nigeria Environment". *International Journal of Scientific Technology and Research*. Vol. 1, issue 8. Pp. 102-107.
8. Ifeoma B Asianuba and Anthony N. Nzeako (2016). "Radiation Pattern of a Uniform Linear Array of Wire Antennas". *International Journal of Scientific and Engineering Research (IJSER)* vol. 7, issue 6, June 2016.
9. Asianuba, I. B., Nzeako, A. N. and Sapreobi, E. (2014). "Methods of Moments for Antenna Analysis" *International Journal of Applied Sciences and Engineering Research* vol. 3, issue 1, 2014.
10. Emechebe, Jonas N. Otavboruo, Ericsson E, Ani, C. I & Nzeako, A. N. (2013). "Lightning Protection System: A Comparative Analysis of Four Modified Models" *International Journal of Electronics and Communication Engineering (IJECE, ISSN 2278-9901)*, Vol. 2, Issue 5, Nov. 2013.
11. Emechebe, Jonas N. Otavboruo, Ericsson E, Nzeako, A. N. & Ani, C. I. (2014). "Comparative Analysis of Original and Modified Lightning Protection Systems". *International Journal of Electronics and Communication Engineering (IJECE, ISSN 2278-9901)*, Vol. 3, Issue 2, Mar. 2014.
12. Emechebe, Jonas N. Otavboruo, Ericsson E, Nzeako, A. N. & Ani, C. I. (2014). "The Improved Rolling Ball Model (IRBM) for Lightning Protection Systems". *International Journal of Electronics and Communication Engineering (IJECE, ISSN 2278-9901)*, Vol. 3, Issue 5, Sept. 2014