Investigating an Interactive Technological Self Study Conceptual Framework for On-board Maritime Education and Training

Ahmed Mohamed Youssef

A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

July 2018

CANDIDATE'S DECLARATION FORM

This form must be completed electronically and signed by the candidate. Please insert answers in the grey boxes or click on choose an item to select from the drop down lists available.

Please note that the Graduate School is unable to accept handwritten, incomplete or unsigned applications.

THE CANDIDATE:

Name: Ahmed Mohamed Youssef Taha

School: School of Engineering, Technology and Maritime Operations

Degree for which thesis is submitted: PhD

Statement of related studies undertaken in connection with the programme of research
(see Regulations G4.1 and 4.4)

No related studies were undertaken in connection with the programme of research

Concurrent registration for two or more academic awards *(see Regulation G4.7)*

Either ☒* I declare that while registered as a candidate for the University's research degree, I have not been a registered candidate or enrolled student for another award of the LJMU or other academic or professional institution.

or ☐* I declare that while registered for the University's research degree, I was, with: the University's specific permission, a *registered candidate/*enrolled student for the following award.

Material submitted for another award

Either ☒ * I declare that no material contained in the thesis has been used in any other submission for an academic award

or ☐ * I declare that the following material contained in the thesis formed part of a submission for the award of:

Signature: Ahmed M. Youssef

DEDICATIONS

To my beloved parents, wife and daughters,

Who have morally supported me with their unlimited love throughout my study at Liverpool John Moores University, I dedicate this to you

ACKNOWLEDGEMENT

First and foremost, I want to thank God Almighty for providing me with the strength, patience and good health to complete this study successfully.

I would also like to express my extreme gratitude to my main research supervisor Dr. Alan Wall, who has continuously supported me both academically and personally throughout the duration of this research with his patience, care, guidance and knowledge whilst allowing me the room to work in my own way.

I am also grateful to my co-supervisor Dr. Barbara Kelly, Dr. Marion Johns and Dr. Frances Tracy, whose professional guidance, support and skilful advice were one of the key factors that helped bring this study to light.

My sincerest gratitude goes to the Organisation I serve, the Arab Academy for Science, Technology and Maritime Transport (AASTMT), for selecting me for this valuable and unique programme, which could not have been possible without their efforts and initiation. Special thanks also go to my colleagues and friends Dr. Mohiye El Sayeh, Ms. Nermine Gohar and programming Engineer Hazem Torab for their encouragement and assistance.

My genuine thanks go to my sweet Mother Amal Al Ahmar, beloved wife Maye El Haddad and my lovely daughters Deliyla and Diyala for their lifelong sacrifices, unfailing love and patience during my study period. Moreover, I would like to express my profound gratitude to my brother Eslam Mohamed Youssef for his constant encouragement and endless support.

Saving the best for last, I offer my sincere regards and blessings to my role model, my mentor, my dear beloved Father Mohamed Youssef Taha for his patience, mentoring and continuous guidance.

ABSTRACT

Merchant marine officers have multiple specific duties and responsibilities to perform. Moreover, there is a need for a well-trained workforce to operate modern ships. In this era, the development of technological tools to assist in the delivery of the syllabus, and develop the marine cadets' practical knowledge during training on-board is highly required.

This study reviewed literature concerning Maritime Education and Training, in addition to personalised learning and online mobile learning. The research proposes the creation, assessment and validation of generic Interactive Maritime Education and Training (iMET) application, that is utilising Near Field Communication (NFC) technology, as a personalised interactive self-study mobile tool, with respect to cadets' different learning preferences.

The main aim of this research is to test the hypothesis that, the iMET tool has a direct positive impact on the Maritime Education and Training process on-board the training ship, and it is an accepted technology, hence will be actually used by the cadets on-board.

In order to evaluate the research hypothesis, the researcher developed a generic prototype of iMET handheld application, as a proof of concept. Moreover, the researcher adapted a Technology Acceptance Model (TAM), from the existing TAM models, that had been used in previous research, in order to asses cadets' acceptance to the proposed iMET application.

Data collection in this research was based on triangulation, in order to measure the perception and expectations of the different maritime stakeholders affiliated with the iMET tool implementation. Accordingly, a questionnaire survey, a semi-structured interview and a quiz for cadets' assessment was conducted. Data collection and surveys were conducted twice, in the pre iMET intervention development phase and post iMET intervention validation phase, in order to support justifying and validating the proposed technological tool in the current study.

This research philosophy is a pragmatic research approach that applied a mixed methodology, to measure the cadets' technology acceptance of iMET and their behavioural intention towards its actual usage. Finally the research will discuss in detail the outcomes and finding.

TABLE OF CONTENTS

CANDIDATE'S DECLARATION FORM ii
DEDICATIONS iii
ACKNOWLEDGEMENT iv
ABSTRACT v
TABLE OF CONTENTS vi
LIST OF TABLES xiii
LIST OF FIGURES xv
LIST OF ABBREVIATIONS xvii
CHAPTER ONE: Introduction and Research Framework 1
1.1 Background 2
1.2 Research Problem 7
1.3 Aim of the Research 8
1.4 Research Questions 9
1.5 Research Hypothesis 9
1.6 Research Methodology 10
1.7 Area of Study and Limitations 13
1.8 Research Significance and Contribution 13
1.9 Research Plan 14
1.10 Summary 17
CHAPTER TWO: Literature Review 19
2.1 Introduction 20
2.2 Maritime Education and Training 21
2.3 Importance of Maritime Education and Training (MET) 22
2.3.1 Standardisation of Maritime Education and Training (MET) 23
2.3.2 STCW Convention 1978 24
2.3.3 STCW Amendments 25
2.3.4 STCW 2010 Amendments 26
2.3.5 MET Programmes Improvements 28

2.3.6 EU Harmonisation of MET Schemes ... 31
2.3.7 METHAR Project ... 31
2.3.8 METNET Project ... 34
2.3.9 EU MET Projects ... 37
2.3.10 MET and the Innovative Concepts ... 38
2.3.11 Provision of MET ... 40
2.3.12 MET in Maritime College ... 42
2.3.13 Training On-Board Ship ... 43
2.3.14 Government Administration and Type of MET ... 44
2.3.15 Quality Seafarer ... 46
2.3.16 EU Quality Seafarers ... 50
2.4 Personalised Learning ... 51
2.5 Learning Theories ... 53
2.6 Personality Types ... 55
2.6.1 Personality Types as Defined by Myers-Briggs ... 56
2.6.2 Pask’s Serialist/Holist/Versatilist Model ... 57
2.6.3 Entwistle’s Deep, Surface and Strategic Learning ... 58
2.7 Technology Enhanced Personalised Learning ... 59
2.8 Learning Models ... 60
2.8.1 Common Learning Models ... 63
2.8.2 Grasha-Riechmann Learning Style Model ... 64
2.8.3 Dunn and Dunn Learning Style Model ... 66
2.8.4 Gregorc’s Mind Styles Models ... 66
2.8.5 Kolb’s Learning Style Model ... 68
2.8.6 Honey and Mumford’s Learning Style Model ... 69
2.8.7 Herrmann “Whole Brain” Model ... 70
2.8.8 Felder-Silverman Learning Style Model ... 71
2.8.9 Implications of Learning Styles in Education ... 73
2.9 Learning Styles Critique ... 75
2.10 Learning Style Adapted in iMET ... 80
2.11 Online and Mobile Learning ... 83

2.11.1 iMET Online Learning 86
2.11.2 Mobile Learning 88
2.12 Summary 90
CHAPTER THREE: Research Methodology 95
3.1 Introduction 96
3.1.1 Theoretical Approach to the Model Used 97
3.1.2 New Technology Implications 98
3.1.3 Introducing New Technology 99
3.1.4 Theory of Reasoned Action (TRA) 99
3.1.5 Technology Acceptance Model (TAM) 101
3.1.5.1 Perceived Usefulness 102
3.1.5.2 Perceived Ease of Use 102
3.1.6 Extension of Technology Acceptance Model – TAM2 104
3.1.7 Cognitive Instrumental Processes 104
3.1.8 Extended Technology Acceptance Model – Perceived Resources 106
3.1.9 Motivation and Acceptance Model – MAM 108
3.1.10 iMET Acceptance Model 109
3.2 Research Philosophy Design 111
3.2.1 Research Anticipated Outcomes 116
3.3 Research Framework and Model 118
3.3.1 Research Questions 118
3.3.2 Research Hypotheses for iMET Technology Acceptance 119
3.3.3 Research Variables 120
3.4 Data Collection 123
3.4.1 Data Collection Procedure 125
3.5 Statistical Tools 125
3.5.1 Data Testing using Validity and Reliability 126
3.5.1.1 Validity Testing 126
3.5.1.2 Reliability Analysis 127
3.5.2 Hypotheses Testing using Correlation and Regression Analysis 127
3.5.2.1 Correlation Analysis 127

3.5.2.2 Regression Analysis 128

3.5.3 Testing Regression Assumptions for Ordinary Least Squares Method 128

3.5.3.1 Normality Test 128

3.5.3.2 Autocorrelation Test 129

3.5.3.3 Multicollinearity Test 129

3.5.3.4 Independent Samples T-test 129

3.6 Summary 130

CHAPTER FOUR: Pre-Intervention Empirical Study for iMET Model Development 131

4.1 Introduction 132

4.2 Pre-Intervention Results and Findings 133

4.2.1 Descriptive Analysis for the Pre-Intervention Using Questionnaire 133

4.2.2 Hypotheses Testing for the Pre-Intervention Using Questionnaire 137

4.2.2.1 Data Testing Using Validity and Reliability for the Pre-Intervention 138

4.2.2.1.1 Validity Testing for Pre-Intervention 138

4.2.2.1.2 Reliability Testing for Pre-Intervention 142

4.2.2.2 Hypotheses Testing Using Correlation and Regression Analysis for the Pre-Intervention 144

4.2.2.2.1 Pre-Intervention Analysis 144

4.2.2.2.2 Testing the First Hypothesis: The Relationship Between Perceived Usefulness and Behavioural Intention in the Pre-intervention 147

4.2.2.2.3 Testing the Second Hypothesis: The Relationship Between Perceived Ease of Use and Behavioural Intention in the Pre-intervention 148

4.2.2.2.4 Testing the Third Hypothesis: The Relationship Between Perceived Resources and Behavioural Intention in the Pre-intervention 149

4.2.2.2.5 Testing the Fourth Hypothesis: The Relationship Between Attitude TowardsUsing Technology and Behavioural Intention in the Pre-intervention 150

4.2.3 Descriptive Analysis for Interview Responses for the Pre-Intervention 151

4.2.4 Interview Results and Findings 151

4.2.4.1 Perception towards Academy Cadets 155

4.2.4.2 Anticipated Training Outcomes 156

4.2.5 Technology Acceptance Perception 167

4.2.6 Main Themes 167

4.2.7 Main Interview Results 170
4.2.8 Summary 171
CHAPTER FIVE: iMET Development and System Framework 176
5.1 Introduction 177
5.2 Near Field Communication (NFC) Background 177
5.3 Implementation of NFC in Training On-board AIDA IV 180
5.3.1 iMET Concept 182
5.3.2 iMET Theoretical Approach 184
5.3.3 iMET Technical Approach and Sustainability 185
5.3.3.1 Teacher Module 188
5.3.3.2 Server Admin Module 188
5.3.3.3 Mobile Application Module 189
5.3.3.4 Evaluation Module 189
5.3.3.5 Adaptive Learning System 190
5.3.3.6 Integration Module 190
5.3.4 iMET Prototype 194
5.4 Project Cost Estimation 199
5.5 Summary 201
CHAPTER SIX: Post-Intervention Empirical Study for iMET Model Validation 203
6.1 Introduction 204
6.2 Post-Intervention Results and Findings 205
6.2.1 Descriptive Analysis for the Post-Intervention 205
6.2.2 Hypotheses Testing of Post Intervention 209
6.2.2.1 Data Testing using Validity and Reliability of Post Intervention 209
6.2.2.1.1 Validity Testing of Post Intervention 209
6.2.2.1.2 Reliability Testing of Post Intervention 212
6.2.2.2 Hypotheses Testing using Correlation and Regression Analysis for Post Intervention 213
6.2.2.2.1 Post-Intervention Analysis 213
6.2.2.2.2 Testing the First Hypothesis: The Relationship Between Perceived Usefulness and Behavioural Intention for Post Intervention 216

6.2.2.2.3 Testing the Second Hypothesis: The Relationship Between Perceived Ease of Use and Behavioural Intention 217

6.2.2.2.4 Testing the Third Hypothesis: The Relationship Between Perceived Resources and Behavioural Intention 218

6.2.2.2.5 Testing the Fourth Hypothesis: The Relationship Between Attitude towards Using Technology and Behavioural Intention 219

6.3 Comparison Between Pre and Post Intervention 220

6.3.1 Comparison Using Multiple Regression Analysis for Pre and Post Intervention Models… … 220

6.3.1.1 Testing the Pre-Intervention Model using Regression Analysis 220

6.3.1.2 Testing the Post Intervention Model using Regression Analysis 222

6.3.1.3 Testing Regression Assumptions 223

6.3.1.3.1 Normality Testing 224

6.3.1.3.2 Autocorrelation Testing 225

6.3.1.3.3 Multicollinearity Testing 225

6.3.2 Comparison using Means of the Pre and Post Intervention Models 226

6.3.3 Comparison Using Mean Scores of Quiz for Pre and Post Intervention Model 227

6.4 Summary 232

CHAPTER SEVEN: Results and Discussion 236

7.1 Introduction 237

7.2 Discussion 238

7.2.1 Model Validation and Data Testing 240

7.2.2 Descriptive Analysis Results 241

7.2.3 Hypotheses Testing Results for the Pre Intervention Phase 245

7.2.4 Hypotheses Testing Results for the Post Intervention Phase 246

7.2.5 Hypotheses Testing Results for Comparing the Pre and Post Intervention Phases 246

7.3 Results 251

CHAPTER EIGHT: Conclusion and Recommendations 254

8.1 Conclusion 255

8.2 Significant Findings of the Study 260

8.3 Recommendations for Further Studies 262

8.4 Research Limitations 266

REFERENCES **268**
APPENDIX **285**
Appendix A 285
Appendix B 291
Appendix C 293

LIST OF TABLES

Table 2- 1: Main relationships between main elements of and main influence on MET 36
Table 2- 2: Types of MET in EU Countries 44
Table 2- 3: Summary of Described Learning Style Models 64

Table 4- 1: Frequency Tables of Research Variables for Questionnaire Respondents for Pre-intervention 134
Table 4- 2: Factor Loadings of Deleted Items for Pre-intervention 139
Table 4- 3: Average Variance Extracted and Factor Loadings of items for Pre-intervention 140
Table 4- 4: Discriminant Validity Between Variables 142
Table 4- 5: Reliability Test for Research Variables for Pre-intervention 143
Table 4- 6: Correlation Matrix Between the Research Variables and Behavioural Intention for the Pre-Intervention 145
Table 4- 7: Summary of Simple Regression Analysis Results of Research variables on Behavioural Intention for the Pre-Intervention 146
Table 4- 8: Summary of Research Hypotheses Response for the Pre-Intervention 146
Table 4- 9: Correlation Analysis Between Perceived Usefulness and Ease of Use for the Pre-Intervention 147
Table 4- 10: Regression Analysis for Impact of Perceived Usefulness on Behavioural Intention for Pre-Intervention 147
Table 4- 11: Correlation for Perceived Ease of Use and Behavioural Intention for Pre-Intervention 148
Table 4- 12: Regression Analysis for Impact of Perceived Ease of Use on Behavioural Intention for Pre-Intervention 148
Table 4- 13: Correlation for Perceived Resources and Behavioural Intention for Pre-Intervention 149
Table 4- 14: Regression Analysis for Impact of Perceived Resources on Behavioural Intention for Pre-Intervention 149
Table 4- 15: Correlation for Perceived Attitude and Behavioural Intention for Pre-Intervention 150
Table 4- 16: Regression Analysis for Impact of Perceived Attitude on Behavioural Intention for Pre-Intervention 150
Table 4- 17: Frequency Tables of Research Variables for Interview Respondents for Pre-intervention 151
Table 4- 18: MET Professionals and their Profile 152
Table 4- 19: MET Professionals and their Teaching Profile 153
Table 4- 20: Industry Personnel Posts and their Studies 154
Table 4- 21: Industry Personnel and their Sea Time 154

Table 6- 1: Frequency Tables of Research Variables for Questionnaire Respondents of Post intervention 205
Table 6- 2: Factor Loadings of Deleted Items for Post-intervention 210
Table 6- 3: Average Variance Extracted and Factor Loadings of Items for Post Intervention 211
Table 6- 4: Discriminant Validity Between Variables 212
Table 6- 5: Reliability Test for Research Variables for Post Intervention 213
Table 6- 6: Correlation Matrix between the Research Variables and Behavioural Intention for the Post Intervention 214
Table 6- 7: Summary of Simple Regression Analysis Results of Research Variables on Behavioural Intention for the Post Intervention 215
Table 6- 8: Summary of Research Hypotheses Response for the Post Intervention 215
Table 6- 9: Correlation for Perceived Usefulness and Behavioural Intention for Post Intervention 216
Table 6- 10: Multiple Regression Analysis for Impact of Perceived Usefulness on Behavioural Intention for Post Intervention 216
Table 6- 11: Correlation for Perceived Ease of Use and Behavioural Intention for Post Intervention 217
Table 6- 12: Regression Analysis for Impact of Perceived Ease of Use on Behavioural Intention for Post Intervention 217
Table 6- 13: Correlation for Perceived Resources and Behavioural Intention for Post Intervention 218
Table 6- 14: Regression Analysis for Impact of Perceived Resources on Behavioural Intention for Post Intervention 218
Table 6- 15: Correlation for Perceived Attitude and Behavioural Intention for Post Intervention 219
Table 6- 16: Regression Analysis for Impact of Perceived Attitude on Behavioural Intention for Post Intervention 219
Table 6- 17: Multiple Regression Analysis of the Pre-Intervention Model 221
Table 6- 18: Regression Analysis 223
Table 6- 19: Skewness and Kurtosis of the Data Under Study 224
Table 6- 20: Durbin Watson Test for Pre and Post Intervention Models 225
Table 6- 21: VIF for Pre and Post Intervention Models 225
Table 6- 22: Comparing Means for Pre and Post Intervention Models 227
Table 6- 23: Independent Samples T-test for the Experimental and Control Group in the Pre-Intervention State 229
Table 6- 24: Independent Samples T-test for the Experimental and Control Group in the Post-Intervention State 230
Table 6- 25: Pair wise T-test for the Pre and Post Intervention of Experimental Group 230
Table 6- 26: Pairwise T-test for the Pre and Post Intervention of Control Group 231

LIST OF FIGURES

Figure 1- 1: Research Structure and Procedures 15

Figure 2- 1: Pareto Chart Identifying Main Sources of Problems 48
Figure 2- 2: Common Factors in Groundings 49
Figure 2- 3: Common Factors in Collisions 50
Figure 2- 4: Phases and Sub-processes of Self-regulation 87

Figure 3- 1: Theory of Reasoned Action Model 100
Figure 3- 2: Technology Acceptance Model (TAM) 103
Figure 3- 3: Extension of Technology Acceptance Model – TAM2 105
Figure 3- 4: Extended Technology Acceptance Model 107
Figure 3- 5: Motivation and Acceptance Model 108
Figure 3- 6: Adapted iMET Acceptance Model 109
Figure 3- 7: Data Sources for Triangulation 112
Figure 3- 8: iMET Acceptance Model 118

Figure 4- 1: Bar Chart of Perceived Usefulness for Questionnaire Respondents for Pre-Intervention 135
Figure 4- 2: Bar Chart of Perceived Ease of Use for Questionnaire Respondents for Pre-Intervention 135
Figure 4- 3: Bar Chart of Perceived Resources for Questionnaire Respondents for Pre-Intervention 136
Figure 4- 4: Bar Chart of Perceived Attitude for Questionnaire Respondents for Pre-Intervention 136
Figure 4- 5: Bar Chart of Behavioural Intention for Questionnaire Respondents for Pre-Intervention 137
Figure 4- 6: Pie Chart of OOW Duties 157
Figure 4- 7: Pie Chart of Stability and Cargo Training 158
Figure 4- 8: Pie Chart of Practical Skills 159
Figure 4- 9: Pie Chart of LSA and FFA Training 160
Figure 4- 10: Pie Chart of Safety Behaviour 161
Figure 4- 11: Pie Chart of Theoretical 162
Figure 4- 12: Pie Chart of Seamanship 163
Figure 4- 13: Pie Chart of Maritime English 164
Figure 4- 14: Pie Chart of Engine Room 165
Figure 4- 15: Pie Chart of Leadership and Teamwork 166

Figure 5- 1: Three operating modes of NFC Devices 178
Figure 5- 2: iMET Actual Usage On-board AIDA IV 181
Figure 5- 3: iMET System Layout 187
Figure 5- 4: iMET Process Flow Chart 191
Figure 5- 5: iMET Training Tasks Flow 192
Figure 5- 6 (a): iMET Prototype Screen Shot 196

Figure 6- 1: Bar Chart of Perceived Usefulness for Questionnaire Respondents of Post Intervention 206
Figure 6- 2: Bar Chart of Perceived Ease of Use for Questionnaire Respondents of Post intervention 207
Figure 6- 3: Bar Chart of Perceived Resources for Questionnaire Respondents of Post Intervention 207
Figure 6- 4: Bar Chart of Perceived Attitude for Questionnaire Respondents of Post Intervention 208
Figure 6- 5: Bar Chart of Perceived Usefulness for Questionnaire Respondents of Post Intervention 208
Figure 6- 6: Overall Scores for the Pre and Post Interventions 232

LIST OF ABBREVIATIONS

AASTMT	Arab Academy for Science, Technology and Maritime Transport
AEHS	Adaptive Educational Hypermedia Systems
ALSI	Approaches to Learning and Studying Inventory
ARPA	Automatic Radar Plotting Aid
ASP.NET	Active Server Pages. Net language
ASSIST	Approaches and Study Skills Inventory for Students
ASTD	American Society for Training & Development
ATI	Aptitude-Treatment Interaction
AVE	Average Variance Extracted
BIMCO	Baltic and International Maritime Council
BRM	Bridge Resource Management
CAMET	Concerted Action on Maritime Education and Training
CBT	Computer Based Training
CD-ROM	Compact Disk – Read Only Memory
CMS	Course Management System
CMTT	College of Maritime Transport and Technology
CPQ	Course Perception Questionnaire
CSS3	Cascading Style Sheets, level 3
ECDIS	Electronic Chart Display and Information System
EGP	Egyptian Pound
EMSA	European Maritime Safety Agency
EPIRB	Emergency Position Indicating Radio Beacon
ERM	Engine Resource Management
EU	European Union
EU R&D	European Union Research and Development
EU RTD	European Union Research Technological Development
FFA	Fire Fighting Appliances
FSLSM	Felder-Silverman Learning Style Model

GB	Giga Bite
GCNS	Glasgow College of Nautical Studies
GlobalMET	Global Maritime Education and Training
GMDSS	Global Maritime Distress and Safety System
HBDI	Herrmann Brain Dominance Instrument
HR	Human Resource
IAMU	International Association of Maritime Universities
ICT	Information and Communication Technology
ILO	International Labour Organisation
ILS	Index of Learning Styles
IMCO	Inter-Governmental Maritime Consultative Organisation
iMET	Interactive Maritime Education and Training
IMLA	International Maritime Lecturer Association
IMO	International Maritime Organisation
IOS	iPhone Operating System
ISF	International Shipping Federation
ISM	International Safety Management
IT	Information Technology
ITF	International Transport workers unions Federation
LAN	Local Area Network
LCMS	Learning Content Management System
LMS	Learning Management System
LNG	Liquefied Natural Gas Carrier
LP	Learning Platform
LPG	Liquefied Petroleum Gas Carrier
LSA	Life Saving Appliances
LSI	Learning Style Inventory
LSRC	Learning & Skills Research Centre
LSS	Learning Support System
M'AIDER	Maritime Aids' Development for Emergency Responses
MAM	Motivation and Acceptance Model

MarEdu	Marine Education
MariFuture	Maritime Future
MARPOL	International Convention for the Prevention of Pollution from Ships
MarTEL	Maritime Test of English Language
MBTI	Myers-Briggs Type Indicator
MCA	Maritime and Coastguard Agency
MET ISSP	Maritime Education and Training Interactive Self Study Program
MET	Maritime Education and Training
METHAR	Maritime Education and Training Harmonisation
METNET	Maritime Education and Training Network
MILC	Maritime Industries Leadership Council
MLE	Managed Learning Environment
MNTB	Merchant Navy Training Board
MS	Microsoft
MSC	Maritime Safety Committee
MVC	Model View Controller
NFC	Near Field Communication
OOW	Officer Of the Watch
OS	Operating System
PC	Personal Computer
PRATAM	Perceived Resources and Technology Acceptance Model
RASI	Revised Approaches to Studying Inventory
RFID	Radio-Frequency Identification
RFQ	Request for Quotation
SART	Search and Rescue Transponder
SEN	Simulated Electronic Navigation
SH	Ship Handling
SIRC	Seafarers International Research Centre
SLSS	Student Learning Styles Scale
SMS	Safety Management System
SOLAS	Safety Of Life At Sea

SOS	Safety On Sea
SPSS	Statistical Package for the Social Sciences
SQL	Structured Query Language
STCW	Standards of Training, Certification and Watchkeeping
STI	Sea Training Institute
STW	Standards of Training and Watchkeeping
TAM	Technology Acceptance Model
TAM2	Extension of Technology Acceptance Model
TB	Tera Bite
TEL	Technology Enhanced Learning
TRA	Theory of Reasoned Action
TUDEV	Turk Deniz Egitim Vakfi (Turkish Maritime Education Foundation)
UK	United Kingdom
UniMET	Unification of Marine Training and Education
VIF	Variance Inflation Factor
VLE	Virtual Learning Environment
WLAN	Wireless Local Area Network
WMU	World Maritime University
WP	Working Package

CHAPTER ONE

Introduction and Research Framework

1.1 Background

Academies and maritime universities contribute to the development of human resources. The introduction of sophisticated computing systems and advanced equipment plays an important role in the method of delivering the syllabus, in educational aids and in developing the cadets' practical knowledge/skills on-board the training ship. In addition, it will contribute to developing quality educated and trained officers whom are familiar with new technologies.

The research considered the relation between academic maritime education, on-board training and technological development as an interactive relation. In Egypt, the Sea Training Institute (STI) is the department in the Arab Academy for Science, Technology and Maritime Transport (AASTMT) assigned to operate the training ship "AIDA IV" and follow up with the cadets' one-year sea training period. The STI's main objective is to implement the cadets' theoretical background into practical knowledge and skills in compliance with STCW code and Manila Amendments 2010 standards. The STI is also responsible for evaluating the cadets during the sea training period (Schröder, Pourzanjani, Zade, & Kaps, 2002).

Due to the limited capacity of the AASTMT training ship "AIDA IV" and the increasing number of the deck cadets, resource allocation per cadet may be limited, which will negatively affect the cadets' education and training level.

Cadet practical training on-board ships in the UK, has traditionally been the responsibility of ship owners. It followed the practical apprenticeship approach, whereby cadets are recruited mostly from traditional seafaring communities and most probably from seafaring families. Cadets were placed under the tutelage of a master mariner with whom they sail and, in the process, acquired the necessary seafaring skills and competencies that would enable them to execute the duties of competent seafarers (Gekara, 2009), however this is a traditional on-board training for cadets among many nations till now and it is not only limited to UK .

A series of behavioural changes in students' or cadets' attitude when dealing with technology and video games were highlighted by Iordãnoaia (2009). The question is how to turn a video game student into a responsible well trained marine officer.

A quality assured maritime education and training must consider the fact that students have reduced specialist knowledge. Therefore, the solution must not be individual and Information Technology must guide the students towards marine themed games (Iordãnoaia, 2009).

Rapid development of information technology, computers and communication technology considered by the International Maritime Organisation (IMO) in the 2010 enhancement of the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Convention and Code of International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW, 2010) in Manila, Philippines, recent STCW amendments include:

- Introduction of a Modern Training Methodology i.e. distance learning and web based learning;
- New competencies required to be built and curriculums to be updated with modern developments and real-life needs;
- Regulation I/14: Companies responsible for the refresher training of seafarers on their ships;
- The promotion of technical knowledge, skills and professionalism of seafarers;

This demonstrates that there are no set standards for the implementation of e-learning in the Maritime Education and Training (MET) as the term Technology enhanced learning (TEL) is not widely applied in the MET.

Technology allows much more refresher training and upgrading training to be carried out on-board, which currently requires seafarers to attend the courses ashore. The opportunity for the seafarers to privately study at sea, a service they have been denied for a long time, will become reality as internet links become common on-board ships (Manuel, 2017).

This research focused on an important aspect of using Technology Enhanced Learning (TEL) for Maritime Education and Training practical on-board training. Through such systems, a quality controlled MET process can be achieved for on-board training.

That Organisational aspect of MET stated by Mazzarino and Maggi (2000) breaks down the new technologies used in MET institutions, as it could be used to manage new technologies on board as follows:

- **Simulation facilities:** All the operators mainly focus on Radar/ARPA (Automatic Radar Plotting Aid) and navigation. Marine equipment manufacturers also pay attention to Global Maritime Distress and Safety System (GMDSS) and engine rooms. Ship owners do the same for ship handling (SH) technologies;
- **Computing facilities**: All the operators think that network PCs and the internet are very important; the same goes for the marine equipment manufacturers; and
- **Workshop and laboratories:** The most important facilities are those related to cargo handling, linguistics and firefighting. Ship owners stress the importance of the diesel engine lab.

The most important educational issues are those related to knowledge in the context of “awareness of facts”. The main subject components of the training programme that should be reformed as per Mazzarino & Maggi (2000) are; automation; computers; physics; and English.

During the time since (Mazzarino & Maggi, 2000) there has been rapid development in computer based technology, so opportunities exist to redefine the current applications of Computer Based Training (CBT) in MET especially for on-board training, so it is TEL now rather than CBT as this term was developed by technology.

Obviously, Maritime Academies and Universities need to make further efforts to use Information Technology in the process of Maritime Education and Training, as it is mainly limited to the watch-keeping task but does not include shipboard seamanship and deck work.

As per STCW Amendments Manila 2010, it was clear that sections (A-I/12) and (B-I/12) cover the simulators based training for ship handling, Radar, ARPA and ECDIS in-detail while section (A-I/6) titled “training” and “assessment” discussed the media while identifying the simulator as the main training tool.

It did not specify any other electronic tool for training and delivering course material, while (B-I/6) mainly discussed distance learning and e-learning without mentioning a clear requirement for training and assessment using them.

As stated by Beer and Meethan (2007) the marine sector skill shortage was widely recognised. Also, a qualitative study carried out by the Seafarers International Research Centre (SIRC), commissioned by the European Maritime Safety Agency (EMSA) had the objective of examining how computer based systems of assessment were being used in seafarer licensing examinations around the world and in the PC based simulator examination (Gekara, 2009).

It is concluded from the above that the objective of having a specialised hands-on interactive Technology Enhanced Learning (TEL) technique is not a concern of the previously mentioned international maritime specialised bodies or the researchers, as they are still focusing on the CBT. Therefore, the need for the researcher's proposed Interactive self-regulated technological iMET smart mobile application, as a personalised Technology Enhanced Learning (TEL) prevails, in order to deliver hands-on training under interactive physical and behavioural realism, to allow cadets to acquire the appropriate practical knowledge, especially in the areas of seamanship training, deck work training, lifesaving appliances training, firefighting equipment training and ship stability. Hence, students/ cadets will learn while they are doing their hands on tasks.

Due to the rapid progression of the technology used in ship operations, MET was developed and changed its teaching methods to cope with technological updates and shipping industry demands. However, implementing MET into shipboard reality through using simulators is a high cost solution due to its high initial cost, maintenance and frequent upgrading. In addition, as discussed in this chapter, simulators do not cover all required training aspects faced during shipboard reality. Practical aspects like seamanship training, deck work and maintenance, safety systems management, shipboard maintenance, inspection routine training and familiarisation with shipboard parts are not covered by simulators. Moreover, practices like enhancing maritime English language and management proficiency are not available in simulators training.

The on-board training, which is job oriented training, is the most effective part of MET, where cadets combine theory with practice on-board, through introducing knowledge and training skills. However, sometimes it is not taken seriously by ship staff, so learning outcomes cannot be predicted (Lewarn, 2001). The need of a quality seafarer in the context of globalisation in the shipping industry derived the need for this research to develop a technological intervention to standardise training on-board and to fulfil the present training gaps, which are not covered by simulators.

This thesis proposes the creation and validation of a generic, Interactive Maritime Education and Training (iMET) technological tool, in the form of mobile application for handheld devices, in order to facilitate practical training on-board the training ship through "learning by doing", a concept aiming to develop the practical training aspect of Maritime Education and Training (MET). Learning by doing originally refers to a theory of education that was founded by the American educational philosopher John Dewey, who was the most famous proponent of hands-on learning. In his classic book, Experience and Education, first published in 1938, he regards experience as an essential component of the educational process. Dewey notes, "I assume that amid all uncertainties there is one permanent frame of reference: namely the organic connection between education and personal experience". Learn by doing implementation in this research, is introduced in chapter 5 through developing the proposed iMET application.

Furthermore, Dewey stated that continuity and interaction are the two fundamental criteria for determining the quality of experience and its implications for education. The learner should be able to connect aspects of a new experience to what he/she already knows, in addition to being able to actively interact with his/her environment and test out lessons developed in that environment. Moreover, Georgiou, Zahn and Meria (2008) stated that, "the heart of experiential learning lies in reflectively observing concrete experience and actively experimenting with abstract conceptualisations"

iMET provides cadets/students with the capability to improve their knowledge by regularly repeating the same training tasks anytime in addition to self-assess in an interactive personalised way in the real workplace.

The aim is to cover the cadets' training requirements in shipboard seamanship and deck work in addition to the watch-keeping task, consequently increasing the quality and productivity of the Education and Training process, while the technology will play the main role in the learn by doing educational concept. Furthermore, it is hoped that the tool will ensure quality standards from the operational techniques and on-board activities perspective to ensure quality control requirements are met (STCW, 2010).

1.2 Research Problem

The lack of standardised of on-board training for marine students/ cadets, that covers conducting the proper quality training for all required training topics during their sea time on-board ships. Moreover, the lack of monitoring system that is able to track the progress of the training process on-board and measure its anticipated deliverables. In addition to considering cadets' different learning preferences during conducting the MET training on-board is not available.

However, the students'/cadets' ability to use their handheld smart mobiles and tablets as personalised training tools, on-board the training ship as a virtual learning environment (VLE) will create a one-on-one environment and provide them with the knowledge and skills required in the practical training phase of their education. After issuing the BIMCO/ISF (2010) report highlighted the present and forecasted significant shortage in skilled seafarers in the global shipping market, MET was brought in, to change teaching methods to bring MET to shipboard reality through using marine simulators, which is a high cost training, as discussed earlier, simulators do not cover all required training challenges encountered during shipboard reality including the practical aspects, the skills and the job oriented training previously mentioned. As explained previously in this chapter, on-board training as job oriented training is a vital phase in students/ cadets training, where cadets combine theory with practice and develop cadets' practical knowledge, through acquiring the required skills in the real workplace on-board the ship.

The need to develop on-board training is a crucial issue in order to provide an integrated practical training that covers all training topics, and the need of a quality marine officers derived the need of this research in order to introduce and develop a generic technological intervention aiming to cover the missing training that whom are not covered by simulators, in addition to standardizing the on-board training processes to fill the present training process gaps which is not covered.

1.3 Aim of the Research

The main aim of this research is evaluating the hypothesis, that "the iMET tool has a direct positive impact on the Maritime Education and Training process on-board the training ship".

The above research aim is addressed through the following objectives:

1. Driving and facilitating more meaningful MET technologies based personalised learning experiences through reviewing literature.
2. Measuring the cadets' requirements and perception of the proposed iMET tool as a training tool for deck cadets during the on-board training.
3. Measuring the Maritime faculty members'/instructors' and ship owners'/operators' requirements and perception of the proposed iMET tool as a training tool for deck cadets during the on-board training.
4. Assessing and validating of the impact of iMET tool on the on-board training for marine cadets will be carried out by measuring their iMET technology acceptance in order to estimate their behavioural intention towards the application's usage.
5. Developing and justifying a generic automated one-on-one Maritime Education and Training (MET) system to enhance the quality of the training process over all the different aspects on-board the training ship.

1.4 Research Questions

The answers to research questions illustrate the extent to which the iMET tool is accepted as an information technology training tool by on-board training ship cadets, maritime faculty and other stakeholders. The research addresses the following questions:

1. What is the key stakeholders' (Student/Cadet, Trainer/Professor and Ship owner/operator) tendency to accept the iMET?
2. To what extent does the iMET fulfil the key stakeholders' requirements and expectations?
3. To what extent do the portable iMET tool's educational resources cover the students'/cadets' different training topics?
4. Does the perceived usefulness, ease-of-use, resource count, resource-richness and attitude towards using of the iMET tool present positive effect on the actual usage of the system?
5. Does the iMET tool have a positive impact on enhancing students'/cadets' knowledge after usage?

1.5 Research Hypothesis

This research hypothesis is that the cadets' MET learning experience can be enhanced through a "system design" approach that is directly relevant to the Maritime Education and Training application in a personalised training context that is inspired by a learning style theory. This study focuses on the identification of the deck cadets' individual learning needs and how they can best be addressed through personalised TEL tools. It seeks to develop using design synthesis and system validation while considering the complete problem which comprises the increasing number of enrolled students in the Maritime College of the AASTMT, the widely recognised skill shortage of the marine fresh graduates and the lack of implementing the Technology Enhanced Learning (TEL) in the Maritime Education and Training (MET). The following hypotheses are adopted for the current study:

H_1: There is a significant positive relationship between the iMET tool's expected usefulness and the behaviour intention towards the tool's usage.

H_2: There is a significant positive relationship between the iMET tool's expected ease of use and the behaviour intention towards the tool's usage.

H_3: There is a significant positive relationship between the iMET tool's expected resources and the behaviour intention towards the tool's usage.

H_4: There is a significant positive relationship between the iMET tool's expected attitude and the behaviour intention towards the tool's usage.

H_5: There is a significant positive change in the research dimensions; expected usefulness, expected ease of use, expected resources, expected attitude and the behaviour Intention between Pre and Post iMET tool implementation on-board the training ship.

1.6 Research Methodology

Quantitative and qualitative researches are the two dominant research approaches used in human and social sciences. Both are modes of inquiry that use different methods to acquire answers (Smith, & Keating, 1997).

However, Onwuegbuzie and Leech (2005) further assert that the choice of research methodology should be dependent upon the research questions. Researchers who consider themselves pragmatists advocate integrating methods within a single study (Creswell, 1994). This research adopted a mixed methodology approach that will be discussed in chapter 3, in order to utilise and analyse the manner in which on-board training participants accept technology, to assist their on-board MET and how the online environment influenced this process, while unstructured interviews reflected participants' perceptions of their experiences (Lebec & Luft, 2007) in chapter 4. This research involved a quantitative analysis supplemented with a qualitative one, were a predominant quantitative approach is adopted as the primary research tool in chapters 4 and 6, supplemented by qualitative data analysis.

The following methods as described in chapter 3 will be employed for data collection:

After obtaining ethical approval as per the university regulations, a questionnaire survey was introduced to the cadets, and a semi-structured interview was conducted to the lecturers at the Arab Academy for Science, Technology and Maritime Transport (AASTMT) and the ship operators. In addition, there was a one-on-one power point presentation preview and discussion about the proposed technological intervention of this research with IMO Secretary-General Sekimizu during his official visit to Egypt (23-26 January, 2015). The discussion was carried out on Friday 23rd of January, 2015, during Mr. Sekimizu's official visit to the Arab Academy for Science, Technology and Maritime Transport in Alexandria. Quantitative analysis had been carried out using the SPSS 22 software.

The qualitative information were analysed by means of a thematic method, which aims to identify emerging themes and concepts.

The location of the research is on board the Arab Academy for Science, Technology and Maritime Transport's (AASTMT) training vessel/ship "AIDA IV", while a generic prototype of the iMET phone application was created and applied to the Emergency Position Indicating Radio Beacon (EPIRB) and Search and Rescue Transponder (SART) training areas to facilitate iMET usage familiarisation.

Data collection had been collected from the students/cadets, lecturers and operators of the training ship "AIDA IV" in addition to Maritime faculty and ship owners/operators. Participation in the research was entirely voluntary and the participants' identities were protected throughout the research process.

Pre and post iMET application intervention survey evaluations were contrasted as representations of assimilated knowledge (Lebec & Luft, 2007). The proposed system's value was judged based on the cadets' pre and post iMET application acceptance and on its ability to provide an alternative or an added value to MET teaching methods.

The pre-intervention survey evaluation had measured the students'/cadets' requirements and their perception of the proposed iMET application as a training tool for deck cadets during on board training, in addition to measuring the Maritime faculty members'/instructors' and ship owners'/operators' requirements and perception of the proposed iMET tool as a training tool for deck cadets during the on board training. Moreover, the survey assessed the impact of the iMET tool on the on-board training of marine cadets by measuring their perception towards iMET technology acceptance, in order to estimate their behavioural intention towards the actual use of the application, and accordingly the researcher developed a generic automated one-on-one Maritime Education and Training (MET) system, to standardise the quality of the training process on all the different aspects on-board the ship.

On the other hand, the post-intervention survey evaluation measured the cadets perception of the proposed iMET tool, as a training tool for deck cadets during on board training, after installing and using the application on their smart mobiles, resulting in further evaluation and validation of the proposed system as a TEL learning/ training tool for the on board training.

The researcher also constructed a multiple choice quiz acting as a validation supporting tool for the proposed mobile application, quizzes had been taken before and after cadets'/students' actual usage of the iMET application. In order to do that, the researcher introduced the quiz about two training subjects on-board the training ship, which are; Emergency Position Indicator Radio Beacon (EPIRB), and Search and Rescue Transponder (SART). Two groups, each consisting of twenty students, had been randomly selected to take the quiz for each training subject. Each group was tested twice; once during the iMET model pre-intervention implementation phase and once again during the iMET model post-intervention validation phase. The both groups were subjected to the same quiz twice. Accordingly, the difference between the pre and post intervention quizzes results of both groups will indicate the impact of the iMET intervention introduced in the current research, in order to support validation and to justify that iMET system is a tool that might improve the efficiency of the Maritime Education and Training (MET) practical training process on-board a training ship.

1.7 Area of Study and Limitations

This research's area of study is the enhancement of the training process of students/cadets on-board the training ship during their practical training phase in the College of Maritime Transport and Technology (CMTT) with the aid of technology, this study was designed to address the research questions within optimal conditions, as there were limitations that might affected the study, but were out of the researcher's control. The limitations as follows:

Firstly, the responses collected were dependent upon the accuracy of the feedback obtained from students/cadets in the questionnaire survey and from the maritime professionals through the semi-structured interview.

Secondly, the study was limited to deck cadets studying in their fifth semester on-board the Arab Academy training ship "AIDA IV", and does not represent entirety marine students'/cadets' population. Finally, readers are cautioned from generalising the results to a different population than the one mentioned in the study.

1.8 Research Significance and Contribution

The rationale for this research was to improve students'/cadets' practical skills, in addition to transforming theory into practice with the use of technology in a personalised manner. The impact of technology in education has been researched from different aspects. However, there is not much research in the field studying learners' behaviour, in regards to MET and the area relating personalised technology enhanced learning in MET practical training.

The research is based on a generic technological tool, where the concept had been founded by the researcher during his work as a marine lecturer on-board the training ship, in order to develop, standardise and follow up the practical training process carried out on-board, in addition to facilitating and transforming theoretical knowledge into practical skills, after considering each individual's learning preference, and to increase the students'/cadets' engagement in the maritime education and training process.

Maritime academies are currently looking for ways to enhance technology usage in the educational process, which is very costly. This research proposes a technological tool that allows students/cadets to use their own smart devices to be able to support their own learning/training, in an environment that meets their learning needs. This research's significance and original contributions' breakdown is as follows:

1- The research consolidated and summarised the existing literature on Maritime Education and Training (MET), personalised learning (including learning styles) and online learning.
2- It developed an Interactive/Intelligent Maritime Education and Training (iMET) application, as a generic handheld technology enhanced learning/training tool, which had been found by the researcher.
3- It validated and justified the concept that, the developed technological tool iMET within a personalised context will develop and enhance students/ cadets knowledge and skills during their training on-board the training ship.
4- It utilised the maritime industry concepts along with maritime academic ones, in order to maintain an efficient method of training that reflects the maritime industry required calibre.

1.9 Research Plan

The research structure represents the plan that has been implemented to test the hypothesis, and answer the research questions, in order to achieve the aim and objectives. The structure of the thesis represented in Figure 1-1 indicates that, chapter one constitutes the research's theoretical framework. Chapter 2 establishes the background and foundation of this study. Chapter 3 represents the methodological framework and research model. While chapters 4, 5 and 6 provide the design and application of the proposed technological intervention iMET and the assessment of the impact of using the iMET handheld tool on enhancing cadets'/students' knowledge and skills gained on-board the training ship. Lastly, chapters 7 and 8 provide discussion, results, conclusions, recommendations and areas for further research.

This thesis's breakdown is as follows:

Chapter 1 constitutes a general introduction about the research topic. It also provides an overview of the research's importance, the problem, the aim, the objectives, the used methodology and the research's originality. Finally, it outlines the thesis structure and clarifies the conceptual framework of the research topic.

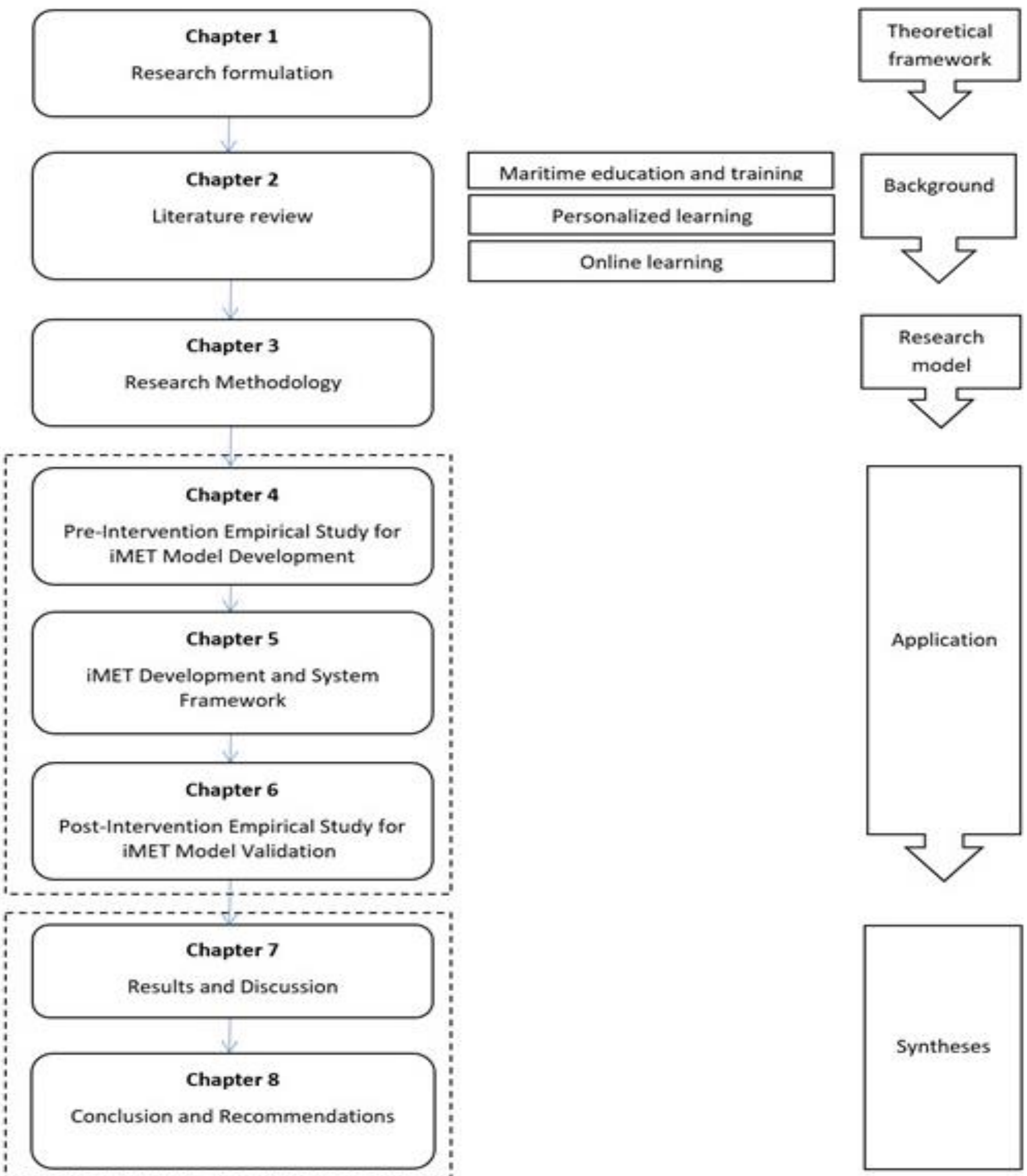


Figure 1- 1: Research Structure and Procedures

Chapter 2 provides a comprehensive theoretical background through reviewing literature in order to consider the research that has been carried out by other authors and Organisations regarding personalised learning and Technology Enhanced Learning (TEL) in addition to incorporating learning styles in the education process. Furthermore, it will focus on academic articles and international conventions related to maritime education and training and will focus to a large extent on articles concerning e-learning in the MET. There are very few research publications that focus in-detail on the impact of technology on the MET and this research attempts to remedy this deficiency. A critical analysis of the different learning styles and existing MET e-learning techniques will serve to build a foundation for the research and will act as a basis upon which an additional contribution will be developed or a completely new contribution will be innovated.

Chapter 3 identifies the research scope, philosophy, approach and the strategy on which the theoretical framework is formulated and the methods, models and techniques used are discussed. It also demonstrates the specifications of variables that are used to validate and assess the proposed technological tool efficiency and provides a brief explanation of the data collection and software used to measure the iMET intervention efficiency.

Chapter 4 contains detailed analysis of the mixed approach resulting from the use of both questionnaires and semi-structured interviews, through introducing the results of the statistical analysis and techniques used for the data collected under this research. Thus, this chapter's objective is to figure out stakeholders' perception about iMET, in addition to one-on-one power point presentation preview and discussion with IMO Secretary-General Koji Sekimizu during his official visit to Egypt (23-26 January, 2015), moreover detecting whether to accept or reject the research hypotheses by applying the statistical techniques selected for the pre-intervention part of the research, prior to iMET development.

Chapter 5 provides background information about Near Field Communication (NFC), in addition to a theoretical and technical approach to the iMET application design, based on chapter 2 and 4 outcomes, a presentation of the iMET framework and a description of the developed prototype supported with its screen shots, as a proof of concept, in addition to the full implementation sustainability and cost effectiveness of iMET, as a training tool on-board the training ship.

Chapter 6 presents the statistical analysis and techniques used to obtain results out of the data being studied. It aims to figure out whether to accept or reject the research hypotheses by applying the statistical techniques selected for the post-intervention study, in addition to comparing it with pre-intervention phase outcomes, after the iMET tool prototype development, implemented and being used by deck cadets/ students on-board the training ship.

Chapter 7 discuss in details the outcomes and findings of the empirical study of the research based on the mixed approach adopted in this research, accordingly providing that research outputs achieved towards iMET tool's direct positive impact in on-board training. Moreover, validating iMET by comparing the results obtained from the pre and post intervention studies, to measure cadets/students Technology Acceptance, and their Intention towards actual usage of iMET application as a training tool. Moreover, research results are presented.

Chapter 8 presents the research conclusions, the limitations of the study and recommendations for the proposed application to researchers and international maritime specialised Organisations, to enhance the MET training goals efficiency. The chapter also highlights the potential areas for further research.

1.10 Summary

This chapter introduced the research topic based on which the aim and objectives of the study have been defined. It highlighted the research importance and clarified its original contributions to the current knowledge, which would be reached on realisation of the aim and objectives.

The chapter also presented the research methodology and processes by which the research aim and objectives are to be achieved. Finally, the outline of the research structure and design was put forward.

The next chapter will introduce and discuss published literature related to Maritime Education and Training, Personalised learning, learning styles and online learning. Based on a literature review, the research gap will be identified in a way that clarifies how this research will contribute to current knowledge. Also, based on this review, the foundation of the research framework will be created.

CHAPTER TWO

Literature Review

2.1 Introduction

This chapter presents an exploration of previous and present literature relevant to enhancing maritime education and training, learning theories and models as an approach to personalised learning/training with the aid of a generic technological tool, in order to understand titles reviewed in this chapter that have an impact on the research from the Maritime Education and Training (MET), personalised learning and online learning points of view.

The scope of the literature review expanded to cover many aspects affiliated with the previously mentioned points of view as follows:

The maritime education and training literature review had been extended to cover Standardisation systems in MET, European Union (EU) Harmonisation of MET schemes, new MET concepts and on-board training, in addition to defining quality seafarer and maritime institutes' roles.

The personalised learning literature review had been extended to cover main learning theories in order to give more understanding of the proper methods of delivering personalised learning methods, that adapt to each students'/cadets' learning preferences. Whereas the online learning literature review had been prolonged to include concepts of self-regulated learning and Adaptive Education Hypermedia Systems (AEHS), to be able to deliver personalised learning/ training, in a technological context. Also; further discussions concerning Technology Enhanced Learning (TEL) via Mobile have been highlighted.

The literature review covers arguments and critiques of the discussed points in order to benefit from the current literature, and to be able to develop a handheld iMET generic technological tool to enhance students'/cadets' training on-board the training ship, in a personalised learning/training context in a manner that is both easy and useful for cadets, in addition to increasing the richness in educational resources available to achieve both training and ship operation market standards.

2.2 Maritime Education and Training

Seafarers, including deck officers and engineers, operate merchant ships around the world. Each of these marine practitioners has specific, multiple and varied duties and responsibilities to perform. The needs for a well-trained, skilful and reliable workforce to operate ships resulted in the creation of education, training and certification systems (Alop, 2004).

The two main basic concepts considered in this part of the research are education and training. Since education may be defined as "providing individuals with knowledge related to the objectives of developing their mental capabilities"; it is more focused on the theoretical aspects of the course or study contents. On the other hand, training is defined as "the activities that need to be performed in order to develop a certain skill to implement a given assignment through performing certain practical exercises and instructions". In simple words, training is teaching skills to individuals. Education and Training create a correlation between knowledge and skill where education leads directly to knowledge, while training leads to developing a certain skill. Maritime training can be accomplished by means of simulation followed by either an on-the-job training approach or on-board specialised ship training (Emad, 2011).

International education and training systems require marine practitioners to continuously upgrade their knowledge and skills throughout their working life. However, there still are large numbers of accidents and incidents ultimately attributed to human failure and their lack of competency.

Maritime accidents are not a new phenomena; they have been occurring for a very long time. We should be clear that the reason why accidents continue to befall ships is, in the vast majority of cases, because somebody, somewhere along the line, did not take proper action to avert a problem, or did something wrong (O’Neil, 2003). In response to that problem and with the aim to diminish accident rates (O’Neil, 2001), the IMO adopted a convention on the Standard of Training, Certification and Watchkeeping of seafarers 1978 (STCW78) to set standards for training mariners (McCarter, 1999).

The great technological revolution in the types of ships, electronic systems and automatic control systems in ship operation led to a complete revision of MET requirements to cope with the actual industrial requirements.

Maritime education and training generally consisted of education in knowledge (defined theoretical subjects) and training of skills (in a number of practical short duration courses) in training institutes, plus a mandatory period of seagoing experience on-board ships. The education and training models are based on interaction and turns of these segments (Emad, 2011).

2.3 Importance of Maritime Education and Training (MET)

Safe operation and handling of a ship rely on the standard of knowledge and skills of shipboard crew rather than the sophistication of the ship's equipment. A ship is expected to face several weather conditions and/or sea circumstances during its period of operation. The crew's knowledge, skills and proper learning are the main factors leading to ensure safety of ship, crew and cargo.

More than a hundred ships with roughly a million tons of deadweight are lost annually worldwide (Baker & Seah, 2004). Statistics of marine casualties' analysis indicate that about 80% of these casualties are due to human error, mainly resulted from inefficient education and training (Ziarati, Demirel, & Albayrak, 2010).

Human factor will remain the most effective element affecting ship safety, clean oceans and seas. Therefore, maritime education and training (MET) is the major key contributor in the attempt to have better qualifications and competency for seafarers resulting in safer ship operation. MET's importance lies in its uniqueness as the introductory step towards the path of an international career.

However, rapid and accelerating technological advances in the maritime transport industry are raising the cost of MET. Modern training equipment such as simulators, labs and workshops have led to considerable discrepancies and variations in the levels of performance and career proficiency among seafarers coming from different countries.

2.3.1 Standardisation of Maritime Education and Training (MET)

The international maritime community struggled for a long time with the requirement for the Standardisation of MET. In 1936, the first international convention on training standards required for seafarers was drafted by the International Labour Organisation. But the convention was not implemented by the majority of countries worldwide (Islam, 1995).

In 1948 an international conference in Geneva adopted a convention formally establishing the Inter-Governmental Maritime Consultative Organisation (IMCO), (changed in 1982 to IMO). The IMCO convention entered into force in 1958 and the Organisation started in 1959.

The purpose of the IMO is “to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships" (IMO, 1948).

One of the overall interests of the Organisation was the standards in maritime training. In 1960 the International Conference on Safety of Life At Sea (SOLAS) recommended that IMO and ILO (International Labour Organisation), in collaboration with the member states, are to set standards aiming to raise the efficiency of MET worldwide. Until the early 1970s, there was no international MET system, although statistics showed that the main contributory factor in maritime accidents and incidents was and continued to be the human element. In 1964 the IMO-ILO Training Committee prepared guidance lines for the MET for masters, deck officers and seamen.

A sub-committee on Standards of Training and Watchkeeping was established as a result of the 1971 IMO General Assembly Article A.248. 1973 –1978. The committee drafted a new convention aimed to set standards for education and training. In 1978, the international Conference on Training and Certification was held in London, followed by The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers ((STCW: a Guide for Seafarers, 2017) which was the first to establish basic requirements on training, certification and Watchkeeping for seafarers on an international level.

2.3.2 STCW Convention 1978

Advancements in information technology have significant impact on the shipping industry. The international community continuously acted in pursuit of the establishment of rules and standards for maritime transport activities and standards of performance of employees. One of the achievements in this area was the issuance of the international Convention on Standards of Training, Certification and Watchkeeping STCW 1978 and amendments. Prior to the 1978 STCW Convention the standards of training, certification and Watchkeeping of officers and ratings were established by individual governments, frequently without reference to practices in other countries. As a result, standards and procedures varied widely worldwide.

The standard set by the Convention applies to seafarers of all ranks serving on seagoing merchant ships registered under the flag of a country party to the convention. The term seagoing merchant ship includes all commercial vessels engaged in domestic or international voyages (ITF, 2017).

The STCW Convention does not apply to seafarers serving on warships, naval auxiliaries (or any other government owned or operated ship engaged in non-commercial service), fishing vessels (there is a separate Convention covering personnel on fishing vessels), pleasure yachts not engaged in trade and wooden ships of primitive build.

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 governs the award of certificates and controls Watchkeeping arrangements. Its provisions does not only apply to seafarers, but also to ship-owners, training establishments and national maritime administrations. The Convention was adopted by the International Maritime Organisation's (IMO) political Conference in 1978 and came into force in 1984.

2.3.3 STCW Amendments

During the late 1980s, it was clear that STCW-78 was not achieving its aim of raising professional standards worldwide. The IMO members decided to revise the convention completely. On July 1995, amendments that represented a major revision were adopted by an IMO conference. While the STCW-78 convention had focused almost entirely on knowledge, the emphasis of the STCW95 amendments had shifted the focus to practical skills and competence underpinned by theoretical knowledge.

In 1995 the STCW Convention was revised and updated in order to clarify the standards of competence required and provide effective enforcement mechanisms. Among the provisions is an obligation that parties to the convention are to provide the IMO with the measures they have adopted to implement the convention nationally. This information is scrutinized by the IMO to ensure that "full and complete effect" is being given to the convention. Upon approval, the party is to be added to the "List of confirmed STCW Parties", which is known as the STCW White List. The Convention has already been accepted by 157 countries including all major labour suppliers and shipping registries (IMO, 2010) which represent more than 98% of the world's merchant fleet. The STCW95 amendments came into force since the first of February 1997 while the requirements for basic safety training, special training for personnel on certain types of ships (tankers and ro-ro passengers) and familiarisation instruction when joining a new ship apply.

Regulations covering personnel on board passenger ships other than ro-ro passengers came into force in January 1999. Starting from 1st of February 1997 and for a period of five years, until 1st of February 2002, the different regulations contained in the convention were phased in. During the five-year transitional period, parties continued to issue certificates of competency in accordance with its previous practices.

Key implications of STCW95 Amendments include the introduction of the following by individual countries:

- Certified Port State Control Inspectors.
- Management Plan and Certificate Structures.
- Assuring that medical standards and documentation meet requirements; this would include a Panel of Medical Practitioners.
- New Maritime Certificates, including provisions for endorsements.
- Required Training Courses and associated resources - this would include comprehensive curriculum packages, and has resource implications for training institutions, both in terms of staffing and physical infrastructure.
- Seafarers' database, keeping an up-to-date record of seafarers.
- Development of quality management systems.
- Supply STCW checklist to local shipping industry (ILO, 1998).

The STCW-95 allows for a more modular approach to training. IMO model courses include ship safety, proficiency in survival crafts, gas tankers familiarisation courses, restricted radio operators, first aid at sea, and a radio operators course and more.

2.3.4 STCW 2010 Amendments

On June 25th 2010, the International Maritime Organisation (IMO) and other major stakeholders in the global shipping and manning industry were holding a Diplomatic Conference in Manila, Philippines, to discuss amendments to the STCW Convention.

The amendments to the convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) and its associated code were formally adopted by the convention parties. The amendments aimed to bring the STCW up to date with developments that occurred since its conception and initial adoption in 1978 and the subsequent amendments in 1995. Main reasons for such a review include: the fast development of the world's shipping industry, the introduction of more applications of new maritime technologies on-board, the stricter standards in maritime safety and pollution prevention, the increasing human functions in maritime technical operations and lastly the flaws in the original convention (Shicheng, 2009).

The amendments accepted by 1st July 2011 resulting in them entering into force on January 1, 2012. The key improvement obtained through the new amendments may be summarised as follows:

1. Certificates of Competency and endorsements are to be issued only by Administration - thereby reducing the possibility of fraudulent practices associated with issue of certificates of competency.
2. The establishment of common medical standards for seafarers - seafarers from one country can serve on board ships of another country without undergoing another medical exam.
3. Revalidation requirements got rationalised for the benefit of the seafarer.
4. Introduction of modern training methodology i.e. distance learning and web based learning.
5. Hours of rest harmonised with the requirements of the ILO Maritime Labour Convention.
6. Regulations introduced to avoid alcohol and substance abuse.
7. New Competencies required to be built and curriculum to be updated in life with modern developments and real life needs
8. Refresher Training is properly addressed within the convention

The review and amendments reflected the trends of specialisation, higher-level of maritime operations on-board, wider coverage of knowledge and techniques of the competency standards. In order to cover advanced navigational technologies, specialised and professional transportation technologies and pollution prevention technologies by incorporating these fields into seafarers' competency standards (Shicheng, 2009).

2.3.5 MET Programmes Improvements

Continues development of ships designs and operation technology, caused an additional education and training requirements, to support the modern shipboard operations. The development of seaborne transportation generally, including modern shipboard technologies, marine environment protection technologies and regulations, is considered very important issues to be included into the seafarers' competency standards. In order to meet these developing requirements, maritime community needed to frequently review the required competences such as; skills, training, selection, instruction and supervision of seafarers at all levels (Barsan, Hanzu-Pazara, & Arsenie, 2007). This approach led to the change of the STCW 78 at Manila Conference in 2010.

MET planners generally work on the programmes (syllabi), rather than other essential elements of the MET system, such as the standards of the teaching staff, training facilities and equipment, which have a strong influence on the success of programmes. Although the STCW covers these issues to a certain degree, it is not satisfactory yet and needs more research and studying. The STCW is the holy book of MET. While conventions such as SOLAS, MARPOL (International Convention for the Prevention of Pollution from Ships) and the ILO regulations are the key elements which regulate most of the changes to seafarers' qualification requirements. Since the SOLAS and MARPOL regulations change more rapidly and frequently rather than the STCW their inclusion in the STCW takes time and this situation causes a delay in reflecting current requirements into qualification standards.

To overcome this delay it is important to establish a link between the STCW and SOLAS, MARPOL, ILO study groups. As far as the study groups are concerned, not only the IMO but other significant Organisations such as EMSA's (European Maritime Safety Agency) contributions should be taken into account (Ziarati, Demirel, Lahiry, & Ziarati, 2011).

The STCW covers the general requirements for competence but not in detail. So, further study is required to define skills, training, selection, instruction, supervision principles and detailed programmes for each level to meet the required standards, which is a lot of work is needed in long durations of studying and excessive man power. Therefore, the best way to achieve such a mission is to achieve a feasible solution to coordinate with other nations and related Organisations, to make international projects a suitable tool to provide mutual support for researchers in different parts of the world.

IMO has revised the standard of education and training for officers and ratings (STCW) to improve the quality of maritime education and training (MET). The MET institutions need to implement the new requirements stated in the STCW 78 (2010) which resulted in many countries initiating studies to implement the revised standards. Not only governments but all the interested parties in the maritime community are also very keen to incorporate recent changes made by IMO in the STCW to establish an effective MET system. These new changes in the STCW have triggered the international cooperation in MET research and development. MET associations such as IMLA (International Maritime Lecturer Association) and IAMU (International Association of Maritime Universities) are supporting the implementation of these recent changes through their conference programmes and through disseminating the implications for MET institutions. Many such as MarEdu, GlobalMET are also very active and are engaged in consolidated cooperation to support the revision of MET practices through the review of existing arrangements. The international cooperation has provided mutual support, implemented information sharing and has led to the development of several new courses and novel tools. Globalisation has emerged as one of the most powerful socio-economic and political forces shaping the world today. Similarly, shipping has for a long time been recognised as one of the strong catalyst of socio – economic development. International trade has become an increasingly important part of the global economy since more than 80 percent of trade travels by ships.

With the rapid growth of globalisation in world maritime trade, standardisation of maritime education and training has become more important to achieve better service quality. The impact of globalisation on shipping has been most phenomenal. International and regional cooperation and integration has become an instrument for attaining accelerating economic development all over the world. It is clearly understood that cooperation provides benefits for all and the exchange of knowledge among nations and improves quality of work in different fields.

The establishment of European Union (EU) has led to a new manner of cooperation. The EU projects became a fruitful tool to reinforce collaboration among member states for transfer of experiences to improve new solutions. Enhanced number of participants elicited better results (Ziarati, Demirel, Lahiry, & Ziarati, 2011).

The BIMCO/ISF Update in particular, redirected the attention of maritime industry to seafarers' shortage in officers seagoing ranks, The International Maritime Organisation (IMO) report prepared in cooperation with the maritime community on the shortage of manpower has started the 'Go to Sea' initiative, to overcome lack of the qualified seafarers' problem. BIMCO/ISF manpower 2010 Update: The Worldwide Demand for and Supply of Seafarers has mentioned that 'the estimation of worldwide demand for seafarers in 2010 is 637, 000 officers and 747, 000 rating' and alerted all parties concerned with the critical manpower shortage expected in shipping for the next decade (BIMCO/ISF, 2010). This report was followed up by Manpower Report in 2015 on the global manpower situation in the shipping industry prepared by BIMCO and International Chamber of Shipping in 2015, which raised the same concerns. In reference to maritime education and training, previous researches have been very helpful. Furthermore, the IMO had identified three major deficiencies:

- That the STCW is the minimum requirement and not the desirable criteria;
- There are failures due to automation on board vessels and;
- There is compelling evidence that deficiencies in English language competences are a cause for concern (Ziarati, 2006).

The changes in the STCW significantly affect the MET causing the MET communities start redesigning their education programmes and systems to meet the new requirements. These efforts together with multinational cooperation are supported in different parts of the world. For instance, Global-MET is working on the subject in Asia-Pacific Area, while the MET community in Europe and MarEdu are working on Unification of Marine Education and Training (UniMET) projects to achieve the same goal (UniMET, 2017).

2.3.6 EU Harmonisation of MET Schemes

States of the European Union are varying on considering objectives, systems, schemes, concepts and training methods of MET. This variety, resulting mainly due to historical reasons, has often led to an inefficient and ineffective use of human and financial resources and to a lack of integration of MET in national education and training systems. This has contributed to the declining interest of European youngsters in a seafaring career. Development along these lines has not only affected the availability of a sufficient number of qualified seafarers for ships under flags of EU countries, but has also had a negative impact on the provision of managerial personnel with shipboard experience for shore-based positions in the maritime industry. Accordingly EMSA is playing a main role in maintaining a harmonised MET process among maritime institutes (EMSA, 2017).

2.3.7 METHAR Project

The EU RTD programmes regarded the issue of MET in a number of its frameworks. The METHAR (Maritime Education and Training Harmonisation) was one of the first projects included under the 4th Framework programmes on Harmonisation of Maritime Education and Training (MET) schemes in Europe commenced in 1996 and concluded in 1999.

The project aimed to contribute to the harmonisation of MET at a European level, by gathering the outcomes from the Concerted Action on Maritime Education and Training (CAMET) involving a wide range of international experts. The goal was to increase the competitiveness of the European maritime industry by improving the level of qualification of seafarers and other maritime personnel, and through a better provision of ship-board experienced personnel in the maritime industry, in order to achieve higher standards of safety, environmental protection and efficiency (METHAR, 2000).

The METHAR project objectives were to:

- Contribute to the development of harmonised syllabuses and their implementation, taking into account the use of modern teaching technologies;
- Identify needs for the adaptation of MET programmes to cope with the requirements of the maritime industry, such as the growing use of advanced technology;
- Provide a better understanding of the new STCW (Standards of Training, Certification and Watchkeeping) Convention as amended in 1995 and suggest a harmonised approach to better meet its requirements;
- Enhance the employability and facilitate the professional mobility of MET graduates within the maritime industry and European countries.

The project commenced subsequent to the entry into force of the STCW 95 Convention, which intended to ensure minimum MET standards globally. The project had similar objectives, not for minimum standards but for harmonised MET standards in Europe. To ensure the compliance with the Convention it became necessary to evaluate the curricula to be able to identify deficiencies and the need subsequent modifications. This was done for thirteen countries of the EU. The existing MET curricula in METHAR countries was noticed to be, generally, in compliance but, for some additional requirements in syllabus, methods of training and assessment emanating from the higher emphasis on competence and its assessment envisaged in the Convention (Ziarati, Demirel, Lahiry, & Ziarati, 2011).

The project, with regards to MET syllabus, defines ‘MET for primary field of occupation’ and ‘MET for secondary field of occupation’. The former refers to the necessary and adequate level MET for the shipboard profession while the latter refers to MET with additional elements catering to the needs of employment areas of the shipboard experienced seafarers in the industry ashore. The project within MET syllabus identifies the 'STCW-Core' subjects, the 'Extensions to the STCW' subjects and the 'Enrichment of STCW' subjects.

The extensions to STCW requirements contain elements which serve the primary field of occupation and are intensifying or exceeding the STCW requirements. These incorporate additional subjects and training inputs desirable for the efficient and safe operation of the ships. These additional inputs arise due to changes in technology, legal, environmental and social issues. For example, the case of the marine engineers, deficiencies have been identified in the following areas and recommendations have been made for inclusion in the curricula (which would be referred to as extensions to the STCW):

- General management proficiency including crew management
- Improvement of English language capabilities
- Training competence (for cadets, apprentices or assistants)

One of the recommendations of the METHAR project (WP5), stipulates that due consideration should be given to the expectations of the European maritime industry to interpret STCW 95 skill standards for seafarers, with a strong reflection on the use of advanced technology on board and shore. This includes the technology for METHAR (2000) in the following.

- Navigation and Watchkeeping
- Internal and external communications
- Cargo handling and ship management
- Propulsion and manoeuvring
- Maintenance and logistics
- Living and catering
- Care of health and accident prevention
- Control of emergencies
- On-board training and recreational activities

MET enrichment means the inclusion of teaching elements which promote the qualification of the seafarers for the secondary field of occupation. This however does not exclude issues related to shipboard operations. These elements may form additional courses of study and should also provide an academic degree.

2.3.8 METNET Project

The METNET (Maritime Education and Training Network) was one of the early projects including in the 5^{th} EU RTD Framework Programmes 2000 – 2003. The project can be considered as a completion to the METHAR project, which conducted the previous Framework Programmes. The need for METNET has arisen from the consequences of the incomplete match of objectives and realities between national MET and international shipping, between maritime human resources in EU countries and a global maritime labour market, between national societal circumstances and international economic necessities. Resulting differences from this situation can hardly ever be fully reconciled, not even by continuous appropriate efforts. A passive national attitude to the effects of an already existing globalisation in shipping would however have grave consequences for the national maritime labour market, both quantitatively for the number of jobs for EU nationals and qualitatively for the competence and the competitiveness of maritime services in EU countries (Schröder, Pourzanjani, Zade, & Kaps, 2002).

The main objective of METNET, the Thematic Network on Maritime Education, Training and Mobility of Seafarers, was to find and exploit ways and means to use maritime education and training of ship officers (MET) as much as possible, for halting and eventually reversing the trend towards the European seafarer becoming an “endangered species”. The core of this objective is the sustainability of competent and competitive maritime services and of the necessary maritime skills base in the EU, especially as education, training and shipboard experience of ship officers are also needed in the maritime sector ashore.

The specific aims of METNET were to improve the quality, harmonise the contents and extend the applicability of MET. Improved MET quality will help to increase the attractiveness of maritime careers, increase the potential and value of ship officers and ex-ship officers in the maritime labour market, create more jobs for EU nationals and make EU shipping safer, more environment-friendly and more efficient. Harmonised MET contents will help to develop the basis for a future European ship officer, improve his/her intra-EU mobility, extend the mutual recognition of ship officers' certificates and facilitate cooperation between MET institutions. Extended MET applicability will make a career as ship officer more attractive. It will help to meet the existing demand in most EU countries for national ship officers increasing the supply – which will also ensure the number of former ship officers who are required to take up positions in the maritime industry ashore (Schröder, Pourzanjani, Zade, & Kaps, 2002).

METNET did however not only aim at improving, harmonizing and extending MET but was also concerned with the conditions and the environment in which MET operates, such as the costs and financing of MET, national databases on seafarers, recognition of certificates of competency and intra-EU mobility of seafarers.

The core network of METNET was the consortium. It comprised representation of all stakeholders in MET, i.e. of MET institutions, ship-owners associations, seafarers' unions, maritime and education administrations, professional associations, universities with maritime programmes and maritime research institutes, ICT (Information and Communication Technology) companies. The extended network included additional representation of MET institutions and of governmental administration of MET, in Reference Groups which brought the number of involved countries to 16 (Belgium, Denmark, Finland, France, Germany, Greece, Iceland (only MET institution), Ireland, Italy, Netherlands, Norway, Poland, Portugal, Sweden, Spain, United Kingdom). A pan-European network was created by the involvement of MET institutions and maritime administrations from East European and Mediterranean accession countries (Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovenia and Cyprus, Malta, respectively) and non-accession countries (Croatia and Egypt, Israel, Morocco, Turkey, respectively). Altogether, 29 countries were represented and participated in METNET (Schröder, Pourzanjani, Zade, & Kaps, 2002).

METNET concludes that, MET quality can be improved by raising the quality of the four main elements of national MET systems: students, staff, programmes and facilities. Obviously, a better quality of MET graduates is a consequence of a quality enhancement of the other three elements. Identifying the main relationships between the four main elements of MET systems and the four main environmental influences on national MET – economics (industry), regulations (administration), society (individuals), technology – shows that programmes are related to all four main environmental influences and offer therefore a promising approach to improving MET quality. Nevertheless, maritime lecturers remain the "change agents" and programmes are their main tool to bring about change and to change themselves (Pourzanjani, Schröder, & Zade, 2002).

Table 2- 1: Main relationships between main elements of and main influence on MET (*Source*: Schröder, Pourzanjani, Zade, & Kaps, 2002)

	economics (industry)	regulations (administration)	society (individuals)	technology
students	x		x	
staff	x	x		x
programmes	x	x	x	x
facilities				x

METNET has developed exemplary syllabi and courses for students which will benefit the industry and the individual, respond to changes in international regulations, make MET more attractive for potential applicants and provide for a better exploitation of modern technology by MET. METNET has also developed courses for teaching staff for a more effective use of modern technology at MET institutions.

Moreover, METNET developed and used the 4E concept of MET for facilitating communication on MET systems and standards. The four Es of the concept are:

- ESSENTIALS (minimum requirements of the STCW 95 Convention),
- EXTENSION (shipboard qualifications beyond those of STCW),
- ENRICHMENT (additional qualifications which prepare for a career in the shore-based maritime industry, BSc degree), and

- ELEVATION (MSc degree for holders of BSc degrees and unlimited certificates of competency).

In the environment of MET, METNET concentrated on costs and financing of MET, national data bases on seafarers, recognition of certificates of competency and intra-EU mobility of seafarers and specified actions for overcoming present weaknesses in these three areas.

2.3.9 EU MET Projects

In 2005, The Maritime Education (MarEdu) Partnership was formed to tackle maritime skill deficiencies based on the IMO reports and recent research into skill deficiencies in Europe (MarEdu, 2005). The IMO has passed responsibility for the delivery and assessment of Merchant Navy education and training to member countries and does not take part in the inspection, evaluation or delivery of these programmes. The EU governments and related industries should all show the same determination to implement these standards. Furthermore, the majority of accidents at sea and in ports are reported to be mainly due to either disregard for rules or inadequate training and assessment. In 2003, the EU established EMSA (European Maritime Safety Agency). A major political impetus to the setting up of EMSA was the fallout from the Erika (1999) and the Prestige (2002) accidents and their resulting oil spills. EMSA commenced monitoring the IMO standards for training and certification of merchant navy personnel (STCW). Governments have also been active. The formation of the Maritime Industries Leadership Council (MILC) are very similar to efforts in France, Italy and Germany, to name but a few, in reviewing the currently well-being of the maritime industry and planning for its future. At least twenty EU R&D (European Union Research and Development) projects related to MET subjects are initiated from 2005 till present (MariFuture, 2005).

In respect to the increasing competition from eastern nations such as Japan and Korea, MariFuture believes that it is now more important than ever to harmonise the efforts of industrial, educational, and governmental maritime organisations across Europe in order to safeguard the wellbeing and competitiveness of the maritime industry.

Through the creation of collaborative partnerships involving universities, research centres, businesses, and stakeholders from all areas of the maritime transport sector, MariFuture works to ensure that all maritime industrial sectors (such as ship operators, ship builders, and support industries) are properly represented.

The MariFuture platform currently includes over fifty active member organisations, many of which are actively involved in many European and EU funded projects. The network consists of a wide range of interested parties from all areas within the waterborne sector (progressive companies, universities, social partners, associations, awarding bodies, accrediting institutions, licensing authorities, government agencies, learnt societies, conferences, and individuals) and possesses the zest and energy to improve maritime education and training through a comprehensive programme of research and development. Projects and initiatives developed by partnerships within the MariFuture platform have been presented to the International Maritime Organisation (IMO) and other important government and industrial bodies.

2.3.10 MET and the Innovative Concepts

Developing of maritime human Skills have depended on primitive tools. Presently, new technologies became essential tools for enhancing maritime human skills through better provision of information and informatics MET systems. MET methodologies have been impacted and becoming more adaptive to cope with current rapid technological advances; whereas MET in the past had been characterised by stability and resistance to change (Davis, 1977).

The increased use of IT in MET, on ships and in shipping have partly changed teaching methods and brought MET closer to shipboard reality at institutes which can afford the purchase of costly simulators and computer systems. These changes have had an impact on MET for some time already. They have led to the closing of MET institutions, in addition to more adaptive actions (METHAR, 2000).

Within the context of the education of deck and engine officers, maritime education and training systems, in the wake of IMO requirements, are subject to crucial updates, especially in regards to developments in computer technology. Amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW 78), adopted by the STCW 1995 and 2010 Conferences, have created new requirements for, and placed new demands on, administrations, ship-owners and maritime academies. At the same time, new concepts in maritime training in order to achieve a job oriented training.

Innovative concepts of marine education are aiming to shift from a knowledge-based to a competency-based training, and the need for constant professional updating and recertification have brought maritime training institutions out the shadows of the maritime administration and industry; now they must assume an equal partnership rather than simply reacting to the others demands. Maritime institutions must implement their course syllabi effectively, guided by to IMO Model Courses; moreover they must improve standards of teaching staff, facilities and equipment.

Simulators used for training or assessing competence are required to comply with provisions contained in Section A-I/12 of the STCW Code, which is especially devoted to the use of simulators. The STCW Code requires that all seafarers should be properly qualified for the position that they hold on board, and the ISM (International Safety Management) Code requires the company to define the responsibility, authority and level of competence required of each crew member. And, instructors, supervisors and assessors are required to be 'appropriately qualified.' But these are minimum sets and are not sufficient to cope with the systems aboard many of today's ships.

It is therefore incumbent on the ship owner or ship manager to adopt best industry standards in respect of the recruitment and training of seafarers; and to ensure that they receive the training necessary for them to carry out their duties - including the operation and/or maintenance of technically complex and multidiscipline systems.

They must also be regularly updated, tested and drilled, through programmes of on-job and continuation training. Those who are involved in the front line of shipping operations ashore must also be properly trained, adequately experienced, skilled and competent, commensurate with the level of responsibility and accountability that they require to perform their duties. Of equal importance, is the need for maritime college lecturers to be properly qualified to teach those competencies for which they are employed to teach, and to have an up to date appreciation of modern day ship operations and of the new technology aboard ships (Ziarati, Demirel, & Albayrak, 2010).

2.3.11 Provision of MET

A proper Maritime Education and Training (MET) program must include theoretical and practical Education and Training in a well-balanced curriculum, and must ensure there are well-designed and internationally recognised programs of education and training, leading to higher qualifications and certifications for career progression as well as for job diversification. There is therefore, a need for clear education and training pathways recognised internationally, with clear progression routes towards degree and higher qualifications in the related subjects.

Maritime Education can be roughly divided into four main areas, Safety, Technical, Commercial and Management.

Safety training relates to the crew, ship security, cargo and environment and is covered by the IMO: STCW, SOLAS and MARPOL Conventions and requirements. Certification for personnel in Watchkeeping Competences, fire-fighting, Oil Tanker Safety and Dangerous Cargoes can be obtained by attending courses and passing assessments. Training is also compulsory on-board the ship through demonstrations, drills and exercises that cover the safety equipment carried, e.g. life jackets, fire extinguishers etc., and the processes and procedures for emergencies on-board, e.g. collision, pollution etc. Participation of on-board training must be logged (IMO, 2010).

Technical training is closely related to safety but not mandatory, apart from broad interpretations of the requirements of the ISM Code, which relate to ship familiarisation and understanding the Safety Management System (SMS). It covers the highly sophisticated equipment – e.g. IT equipment and software, which is often, carried on-board ship and the introduction of new technology or processes to the ship, anything from new radar being fitted to the change in a bunkering procedure. Frequently, because of the schedule and operation of the ship, training and instruction in this is left to the installation team to provide a ship's Officer with how to switch it on and operate it and for him or her to train the remainder of the on-board crew (Muirhead, 2004).

Commercial training covers the business related activities of the ship and its operation, the procedures and processes for complying with the contractual requirements of the operation, rather than the statutory obligations, e.g. charter party/ contract law, cargo claims etc. It also covers the commercial and social requirements of crew management e.g. pay, reliefs and accident claims.

Management areas of training include management training, with all the areas of finance and budgets, personnel or human resources, marketing, public relations, administration, training provision and secretarial skills. Obviously, these functions of the officer's role are highly demanding, time consuming and in many cases, totally overlooked by owners, operators and training establishments (Shicheng, 2009).

As seen already, there is a wide diversity of training subject areas expected to be provided to seafarers, but there is, also, a wide diversity in the methods of training, routes and media for delivering the education and training identified. The main channels for delivering training are through colleges, company in-house programs, professional institute seminars and training consultants.

However it is provided, all training stems from the basic needs of providing relevant and up-to-date information, unfortunately this often overlooked, with many training providers delivering what they think is necessary rather than what is relevant. Frequently, passing on useful, practical information comes second to passing academic examinations.

2.3.12 MET in Maritime College

Formal education is designed to provide the knowledge and understanding required by the students to underlay their future tasks on the job. This is also the case with the maritime education and training system. The main purpose is to give the students the theoretical background and knowledge that they require on-board ships. Certification assessment does not correlate with what is required on-board ship, so that the students learn to pass tests rather than learn for on-board work.

Education in the college is not a pre-requisite for obtaining a certificate of competency, but success in certain written and oral examinations implemented by the national maritime administration is a compulsory requirement. Written examinations are in the form of multiple-choice and long answers, and after success in those, students also attend an oral exam. There is no specific requirement from the administration to assess the competency of the candidate for all required tasks through evaluating their performance, while they are actually doing the task either on the job or in a job-like environment (Emad, 2011).

In contrast to the education, the training in the maritime colleges is more successful in reaching its objectives. Unfortunately, the college-based training covers only part of the skills that mariners need on-board ships. As a result, the training in the colleges by itself, although effective, but may not close the existing gaps between what is learned in training institutes and what is needed on the job. Successful training in a series of short duration technical courses in maritime colleges is a compulsory aspect of the certification system. The training courses generally are approved by the administration. It means that in most cases, the colleges have the authority to assess the students for the courses and issue the relevant certificate.

The practical nature of these courses and the direct relation that the students could establish between their training and the practice on-board ships was an important motivating factor for students.

The SEN (Simulated Electronic Navigation) course, students are comfortable after having taken the SEN course. They are working on boats/ships (in the simulator) and running at night and all of that stuff.

They find when they did SEN, it really fun; it includes all practical, very useful stuff (Canada, 2008). The short courses are very close to competency-based criteria and provide the satisfactory result. The analyses reveal (Emad & Oxford, 2008) that the students are more satisfied by these courses than by other aspects of their college-based education. Consequently, they felt more confident, prepared, and competent to do what is required of them in their workplace.

2.3.13 Training On-Board Ship

On-the-job training is generally held to be the most effective part of the training system in which they develop the competency needed to act successfully on-board ships. On-the-job training is not taken seriously by most of the ships' staff, thus its learning outcomes are unpredictable. The main problem encountered was the lack of supervision and cooperation with the students' learning on-board ships by ships' officers, shipping companies, and training institutes (Lewarn, 2001).

Working on-board ships for a specific period of time is a prerequisite for the certificate of competency. The idea is for candidates to spend time in the workplace where they can gain the appropriate required job-related competencies.

There is an alternative method to the structured on-the-job training. The alternative method to the structured on-board training (as stated in the STCW95, regulation II/1 part 2.2) is to spend longer period of time on-the-job.

The proposed iMET tool in this study will be able to achieve on-the-job training, in addition to adequate provision of MET in the context of balancing the theoretical and practical aspects of MET. Hence, achieving productive training on-board ships, addressed for future mariners through structuring and automating the training process.

Thus, one of the experienced mariners stated, “sea time is not structured at all in any way. I am not training at work; I'm just learning by myself". Although the STCW95 stipulates that on-the-job training is one of the most important parts of training system, in actual practice, this most promising aspect of training is associated with the predictable outcomes (Emad, 2011).

Table 2- 2: Types of MET in EU Countries *(Source: METHAR, 2000)*

Type	BE	DK	FI	FR	DE	GR	IS	IE	IT	NL	NO	PT	ES	SE	GB
Monovalent	X	X	X		X	X	X	X	X		X	X	X	X	X
Bivalent		X*		X	X**					X					
Semi-bivalent															
Sea time before studies		X			X		X				X (1)			X (1)	X (2)
Sea time between studies	X (1/2)			X		X	X	X (2)		X	X	X	X	X	X
Sea time after studies	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Knowledge-based	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Skill-based	X		X	X		X	X	X		X	X		X	X	X

(1) optional, (2) deck only. * Up to OOW level. ** Likely to cease

2.3.14 Government Administration and Type of MET

The Ministries of Education, Transport, Mercantile Marine, Business and Industry may be involved in the administration of MET. The European Project METHAR found that in 6 of 15 European countries the Ministry of Education is involved in MET Organisation. It shares responsibility for MET with the Ministry of Transport in three countries and with another ministry in one country. The Ministry of Education is dealing with the Organisation of the studies, education and training programmes and academic degrees (if any).

In one country only these matters are in the hands of the regional government but under the co-ordination of the Ministry of Education. The Ministry of Transport deals with the professional certificates and the meeting of the STCW requirements. In a few cases other ministries such as Mercantile Marine, Business and Industry are involved in the administration of MET.

In the last years the Ministries of Education have been more and more involved in the administration of MET because studies were upgraded to university level in some countries and qualify for positions both on board ships and on shore in, for example, the maritime administration and shipping companies (METHAR, 2000).

Most of maritime academies and institutes in the various countries are offering courses leading to unlimited certificates of competency (polytechnic, vocational institutes). Courses for limited certificates of competency are offered at the same MET institutes that offer courses for unlimited certificates of competency. There are, however, a few countries in which limited certificates are also offered at special institutes for these certificates (Germany) and there is a country where limited certificates are offered at special institutes only (Spain).

Monovalent is the usual type of MET in many countries. European METHAR project indicate that 12 European countries of 15 have monovalent type. Only France and Netherlands have full bivalent MET. In Denmark MET studies are leading to bivalent certificates on the OOW (Officer Of the Watch) level. Sea time sandwiched between shore studies is a widely used system. Some countries require sea training before studies. All countries require shipboard experience after studies for obtaining the highest certificate of competency.

Knowledge-based MET is considered to be mainly focused on learning of theoretical subjects with limited emphasis on the application of theories. Skill-based MET places emphasis on the practical teaching subjects and the student is expected to demonstrate professional skills. Knowledge-based training is the most usual system but in most countries it is claimed that it is “blended” with skill-based training. Table 2-2 gives the type of MET applied in the 15 European countries (Schröder, Pourzanjani, Zade, & Kaps, 2002).

2.3.15 Quality Seafarer

The shipping industry consists of a wide variety of shipping business and operations known as "industrial chains". The chains are spreading in the context of globalisation of world economy and integrated transportation, and therefore, play more and more important role in the macro economy. As one of the key elements in the chains, seafarers are not only the navigators at sea, but also a very important resource of shipping talents for shore-based shipping operations in shipping industry, it is widely accepted that shipping-related professionals ashore are ideally those with sea-going background (Shicheng, 2009).

Also, Shipping is one of the safest means of transport, yet thousands of accidents still occur each year and the great majority of these involve human error. The main issues which can have an effect on the potential for human error are education and training and working conditions. Therefore, the better the education that seafarers receive, the safer shipping will become (EMSA, 2017).

Furthermore, the requirements for quality seafarers keep updating, because of the advancement of navigational technology, development of maritime administration systems and higher standards in maritime safety, security and marine environment protection. Ships are becoming bigger, faster and more automatic. Seafarers are required to be more professional and specialised. MET universities and academies should pay special attention to those, and understand that Quality seafarers need to be developed to satisfy the social request for quality shipping industry. Quality seafarers refer to those with good experiences on-board, excellence in seamanship, computer operations, English language, ship management, interpersonal communication, professional virtues and commitment, etc. (Shicheng, 2009)

Human Errors and Accidents alarming is that sea transportation is growing and with this growth the numbers of accidents, despite having modern technologies, well equipped and seaworthy ships with qualified crew.

According to the data analysis of a multi-year Project undertaken by the American Bureau of Shipping, approximately 50% of maritime accidents are initiated by human error, while another 30% of maritime accidents occur due to failures of humans to avoid an accident. In other words, in 30% of maritime accidents, conditions that should have been adequately countered by humans were not (Baker & Seah, 2004).

Mistakes are usually made not only because of faulty, deficient or inadequate regulations, but because some of the regulations and standards that do exist are often ignored. The IMO accident analysis reports (Ziarati, 2006, and 2010) clearly indicate the causes of many of the accidents at sea are due to deficiencies in the education and training of seafarers or disregard for current standards and regulations.

One of the most important duties of MET institutions is to prepare their cadets for the future and not for the past. The MET have a major responsibility to initiate and support research identifying the causes of incidents and near-misses and through research find out how accidents can be prevented in the future.

Two reports submitted by the Maritime and Coastguard Agency (MCA) to the IMO MSC82 (reports MSC 82/15/2 and MSC 82/15/3, 2006) regarding automation failures. Automation has brought with it a new problem and specific types of accidents which need to be fully understood if accidents due to automation failures are to be a thing of the past.

Causes:

A Use of navigation equipment	28%
B Communication	24%
C Equipment failure including engines	16%
D Confusion due to standards and regulations	12%
E Inadequacy of standards/applications by third parties	8%
F Unknown	12%

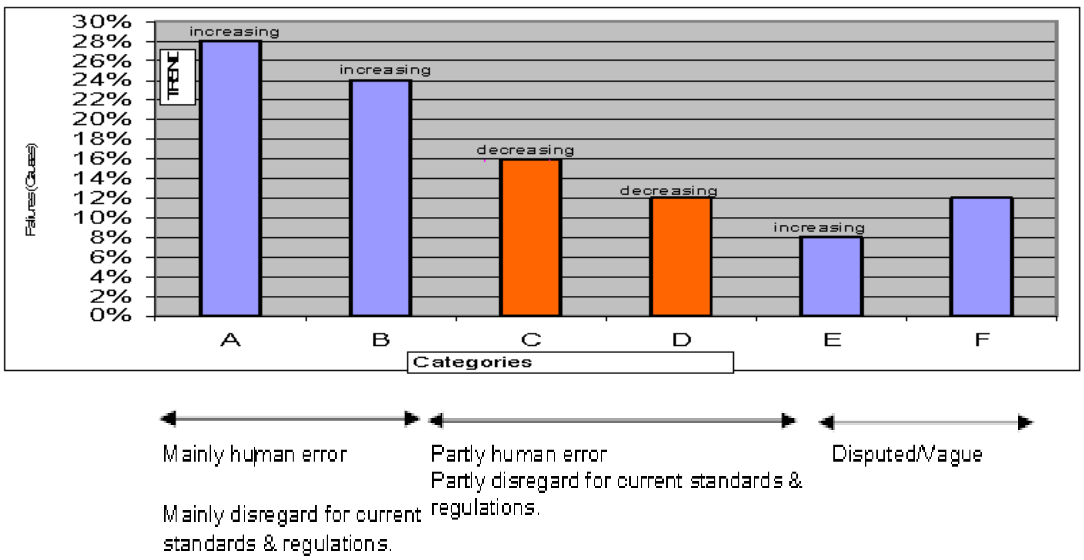


Figure 2- 1: Pareto Chart Identifying Main Sources of Problems (*Source: Ziarati, Demirel, & Albayrak, 2010)*

The results of a number of research and development programmes such as METHAR (2000) and METNET (Schröder, Pourzanjani, Zade, & Kaps, 2002) were also taken into consideration exploiting; in addition, the information contained in.

The work being conducted under the EU funded Leonardo Safety on Sea (MarEdu, 2005) Project led to a paper (Ziarati, 2006) which identified several causes of the accidents as education and training problem areas for analysis, these are depicted in the diagram shown in figure 2-1.

The SOS (2005) project demonstrated that for the MET programmes to be more effective it is crucial that they are underpinned by a vigorous programme of research and development; and to share this burden and learn from one another, it is good practice to form a partnership and be willing to solve or analyse a problem or deficiency and incorporate the situation/outcome into the maritime provision. The introduction of Bridge Resource Management (BRM), Engine Resource Management (ERM) and Ship Handling (SH) by the maritime industry and their inclusions in the MET programme of officers of watch was considered an innovative undertaking by many MET institutions. This is just an example to show that innovation can be highly beneficial and that it is possible to work from the outside and then offer opportunities for the regulatory bodies to adapt a given good practice. There was a paper to the IMO and presentation by the MarTEL team (MarTEL, 2010) at the IMO's STW meeting on 12 January 2010 to promote the inclusion of more regulated standards for maritime English (Cole & Trenkner, 2010).

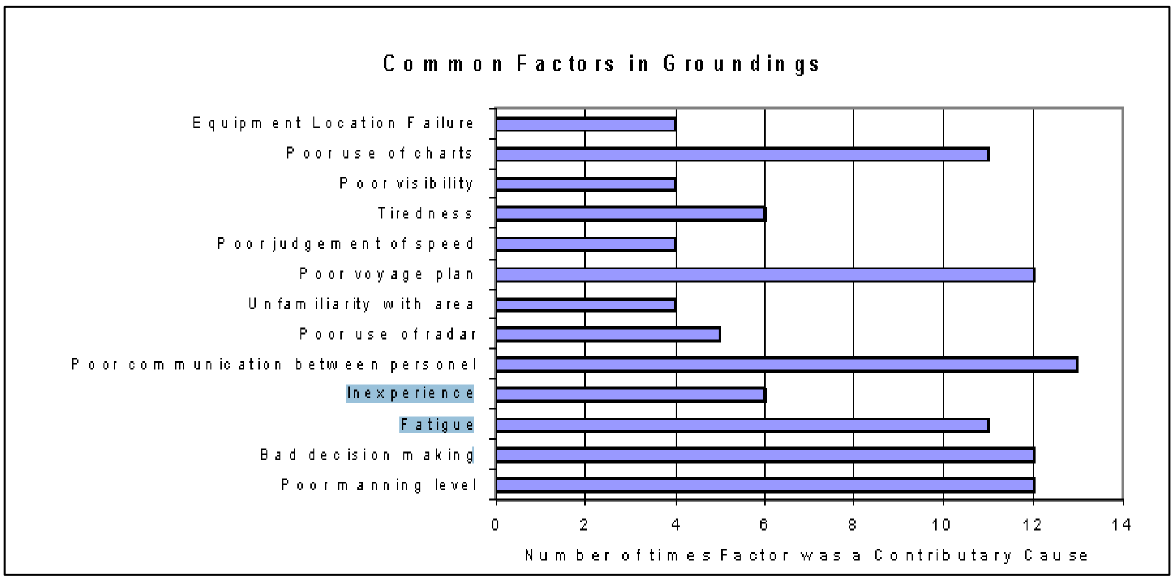


Figure 2- 2: Common Factors in Groundings *(Source: Ziarati, Demirel, & Albayrak, 2010)*

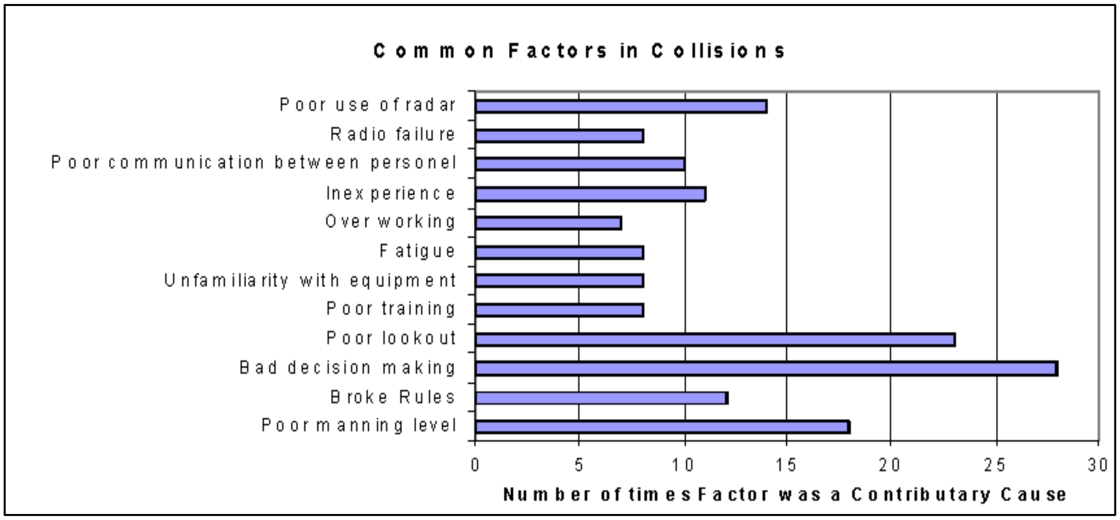


Figure 2- 3: Common Factors in Collisions (*Source: Ziarati, Demirel, & Albayrak, 2010)*

Another example is a new EU funded project called M'AIDER (Ziarati, Demirel, & Albayrak, 2010) which is expected to study accident reports and research, such as those presented in figures 2-2 and 2-3 and in parallel conduct surveys to identify the causes that have led to near misses, which are reported but not investigated by accident investigation agencies. The outcome of M'AIDER is considered important in preparing seafarers for emergency situations (Ziarati, Demirel, & Albayrak, 2010).

2.3.16 EU Quality Seafarers

Although many seafarers operating in EU waters were educated, trained and certified in Europe, it is important to note that EU registered ships are often manned by seafarers who are not nationals of EU Member States. This fact needs to be taken into account when determining the best ways of ensuring that crew members on board EU registered ships are appropriately educated and trained. The EU legislation introduced a specific procedure based on which the assessment of compliance with the requirements of the International Maritime Organisation's STCW Convention by non-EU countries is conducted by the European Commission for a wider recognition of their certificates of competency by EU Member States.

With the support of EMSA, the European Commission assesses seafarer certification procedures and maritime education and training (MET) establishments in non-EU countries on behalf of EU Member States and in line with the STCW Convention. All assessments take place based on a five year cycle so that, in addition to the occasional evaluation of proposed new countries, each country that has already been recognised at EU level will be inspected on a regular basis (EMSA, 2017).

TRAIN 4C projects have enabled improved safety at sea through a mobility programme involving the transfer of groups of cadets from TUDEV (Turkish Maritime Education Foundation) in Turkey to Glasgow College of Nautical Studies (GCNS). 16 cadets have transferred for period from January 2007 to May 2007. The second group transferred from April 2010 to September 2010 and the third group was 5 cadets transferred from September 2012 to March 2013. Cooperation Through mobility of seafarers is an important tool to improving quality of seafarers which could lead to safer and cleaner seas and ports (SOS, 2005).

2.4 Personalised Learning

This research aims to develop technology enhanced personalised learning and training under an individualised structured technological tool, tailor made for marine cadets/students training on-board a training ship.

Dewey (1938) highlighted the important role of adapting materials to individual needs to ensure a successful education experience; also careful assessments to the students are needed in order to provide a challenging learning experience. Furthermore, Khan (2012) discussed the effective role of apprenticeships in delivering meaningful experience to students and Zull (2002) highlighted the benefits of active experience in the real world through role playing and collaboration in order to achieve an effective learning and students’ motivation.

The personalised learning application developed in this research focuses mainly in involving the student in the learning process in a self-regulated manner, while the instructor/ trainer will act as a facilitator within success oriented learning and training program. Sprenger (2010) mentioned that personalised learning may include mentoring programs and online classes. Richardson (2012) defined personalised learning as a process through which the student is allowed to choose his/ her own path through the curriculum. Also, Childress and Benson (2014) defined personalised learning as a learning experience that is tailored to each individual needs, skills and interests.

The researcher aim is to achieve a technological tool for personalised learning/ training with all day availability within the real workplace as per stated by Bray and McClaskey (2013) that the personalised learning definition was simplified in series of nine qualifiers stating that learner knows how his/her be able to learn best; self-direct and self-regulate; learner has a voice and choice; learner able to design his/her own path; access flexible learning anytime and anywhere; co-designs curriculum and learning environment; has a high quality instructors as a part of the learning; uses competency based models; learner being motivated and engaged in the learning process.

Personalised learning was found related to learning styles strategies and theories, were ‘Learning style’ describes an individual’s preferred method of gathering, processing, interpreting, organising and analysing information. The VARK model which was developed by Fleming and Mills (1992) provides the learners with a profile of their learning styles, based on the sensory modalities which are involved in taking in information. VARK is an acronym for the Visual (V), Auditory (A), Read/Write (R) and the Kinaesthetic (K) sensory modalities.

The visual learners process the information best if they can see it. The auditory learners like to hear information. The read-write learners prefer to see the written words. The kinaesthetic learners like to acquire information through experience and practice. According to the VARK model, the students’ learning styles are dependent upon how they prefer to perceive/receive information. They may prefer a single mode (uni-modal), two modes (bi-modal), three modes (tri-modal) or all four modes (quadri-modal) of the information presentation.

Further readings on this matter might add confusion, regarding the elements of the elements to include in a personalised learning, for example the elements that should be personalised and elements to be personalised partially like curricula, instruction, schedule, assessment, physical space and student advisors (Richardson, 2012), the proposed iMET tool of this research considered VARK model as an initial ground to build upon the technological intervention.

2.5 Learning Theories

Theories of learning are multidiscipline such as education philosophy, psychology, pedagogic, sociology and more. Such variety of feeding disciplines had enriched the learning theories and provided more understanding for learning, as a step towards exploring different popular learning styles, in order to achieve a clear understanding of personalised learning.

The behaviourist learning perspectives, which consider learning as an observable change in behaviour, however it demonstrated the importance of setting clear learning targets and a learning structure to achieve the required targets. Behaviourist theory is shaped and directed through the teacher's role in designing and controlling the learning environment by using of organised activities, practice and repetition to enhance skills, in addition to specifying content, discipline strategy and delivering learning, moreover, instructional design, incentives, rewards and penalties (Parkay & Hass, 2000).

Criticism of behaviourist theory principles is that it is a teacher-centred process, as the teacher is seen as the owner of knowledge and students as passive recipients (Massouleh, 2012). Cognitive and constructivist perspective, which took a holistic view of behaviour and mind, as it sees minds seeks patterns, relationships and interpretation of information rather than learning only what is just in front of the learner.

Cognitive and constructivist perspective considers a mind is a pattern-seeking and cognitive restructuring to assimilate new experiences to make sense of the world.

Criticism of cognitive and constructivist perspective was that we will be able to improve education once we understand how are we going to deal with information mentally.

Moreover, learners manage to construct and invent, not only on how much they repeat and copy. Accordingly, learning should itself be active and each time we teach learners something too quickly, we keep them off reinventing it themselves (Papert, 1999).

Previous theories initiated a philosophy of learning known as “Constructivism”, where knowledge can be constructed only in the mind of the learner.

The main contribution of these theories is that learners are not considered passive, constructivists do not reject behaviourist theory, but they argue that behaviourist perspective is only an isolated part of a more general process of learning.

Constructivists theories aligns with the proposed iMET technological tool in this thesis, where the learner represented in this research as the cadet being trained on-board the training ship. However the effective learning and training process is actively involved in knowledge construction.

Evidence supports that learning process has more durable retention when taught using active constructivist methods. Which aligns with Dochy et al. (2003) that conducted studies on the effect of problem based learning and found a positive effect on skills development; on the other hand students gained slightly less knowledge when taught in a conventional teaching.

Same concept was reinforced by Doğru and Kalender (2007) in a competitive study teacher and student centred methods in science classes, were no significant differences had been revealed in immediate tests, while students taught by constructivist methods showed better retention of knowledge in a follow up assessment after 15 days.

Accordingly, the proposed iMET technological tool in this study will adopt constructivist methods after reviewing different learning styles in the incoming section in this chapter, a constructivist will be considered, where the role of the instructor will be a facilitator through guiding the learners/ cadets and providing “Scaffolding” to learning, in order to ensure that students/ cadets has the requisite knowledge needed.

iMET tool will adopt an active method in constructing the learners understanding of knowledge, in a way that focus on discovery, exploration, experimentation and enquiry based learning methods, iMET will be introduced in the context of research based learning, with the aid of reflective learning activities and self-assessment. Criticism of teaching based on cognitive and constructivist principles was stated by Kirschner, Sweller, and Cla (2006), as constructivist teaching in the context of student centered is an unguided method of instruction. Moreover, sociologists concern on how individual learn, and if this occurs in isolation.

iMET proposed technological intervention considered such criticism by enhancing the teacher/ instructor role in the class room to deliver the needed knowledge to the learners, in addition to teachers' follow up tasks. iMET proposed application will consider sociologists concerns by introducing the usage of iMET in group not individually to avoid the occurrence of isolation. In order to maintain among learners a shared interest, passion and commitment among learners within a common interest, moreover enhancing active engagement and interaction, while each learner is using the iMET application within a group that share competence and uses a technical language. That goes with social learning theory, as much learning occurs by observing and imitating learners behaviour around, through (watch and learn) to develop students/cadets self-efficiency (Bandura, 1977).

2.6 Personality Types

Students have different learning styles as they tend to focus on different types of information, individuals tend to perceive and process information in different ways, in order to achieve understanding of knowledge. Methods of teaching has an important role to achieve student satisfaction and to maintain proper gain and longer retain of information, in addition to having a more positive attitude towards the course in particular and the institute in general. Although student cannot change his/ her preferred style of learning to match a teaching style, the following sections will overview the personality types and learning models, in order to be able to select a method that fits the proposed technological intervention of this study, aiming at producing a personalised enhanced learning tool addressed to the Maritime on-board training, with the aid of the smart handled devices.

2.6.1 Personality Types as Defined by Myers-Briggs

Myers-Briggs Type Indicator (MBTI) (Myers, 1962) is a personality test and does not focus specifically on learning. Nevertheless, the personality of a learner influences his/her way of learning. Accordingly, MBTI includes important aspects for learning. In addition to, other learning style models are driven from the considerations of MBTI. Based on Jung's theory of psychological types (Jung, 1964), the MBTI distinguishes a person's type according to four dichotomies: extroversion/introversion, sensing/intuition, thinking/feeling, and judging/perceiving. All possible combinations can occur, so a result in a total number of 16 types (Graf & Kinshuk, 2007).

The extrovert and introvert dimension refers to the individual's orientation. The preferred focus of people with an extrovert attitude is on the surroundings such as other people and things, while an introvert's preferred focus is on his/her own thoughts and ideas. *Sensing and intuition* deal with the way people prefer to perceive data.

While sensing people prefer to perceive data from their five senses, intuitive people use their intuition and prefer to perceive data from the unconscious. The judgment based on the perceived data can be distinguished between *thinking and feeling*.

Thinking means that the judgment is based on logical evaluation such as "true or false" and "if-then" while feeling refers to "more-less" and "better-worse" evaluations. However, judgment and decisions are in both cases based on rational considerations. The last dichotomy describes whether a person is more extroverted in his/her stronger *judgment* function (thinking or feeling) or in the *perceiving* function (sensing or intuition). Judging people prefer step by step approaches and structure as well as coming to a quick closure. Perceiving people have a preference for keeping all options open and tend to be more flexible and spontaneous (Graf, 2007).

The preferences on the four dimensions interact with each other rather than being independent, and for a complete description of a person's type, the combination of all four preferences needs to be considered.

The standard version of MBTI is a 93 items Form 'M' (Myers & McCaulley, 1998). While the previous version is a 126 items Form 'G' (Myers & McCaulley, 1985), moreover an abbreviate version of 50 items. The instruments include forced choice questions, related to the four bipolar scales and answers are driven according to the personality type calculation.

2.6.2 Pask's Serialist/Holist/Versatilist Model

During the development of the conversation theory (Pask, 1972, 1976a, 1976b), Pask studied patterns of conversations between individuals to identify various styles of learning and thinking. A critical method according to the conversation theory is the "teach back" approach, where students teach their peers. Different patterns for designing, planning, and organising of thought as well as for selecting and representing information were investigated, resulting in the identification of three types of learners (Pask, 1976b). *Serialist* students use a serial learning strategy.

They tend to concentrate more or less on details and procedures before conceptualising an overall picture. They work from the bottom up, learn typically step-by-step in a linear pattern and concentrate on well-defined and sequentially ordered chunks of information.

According to Pask, serial learners tend to ignore relevant connections between topics, which can be considered as their learning deficit. In contrast, *holists* use a holistic learning strategy, were they tend to concentrate on building broad descriptions and use a top-down type approach. They focus on several aspects of the subject at the same time and use links to connect multi levelled information.

They are good in building connections between theoretical and practical aspects, in addition to personal aspects of a topic. However, holistic learners do not focus much on details, which can be seen as their learning deficit. *Versatile* learners employ both, serial and holistic learning strategies. They get engaged in both global and detailed approaches and succeed in achieving a full and deep understanding. Therefore, versatile learners are proficient at learning from most or all modes of instruction (Graf, 2007).

Pask developed tests such as the Spy Ring History Test (Pask and Scott, 1973) and the Clobbits Test (Pask, 1975) to measure the serial, holistic and versatile thinking. Later, Entwistle (1981; 1998) and Ford (1985) developed self-report inventories in order to identify the preference for serial, holistic, and versatile learning styles.

2.6.3 Entwistle’s Deep, Surface and Strategic Learning

The research conducted by Entwistle and his colleagues (Entwistle, 1981, 1998; Entwistle, McCune & Walker, 2001) dealt with the involvement of students’ intentions, goals and motivation during their learning approach. Entwistle argued that the students’ orientations to learning and conceptions of learning may lead to and might be affected by the student’s approaches to learning.

The model is based on research by Pask (1976b), and Biggs (1979) and distinguishes between three approaches for learning and studying (Entwistle, McCune, and Walker, 2001): learners applying a *deep learning approach* are intrinsically motivated and have the intention to understand the ideas for themselves. They learn by relating ideas to previous knowledge or experiences, looking for patterns, checking evidence and relating it to derive conclusions.

They use logic and arguments cautiously, develop an understanding about the topic, and become actively interested in the course content. In contrast, learners who apply a *surface learning approach* are extrinsically motivated and aim at meeting the requirements of the course. They treat the course content as unrelated bits of knowledge, try to identify parts of a course that are mostly will be assessed and focus mainly on memorising these details. They carry out procedures as a routine and sometimes they find difficulty in making sense of new ideas presented (Coffield, Moseley, Hall, & Ecclestone, 2004a).

Popescu (2009) see little value or meaning in either courses or tasks set, study without reflecting on either purpose or strategy, and feel undue pressure and worry about their work. While, the *strategic learning approaches*, students combine both the deep and surface approaches in order to achieve the best possible outcome in terms of grades.

Students adopting a strategic approach put consistent effort into studying, manage time and effort in an effective way, find the right conditions and materials for studying, and monitor the effectiveness of their studying ways. Moreover, they are alert to assessment requirements.

For measuring the adopted approach of learning and studying of students, several versions of a questionnaire have been evolved such as the Approaches to Studying Inventory (ASI) (Ramsden & Entwistle, 1981), Course Perception Questionnaire (CPQ) (Ramsden & Entwistle, 1981), and Approaches to Learning and Studying Inventory (ALSI) (Tyler & Entwistle, 2003). Since Entwistle's model is based on Pask's serial and holistic learning strategy, this concept is also included in the questionnaires. For example, in the ASSIST, the currently most often used instrument, the serial and holistic learning strategy is included as subcategory of the deep learning approach (Graf, 2007).

2.7 Technology Enhanced Personalised Learning

The design of the technology to support personalised learning lead to the concept of universal design, in education the universal design for learning term represents dynamic processes of teaching and learning, it is described by Thompson, Johnstone and Thurlow (2002) to be inclusive, precise, accessible, amenable, simple, readable, and legible.

In addition to Basham and Marino (2013) stated the main elements of universal design: clear goals, learner variability planning, flexible methods and materials, and timely progress monitoring, Basham and Marino showed elasticity in order to meet each learner needs.

There are two types of Technology Enhanced Learning, synchronous and asynchronous which available in different learning situations and its educational benefits had been observed as it had an impact lead to increasing the students' engagement (Bryant, 2014; Garrett & Steinberg, 2015), also lead to an increase in student and teacher collaboration in addition to instructional pacing towards specific students individual needs (Baran, Correia, & Thompson, 2011; Yamagata-Lynch, 2014).

Synchronous learning environments require the student and instructors to be available in the same time (Martin, Parker & Deale, 2012), for example videoconferencing and webcasts. Hence, providing a real time learning interaction and collaboration, where instructor and student can communicate. Also, synchronous learning technology develops students' metacognition (Warden et al., 2013). Accordingly, achieving personalised flexible learning, for specific individual needs, through face to face synchronous learning. Personalised learning tools include laptops, tablets, web applications, and smart phones. Yates (2014) stated that the challenging aspect of online learning is the reliability and inconsistency of synchronous technologies in addition to the need of computer literate instructor and student.

Asynchronous learning is similar to synchronous learning, but it gives the student additional time for reflection, collaboration and interaction with instructors (Yamagata-Lynch , 2014). Asynchronous learning the prevalent learning due to the presence free technology enhanced learning tools and used according to the student pace.

Some researches stated that students of asynchronous technology learning reported less motivation and isolation (Croxton, 2014; Hart, 2012), on the other hand there is a self-paced students who benefit from asynchronous technology learning (Croxton, 2014).

The proposed iMET tool in this study can be used as synchronous or asynchronous, which can be available in different learning situations to fulfil the anticipated learning and training outcomes.

2.8 Learning Models

In this section, the research shall review literature of the learning strategies and models, in addition to relations between online learning and learning styles, based on the research area which is the Maritime Education and Training on-board the training vessel.

The field of learning styles models is wide and influenced by several inputs, thus leading to different views and concepts. Various learning style models are in literature, each is proposing different descriptions, approach and classifications of learning types. Coffield, Moseley, Hall, and Ecclestone (2004b) identified 71 models of learning styles and categorized 13 of them as major models with respect to their theoretical importance in the field, their wide spread use, and their influence on other learning style models. Furthermore, a lot of research has been carried out with respect to different aspects of learning style models.

(Akkoyunlu & Soylu, 2008) stated that Instructors and researchers have realized the importance of learning styles. Educators have for many years noticed that some students prefer certain methods of learning more than others (Eisenberg et al., 1991). Researches on learning styles have found that students' learning styles affect performance in a learning environment. Learning styles form a student's learning preference and help instructors in the planning process of learning/teaching environment (Kemp, Morrison & Ross, 1998).

As stated by Coffield et. al (2004b), many articles have been written related to the Myers-Briggs Type Indicator (Myers, 1962) and many publications have been written about the Kolb learning style model (Kolb, 1984) as well as the Dunn and Dunn learning style model (Dunn & Dunn, 1974). (Akkoyunlu & Soylu, 2008) stated that numerous studies have investigated the impact of learning styles in community college courses (Jones et. al, 2003, Terry, 2001).

Fewer studies have evaluated the students' perceptions in learning styles and blended learning environment (Lemire, 2002; Raschick, Maypole, & Day, 1998; Terrell & Dringus, 2000; Simpson & Du, 2004; Richmond & Liu 2005). The studies about learning styles mostly focus on the success of learners in traditional learning environments, attitudes towards learning environments or the rate of students' involvement in the learning environment (Akkoyunlu & Soylu, 2008). The researcher had found a lack in the literature about correlating the learning styles models with the Maritime Education and Training field. Moreover, researcher did not find literature covering the relation between learning styles and MET practical training aspect.

Definition of the term learning style has been presented by number of researchers in different way. Honey and Mumford (1992) defined learning styles as "a description of the attitudes and behaviours which determine an individual's preferred way of learning". While, Felder (1996) defined learning styles as “characteristic strengths and preferences in the ways learners take in and process information”.

Moreover, James and Gardner (1995) defined learning styles in more precise terms by stating that learning style is the “complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn” (Graf & Kinshuk, 2007).

People learn in different ways as they tend to adopt a particular strategy in learning (Akkoyunlu & Soylu, 2008). Most students have a preferred learning style but some may adapt their learning styles according to tasks (Pask, 1976a). Learning style also defined as personal qualities that influence a learner’s ability to acquire information, to interact with peers and the teachers, and participate in learning experiences (Grasha, 1996).

Learning styles are the traits that refer to how learners are approaching their learning tasks and processing information (Kemp, Morrison & Ross, 1998). As per Li (2015), he stated that learning style is a preferred way of thinking, processing, and understanding information.

Counting on the ideas and aspects of the meaning of learning styles, other terms such as learning strategy and cognitive style are often used in a similar context or even interchangeable to the term learning style. In the following paragraphs, definitions of the terms learning strategies and cognitive styles are introduced and the difference to learning styles is described.

Learning strategies is considered a short term methods, which students apply in a particular situation. These strategies can change by time, teacher, subject, and situation. When learning strategies are frequently used by students, learning styles can be derived from such strategies (Pask, 1976b).

Based on Pask’s work, Entwistle, Hanley, and Hounsell (1979) definition of learning strategy is “the way a student chooses to tackle a specific learning task in the light of its perceived demands” and learning style “as a broader characterisation of a student’s preferred way of tackling learning tasks generally”. Furthermore, they argued that distinct learning styles underlie learning strategies.

According to Jonassen and Grabowski (1993), learning styles can also be seen as applied cognitive styles in the domain of learning, removed one more level from pure processing ability. For measuring them, instruments are used that ask learners about their preferences. In contrast, cognitive styles are identified by task-relevant measures, which test the actual ability or skill. The next subsection introduces several commonly used learning models.

Subsequently, the implications of learning styles for education as well as criticism and challenges of the field of learning styles are discussed.

2.8.1 Common Learning Models

As stated previously in this chapter, a high number of learning style models exists in literature. Coffield, et. al (2004b) classified learning style models into 5 families which are based on some overarching ideas behind the models, attempting to reflect the views of the main theorists of learning styles. Coffield, Moseley, Hall, and Eccjestone (2004a) in the LSRC (Learning & Skills Research Centre) reference report stated that the first family based on the idea that learning styles and preferences are largely constitutionally based including the four modalities: visual, auditory, kinaesthetic, and tactile. While the second family based on the idea that learning styles reflect deep-seated features of the cognitive structure, including patterns of abilities. The third family refers to learning styles as one component of a relatively stable personality type.

In the fourth family, learning styles are seen as flexibly stable learning preferences. The fifth family moved from learning styles to learning approaches, strategies, orientations and conceptions of learning.

Table 2- 3: Summary of Described Learning Style Models (*Source: Graf, 2007*)

Learning styles as relatively stable personality type	Learning styles related to approaches and strategies	Constitutionally-based learning styles	'Flexibly stable' learning styles
Myers-Briggs	Pask	Dunn and Dunn	Kolb
	Entwistle	Gregorc	Honey and Mumford
	Grasha-Riechmann		Herrmann
			Felder and Silverman

The selection of these models is based on Coffield's review (Coffield, Moseley, Hall, & Ecclestone, 2004a), including models theoretical importance in the field, their widespread use, and their influence on other learning style models (Popescu, 2009). Additionally, the applicability of the learning style models in technology enhanced learning was considered as important criterion, including the application of learning style models in already existing systems as well as their potential to be used in a system.

Since this thesis focuses on reviewing literature about learning styles rather than cognitive styles, models that measure the cognitive abilities were excluded, as learning styles are seen as features of a cognitive structure. Table 2-3 shows learning style models grouped according to the classification by Coffield, et. al (2004b) and ordered according to the dependencies of the models among each other.

2.8.2 Grasha-Riechmann Learning Style Model

The Riechmann and Grasha (1974) focus on the students' social interaction with their teachers and fellow students in the classroom environment. Grasha and Riechmann identified three bipolar dimensions in order to understand the students' behaviour with respect to their social interaction: the participant/avoidant, collaborative/competitive, and dependent/independent dimension.

The *participant/avoidant* dimension indicates how much a student intending to become involved in the classroom environment. Students who adopt a participant style desire to learn the course content and enjoy attending the class.

They take responsibility for their own learning and enjoy participating in the learning activities. On the other hand, students who adopt an avoidant style do not like to learn and do not enjoy attending the class. They also do not take responsibility for their learning and avoid taking part in the course activities.

The *collaborative/competitive* dimension measures the motivation behind a student's interactions with others. Collaborative learners are learners who are cooperative, enjoy working with others, and see the classroom as a place for learning and interaction with others. On the other hand, competitive learners see their fellow students as competitors. They have the motivation to do better than others, enjoy competing, and see the classroom as a win-lose situation.

The *dependent/independent* dimension measures attitudes towards teachers and how much the student's desire freedom or control in the learning environment. Dependent students see the teacher as the source of information and structure. They want to be told what to do and learn only what is required. Independent learners are characterised as confident and curious learners. They prefer to think for themselves and work on their own.

For measuring the preference of students with respect to the six learning styles, a 90- item self-report inventory was developed called Student Learning Styles Scale (SLSS). The questionnaire is addressed in particular for college and high school students. It is divided in six subcategories, each for one learning style.

Each subcategory consists of 15 questions. Students are asked to rate their agreement or disagreement to the questions on a 5-point Likert scale. Considering the issue that the styles may change from class to class for each student, two different forms are designed; one assesses a general class, and a second that relates to a specific course.

2.8.3 Dunn and Dunn Learning Style Model

The Dunn and Dunn learning style model (Dunn & Dunn, 1974; Dunn & Griggs, 2003) was proposed in 1974 and then had been refined and extended over years. The model includes five variables where each variable consists of several factors. The *environmental* variable includes sound, temperature, light, and furniture design. The *sociological* variable incorporates factors dealing with the preference for learning, alone, in a pair, in a small group, as part of a team, with an authority, or in varied approaches.

The *emotional* variable consists of the factors of motivation, conformity/responsibility, persistence, and need for structure. The *physical* variable is comprised of factors regarding perception/modality preferences (visual, auditory, tactile/kinaesthetic external, kinaesthetic internal), food and drink intake, time of day and mobility. The *psychological* variable was added later to the model and includes factors referring to global/analytic preferences, and impulsive/reflective preferences.

In order to detect the learning style preferences according to the Dunn and Dunn learning style model, different versions of questionnaires were developed.

2.8.4 Gregorc's Mind Styles Models

Gregorc's mind style model (Gregorc, 1982a; Gregorc, 1982b; Gregorc, 1985) is based on two dimensions dealing with the preferences for *perception* and *ordering*. Regarding perception, people can prefer an abstract or concrete way of perception, or some combination of both. Abstract perception refers to the process information through reason and intuition. In contrast, concrete perception emphasises the physical senses and refers to the ability to process information through these senses. The way a learner is arranging, prioritising, and using information in either a sequential or random order, or combining both. While a sequential style uses a linear, step-by-step scheme, a random order. The perceptual and ordering preferences can be combined into four basic mediation channels which lead to four types of learners.

The *concrete sequential* learners prefer to use their five senses for processing information and are considered as orderly, logical, and sequential. These learners look for authority and guidance in a learning environment and prefer to extract information from hands-on experiences. The *concrete random* learners need to experiment with ideas and concepts and will employ trial-and-error in learning. They like to explore the learning environment, are considered as insightful, can easily move from facts to theory, and do not like authoritative interventions.

The *abstract sequential* learners have their strengths in the area of decoding written, verbal, and image symbols. They prefer rational and sequential presentations and are good in synthesising ideas and producing new concepts or outcomes to new conclusions. They will defer to authority and has a low tolerance for distractions.

The *abstract random* learners are characterised by a keen awareness of human behaviour and an ability to evaluate and interpret atmosphere and mood. They prefer an unstructured learning environment and collaborations with others, they tend to be reflective and need time to process data before reacting to it. A description about the characteristics and preferences of the four types of learners is provided by Gregorc (1982a; 1982b).

The Gregorc Style Delineator (Gregorc, 1982b; Gregorc, 1985) is a self-report instrument to detect learners' preferences for the two dimensions and therefore their preferred channels. The instrument presents the students with 40 words arranged in 10 columns of four items each. The learners are then asked to rank the four words relative to how they fit to themselves (1 for being least and 4 for being most like themselves). Scores for each of the four learner types can range from 10 to 40, calculated by summing up the ranks of the respective words for each channel.

2.8.5 Kolb's Learning Style Model

The learning style theory by Kolb (1984) is based on the Experiential Learning Theory, which models the learning process and incorporates the important role of experience in this process. Following this theory, learning is conceived as a four-stage cycle.

Concrete experience is the basis for observations and reflections, these observations are used to form abstract concepts and generalisations, which again act as basis for testing implementations of concepts in new situations. Testing implementations results in concrete experience, which closes the learning cycle (Graf & Kinshuk, 2007).

According to this theory, learners need four abilities for effective learning: a) Concrete Experience abilities, b) Reflective Observation abilities, c) Abstract Conceptualisation abilities, and d) Active Experimentation abilities. On closer examination, there are two polar opposite dimensions: *concrete/abstract* and *active/reflective*. Kolb (1981) described that "as a result of our hereditary equipment, our particular past life experience, and the demands of our present environment, most of us develop learning styles that emphasise some learning abilities over others".

Based on this assumption, Kolb identified four types of learning styles.

Convergers' dominant abilities are abstract Conceptualisation and active experimentation. Therefore, their strengths lie in the practical applications of ideas. The name "Convergers" is based on Hudson's theory of thinking styles (Hudson, 1966), where convergent thinkers are people who are good in information gathering and facts, then putting them together to derive a single correct answer to a specific problem.

In contrast, *Divergers* excel in the opposite poles of the two dimensions, namely concrete experimentation and reflective observation. They are good in viewing concrete situations in many different perspectives and in organising relationships to a meaningful shape. According to Hudson, a dominant strength of Divergers is to generate ideas and therefore, Divergers tend to be more creative.

Assimilators excel in abstract Conceptualisation and reflective observation. Their strength lies in creating theoretical models. They are good in inductive reasoning and in assimilating unrelated observations into an integrated explanation.

Accommodators are the contrary of Assimilators. Their dominant abilities are concrete experience and active experimentation. Their strengths lie in doing things actively, carrying out plans and experiments, and becoming involved in new experiences, they are also characterised as risk-takers and as people who excel in situations that call for adaptation to specific immediate circumstances.

For identifying learning styles based on Kolb's learning style model, the Learning Style Inventory (LSI) was developed (Kolb, 1976) and revised several times (Graf & Kinshuk, 2007). The current LSI version (Kolb & Kolb, 2005) uses a compulsory grading technique to assess a candidate's learning preferences (Concrete Experience, Reflective Observation, Abstract Conceptualisation and Active Experimentation). Individuals are asked to complete 12 sentences about their preferred way of learning. Each sentence has four endings and the individuals are asked to rank the endings according to what best describes how they learn (4 = most like you; 1 = least like you). The results of the LSI indicate the individuals' preferences for the four modes.

Furthermore, their score for the active/reflective and concrete/abstract dimensions can be derived from the preferred modes, which again lead to the preferred type of learning style.

2.8.6 Honey and Mumford's Learning Style Model

The learning style model by Honey and Mumford (1982) is based on Kolb's Experiential Learning Theory and is developed further on the four types of Kolb's learning style model (Kolb, 1984). The active/reflective and concrete/abstract dimensions are strongly involved in the defined types as well. Furthermore, Honey and Mumford stated that "the similarities between his model [Kolb's model] and ours are greater than the differences" (Honey & Mumford, 1992).

As described by Graf (2007), Honey and Mumford's learning style model the types are called: Activist (similar to Accommodator), Theorist (similar to Assimilator), Pragmatist (similar to Converger), and Reflector (similar to Diverger). *Activists* involve themselves fully in new experiences, are enthusiastic about anything new, and learn best by doing something actively.

Theorists excel in adapting and integrating observations into theories. They need models, concepts, and facts in order to engage in the learning process. *Pragmatists* are interested in real world applications of the learned material. They like to try out and experiment on ideas, theories, and techniques to see if they work in practice. *Reflectors* are people who like to observe other people and their experiences from many different perspectives and reflect about them thoroughly before coming to a conclusion, for reflectors, learning occurs by observing and analysing the observed experiences.

The Learning Style Questionnaire (LSQ), a self-report inventory for identifying learning styles based on the Honey and Mumford learning style model, as well as its manual was initially developed in 1982 (Honey & Mumford, 1982), revised in 1992 (Honey & Mumford, 1992) and then replaced in 2000 (Honey & Mumford, 2000) and then revised in 2006 (Honey & Mumford, 2006). Currently, two versions of the LSQ exist, one with 80 items and one with 40 items.

2.8.7 Herrmann "Whole Brain" Model

The Herrmann "Whole Brain" model (Herrmann, 1989) is based on the split brain research that was carried out by Sperry (1964), separating the brain in the *left and right cerebral hemispheres*. In addition, the Herrmann "Whole Brain" model considers, following MacLean (1952), the hypothesized functions of the brain's limbic system.

Accordingly, individuals are modelled with respect to how they process information using either a *cerebral mode*, by thinking about the problem, or a *limbic mode*, which is a more active approach based on experimentation.

The Herrmann "Whole Brain" model distinguishes between four modes or quadrants. Learners who have a primary preference for quadrant A (*left hemisphere, cerebral*) prefer logical, analytical, mathematical, technical thinking and can be considered as quantitative, factual, and critical. Learners with preference for quadrant B (*left hemisphere, limbic*) tend to be sequential and organised, like details, structure and plans and have a structured, Organisational and controlled thinking style. Learners with preference for the quadrant C (*right hemisphere, limbic*) are characterised as emotional, interpersonal, sensory, kinaesthetic, and musical. Learners who have a preference for quadrant D (*right hemisphere, cerebral*) tend to be visual, holistic, and innovative and prefer conceptual, synthesising, and imaginative thinking.

In order to identify the preferred quadrant, the Herrmann Brain Dominance Instrument (HBDI) was developed (Herrmann, 1989). The HBDI is a self-report inventory, containing 120 questions. As a result of the HBDI, a brain dominance profile is calculated, which shows individual's primary, secondary and tertiary preferences.

2.8.8 Felder-Silverman Learning Style Model

In Felder-Silverman learning style model (FSLSM) (Felder & Silverman, 1988), learners are described by four dimensions. These dimensions show how learners prefer to process (active/reflective), perceive (sensing/intuitive), receive (verbal/visual), and understand (sequential/global) information. Felder and Silverman describe the learning styles by using scales from +11 to -11 for each dimension (including only odd values). Therefore, the learning style of each learner is characterised by four values between +11 and -11, one for each dimension (Graf, Lin, & Kinshuk, 2008).

These scales are describing the learning style preferences in details. Additionally, the usage of scales allows expressing balanced preferences, indicating that a learner does not have a specific preference for one of the two poles of a dimension. Furthermore, Felder and Silverman consider the resulting preferences as tendencies, meaning that even a high preference learner for a particular learning style can act differently sometimes.

The *active/reflective* dimension is equivalent to the respective dimension in Kolb's model (1984). Active learners learn by working actively with the learning material, by applying the material, and by trying things out. Moreover, they tend to be more interested in communicating with others and prefer to learn by working in groups to discuss about the learned material. In contrast, reflective learners prefer to think about and reflect on the material. Concerning communication, their preference is to work alone or in a small group together with one good friend.

The *sensing/intuitive* dimension is taken from the Myers-Briggs Type Indicator (Myers, 1962) and has also similarities to the sensing/intuitive dimension in Kolb's model (Kolb, 1984). Learners with a sensing learning style like to learn facts and concrete learning material, using their sensory experiences of particular instances as a primary source. They like to solve problems with standard approaches and also tend to be more patient with details (Graf, Kinshuk, & Liu, 2009).

Furthermore, sensing learners are considered realistic and sensible; they tend to be more practical than intuitive learners and tend to relate the learned material to the real world. In contrast, intuitive learners prefer to learn abstract learning material, such as theories and their underlying meanings, with general principles rather than concrete instances being a preferred source of information. They like to discover possibilities and relationships and tend to be more innovative and creative than sensing learners.

Therefore, they score better in open-ended tests than in tests with a single answer. This dimension varies from the active/reflective dimension in a significant way, as the sensing/intuitive dimension deals with the preferred source of information while the active/reflective dimension covers the process of transforming the perceived information into knowledge, whilst the third dimension, were *visual/verbal* dimension deals with the preferred input mode. The dimension differentiates learners who remember best what they have seen (e.g., pictures, diagrams, flow-charts), from learners who get more out of textual representations, regardless of the fact whether they are written or spoken.

Moreover the fourth dimension, learners are distinguished between a *sequential and global* way of understanding. This dimension is based on the learning style model by Pask (1976b), where sequential learners refer to serial learners and global learners refer to holistic learners. Sequential learners learn in small incremental steps and therefore have a linear learning progress. They tend to follow logical stepwise paths in finding solutions.

In contrast, global learners use a holistic thinking process and learn in large leaps. They tend to absorb learning material almost randomly without seeing connections but after they have learned enough material they get the whole picture. Then they are able to solve complex problems and put things together in novel ways; however, they have difficulties in explaining how they did it. Because the whole picture is important for global learners, they tend to be more interested in overviews and in a broad knowledge, whereas sequential learners are more interested in details (Graf, Viola, Kinshuk, & Leo, 2006).

For identifying learning styles based on the FSLSM, Felder and Soloman developed the Index of Learning Styles (ILS), a 44-item questionnaire. As mentioned earlier, each learner has a personal preference for each dimension. These preferences are expressed with values between +11 to -11 per dimension, with steps +/-2. This range comes from the 11 questions that are posed for each dimension (Graf, Viola, Leo, & Kinshuk, 2007).

2.8.9 Implications of Learning Styles in Education

Through reviewing the literature, researchers and theorists consider learning styles as an important factor in the learning process and see incorporating them in education has a positive potential to make learning easier for students. Furthermore, Felder argued that learners with a strong preference for a specific learning style might face difficulties in learning if their learning style is not supported by the teaching environment (Felder & Silverman, 1988). Thus, from a theoretical aspect, it can be argued that incorporating the learning styles of students makes learning easier for them and increases their learning efficiency. On the contrary, learners who are not supported by the learning environment may experience problems in the learning process.

Graf (2007) mentioned that learning styles can be considered in different ways in education. A first step is to make learners aware of their learning styles and presenting their individual strengths and weaknesses. The knowledge about learners' learning styles helps them to understand why learning is sometimes difficult for them and to develop their weaknesses.

Furthermore, students can be supported by matching the teaching style with their learning styles. Accordingly, providing them with learning material and activities, that fit their preferred ways of learning, in order to make learning easier for them. However, the matching approach aims at a short-term goal, namely to make learning as easy as possible at the time students are learning. However, at long-term goals, educational theorists such as Kolb (1984) and Grasha (1984) suggested that learners should also train their not-preferred skills and preferences. They argued that learners are required to adapt to a variety of instructional methods and styles.

The learners' ability to adapt to different instructional styles will prepare them with important skills. For example, providing visual forms of instruction to verbal learners will force them to develop their visual skills. For Grasha, the mismatching approach is relevant in order to make learning interesting and challenging for students and Kolb argued that the educational objectives for mismatching are personal growth and creativity.

On the other hand, in Gregorc's model, learning styles are seen stable, and he argued that a mismatched approach can harm students (Gregorc, 2002). Felder advises against the unintentional, permanent mismatch of teaching styles and learning styles, where teachers are unaware of their own learning styles and may, as a result, teach only according to this style, thus favouring certain students and disadvantages others (Felder, 1993).

Summarising these aspects, conclusion can be drawn that the learning style in matching and mismatching approach should be applied intentionally and depending on the learner's needs. In an environment, where students get their individual learning material and activities, the matching and the mismatching approaches can be applied in a regulated method, depending on specific circumstances such as the current learning goal, the experience of the learner in a specific subject, their motivation, the learning environment and so on.

A less demanding approach for teachers is to support their learners by including learning material and activities in their courses that address different learning styles rather than teaching in a way that contain only one learning style.

For example, if the learning material consists mainly of abstract material, teachers can include some concrete examples to support a sensing/concrete learning style or if the teacher is mainly lecturing in the course, he/she can consider adding some group work activities in order to support active learner. By adopting different learning styles, some activities match with the student's strength and some other with their weakness. Accordingly, the composition is not controlled since the course is the same for all students.

2.9 Learning Styles Critique

The field of learning style is multifaceted and although a lot of research has been conducted, important questions are still unanswered and debatable issues are under debate. The challenge is to clarify these debatable issues, answer the open questions and provide a clear understanding.

Currently, plenty of learning style models exists, each integrating some aspects of learning, and some of them overlapping with each other. Such amount of learning style models leads to criticism and to the question of how to integrate all different dimensions of learning styles in different courses, were each course has special requirements and outcomes within an integrated educational process, from a practical view; which learning style model is most appropriate to be used with the cadets training on-board the training vessel. Furthermore, the similarities and relationship between these different learning style models and dimensions are mostly not elaborated.

Accordingly, an existing challenge of the field of learning styles is to carry out research that involves all learning style models and dimensions, fetch clarity in its relationships to each other as well as to other relevant factors of learning (e.g., cognitive styles and cognitive abilities), evaluate them in order to discover major learning style models/dimensions, and build up a holistic model that integrates all relevant aspects of learning styles.

Furthermore, few debatable issues such as whether learning styles are stable or not over time, subject and environment should be clarified. Depending on the basic ideas behind the learning style models, theorists and researchers made different point of views for the degree of stability in their learning style models. Some researchers and theorists in this aspect state that learning styles similar to learning strategies, a flexible and changeable from context to context and even from task to task. Some other researchers and theorists see learning styles as “flexibly stable”, arguing learner previous learning experiences and other environmental factors form the learning styles of learners. While, others link learning styles strongly to cognitive styles and abilities and argue that they are stable over a long period of time or even see them as God-given and not changeable.

However, based on the incorporation of dimensions in different models with different ideas about the stability, controversial issues occur. For example, the serial and holistic learning style by Pask (1976b) is related to the sequential and random style by Gregorc (1982a). However, Pask considers the dimension as relatively flexible while Gregorc claims that the learning styles are not changeable. Therefore, future research is needed in order to shed light on the stability of specific dimensions as well as learning style models.

Another issue concerning the implications of learning styles in education, inconsistent results are obtained by studies dealing with studying the reflection on achievement when providing matched and mismatched instructions for learners with different learning styles.

Yet the overall impression is that even if the concept of learning style were acceptable, the prospect of matching is unrealistic and largely unsupported by research (Doyle & Rutherford, 1984).

Joughin (1992) criticizes the assumption that matching will enhance learning as simplistic, ignoring "both the potential value of creatively mismatching teacher and learner and the equivocal outcomes of research on matching itself, a view shared by Ruble and Stout (1993) in particular reference to LSI.

Currently, no unchallenged and hard evidence exist that learning style matching approach has a significant positive effect on the students' achievement (Coffield et. al, 2004b). As Jonassen and Grabowski (1993) summarised, several reasons for such inconsistent results are known in the field of aptitude-treatment interaction (ATI) research.

Limitations might include "small samples size, abbreviated treatments, specialised aptitude constructs or standardised tests, and a lack of conceptual or theoretical linkage between aptitudes and the information-processing requirements of the treatment" (Jonassen & Grabowski, 1993). This conclusion shows that more research is required to get a clear result about the effect of specific learning styles and other factors on achievement.

However, the main criticism regarding the matching approach is that it is simply "unrealistic, given the demands of flexibility it would make on teachers and trainers" (Reynolds, 1997). In traditional learning, teachers are required to routinely change their teaching style to accommodate the different learning styles in a class.

Therefore, the feasibility of the matching approach is depending on the number of students and on the adopted learning style model. Pask (1976b), for example, distinguishes between three learning styles, Honey & Mumford (1982) propose four types of learners, the Myers-Briggs Type Indicator (Myers, 1962) includes 16 different types and in the Felder-Silverman learning style model (Felder and Silverman, 1988), learners can have up to 625 (=5^4) different learning styles when arranging each of the four dimensions into five groups (e.g., strong active, moderate active, balanced, moderate reflective, strong reflective).

Therefore, teachers in a traditional class might not have the capacity to provide each learner with an individual combination of learning material and activities, considering the number of students and their number of different learning styles. However, in the proposed iMET as technology enhanced learning tool, changing the teaching styles to fit each student.

Therefore, tailoring courses to the individuals' needs is possible, even for a high number of individuals with different learning styles. Many researches are carried out in the area of adaptive educational systems, and recently more researchers are dealing with personal characteristics of learners, such as learning styles (Graf, 2007).

In Chapter 5, an approach for the proposed Interactive Maritime Education and Training iMET application associated with adaptive educational resources in order to provide adaptive maritime courses for the deck cadets in a holistic perspective, inspired by the Felder-Silverman learning style model is introduced.

Another point of criticism is the method for measuring learning styles. Most learning style models provide a questionnaire or an instrument to measure students' learning style, where students are asked about their preferences with respect to the learning style model. These questionnaires raise several problems (Graf, 2007).

Questionnaires, in general, have to deal with a problem were given answers might not correspond or reflect the real behaviour the questions aim to investigate (Draper, 1996; Paredes & Rodriguez, 2004). The use of questionnaires in general and as an instrument for identifying learning styles is based on several assumptions as follows:

Firstly, the assumption is made that students are motivated to fill out the questionnaire properly according to their knowledge about their preferences. Secondly, filling out a questionnaire about the preferred way of learning requires that the students are aware of their preferred way of learning.

However, Stash, Cristea, & De Bra (2006), for example, identified that the Masters students participating studies about adaptation to learning styles had only little meta-knowledge on their own learning preferences, and Merrill (2002), for example, even argued that most students are unaware of their learning styles. Thirdly, social and psychological aspects such as the students' beliefs about how people should behave can influence their answers on the questionnaire.

Furthermore, using questionnaires for identifying learning styles within the debate whether that the learning styles are stable for a long period of time or not, the results of the questionnaires might not be valid anymore by time and students would have to do it again to identify their new learning styles, if it was not stable. However, this will cause new issues, concerning investigating how to motivate students to fill out the questionnaire number of times.

Another issue is the validity and reliability of the questionnaires. According to (Coffield, Moseley, Hall, & Ecclestone, 2004b), four criteria have to be fulfilled for any instrument that will be used to redesign pedagogy: construct validity, predictive validity, internal consistency reliability, and test-retest reliability. Most learning style questionnaires are tested according to these criteria. However, instruments often lack one or several of these criteria, researchers achieve inconsistent results or even identify latent dimensions. Coffield, Moseley, Hall, and Ecclestone (2004b) argued that from the 13 major learning style models they have identified and studied, only three of the models “could be said to come close to meet such criteria”.

Another point that has to be highlighted, which is focusing on tailoring courses through identifying the learning styles without considering the complex socio-political forces in the larger society, ‘personal warmth, trust and community’(Giroux, 1981), or the different perspectives of feminist and anti-racial behaviour.

Laurillard’s *1979* conclusion is more convincing. She wrote: “It would therefore be hazardous for an investigation of learning to proceed on the assumption that learning is a process that is independent of external factors, or those students’ posses’ inherent, invariant styles of learning”. And, “Learning should be studied in the context in which it occurs, rather than in the laboratory, and one way of beginning this difficult task is ... to make use of students' awareness of what they are doing and why.” Laurillard (1979: 408).

That was supported by, Curry (1983), who proposes that learning style theories and their supporting instruments can be thought of in three levels, resembling layers of an onion. This model has “ cognitive personality style” as relatively stable at the core, an intermediate and less stable layer of “information processing style” (Kolb LSI, for example), and an outer layer called “instructional format preference indicator” allowing for the individual’s choice of learning environment. However, in the proposed iMET as technology enhanced learning tool, made setting these three levels stated by Curry (1983) is possible.

From all these argumentations, the conclusion can be derived that questionnaires have to deal with several problems and restrictions. People who are using such questionnaires for identifying learning styles should therefore be aware of these problems and restrictions as well as consider the limitations of the questionnaires when interpreting the results, therefore the proposed iMET tool did not apply an instrument to measure cadets/students learning style. Since the proper identification of learning styles is a crucial issue, and to develop an approach that measures learning styles more accurately and reliably is not within the scope of this study. In Chapter 5, the researcher will introduce an approach to conduct TEL based Maritime Education and Training on-board the training vessel, which aims at overcoming the above mentioned problems concerning learning styles arguments and restrictions of questionnaires.

2.10 Learning Style Adapted in iMET

The proposed iMET tool developed in this study was inspired by FSLSM model, as information about learning styles is critical when categorizing relationships between learning styles and the performance of students in an online course (Allinson & Hayes, 1996).

FSLSM is used often in researches related to learning styles in advanced learning technologies. According to Carver, Howard, and Lane, (1999), “the Felder Model is most appropriate for hypermedia courseware”. Kuljis and Liu, (2005) confirmed this by conducting a comparison of learning style models with respect to the application in e-learning and Web-based learning systems.

As a result, they also suggest FSLSM as the most appropriate model. Moreover, it focuses on aspects of engineering education and is very popular among engineering educators, as it was developed specifically for use in engineering education (Ipbuker, 2009). This is a close type of education to MET different fields.

There are four dimensions in FSLSM that were covered in planning the iMET technological tool within the virtual teaching/ training environment on-board the training ship as follows:

The first dimension covers active-reflective: Active learners learn best by working actively with the learning material, by applying the material, and by trying things out. In contrast, reflective learners prefer to think about and reflect on the material.

This dimension is adapted in the proposed technological tool by adding a Texts and narrated clips classified into three categories (Overview, tutorial and inspection) in addition to the learner presence in the real work environment to provide direct interaction with the educational items on-board. In order to make the leaner being able to try things out and to think about reflect on the items being trained on.

The second dimension covers sensing-intuitive: Sensing learning style like to learn facts and concrete learning material, sensing learners are considered to be more realistic and sensible. In contrast, intuitive learners prefer to learn abstract learning material, such as theories and their underlying meanings.

This dimension is adapted in the proposed technological tool by adding detailed texts and images covering the theory, its function and method of using it in a detailed way supported by the item being trained on references in the affiliated maritime conventions and regulations, in the real workplace.

The third dimension covers visual-verbal: Are learners who learn from what they have seen (e.g., pictures, diagrams and flow-charts), and learners who get more out of textual representations, regardless of whether they are written or spoken.

This dimension is adapted in the proposed technological tool by adding images, diagrams and English language narrated clips, classified into three categories (Overview, tutorial and inspection) to cover all the required training materials of the item being trained on.

The fourth dimension covers sequential-holistic: Sequential learners learn in small steps and therefore have a linear learning progress. They tend to follow logical paths in finding solutions. In contrast, holistic learners use a holistic thinking process and learn in large leaps. They tend to absorb learning material almost randomly without seeing connections but after they have learned enough material they suddenly get the whole picture.

This dimension is adapted in the proposed technological tool by all previously mentioned added training materials in addition the learners presence in the real work place in order to enhance his/ her logical and thinking process.

Finally, it can be concluded that several debates and unsolved problems still exist in the field of learning styles. It seems that we are still far away from a model of learning styles that integrates all relevant aspects of learning styles and provides a clear understanding.

However, the debate and criticism of learning styles show challenges in the field, in addition to the lack of any previous studies about applying learning styles in the MET process, especially in the MET practical training on-board a ship.

This thesis is an intervention that tackles some of the challenges and introduces new interactive TEL approach, which contributes to get closer to solve some of the mentioned problems in the Maritime Education and Training, and to be a mile stone in applying the learning styles in within a VLE for marine cadets’ practical training, as described in chapter 5.

The researcher after reviewing literature findings, researcher planned a holistic learning/ training model that integrates all relevant aspects of learning styles reviewed in the literature, which is inspired mainly by FSLSM as discussed previously in this chapter, and a prototype had been developed accordingly as a proof of concept presented in chapter 5.

A holistic learning style adopted in the proposed iMET tool, in order to avoid many confusing points such as learning style multifaceted issues and unanswered questions and debatable issues, such as using questionnaires for identifying learning styles, and the question whether learning styles are stable or not over time, subject and environment.

Although the proposed iMET application is inspired by FSLSM model, it also aligns with Kolb (1984) experiential learning theory. As iMET application is rich with its educational resources that are represented in different methods, such as text, video, audio, figures and diagrams, which is classified into three categories (Overview, tutorial and inspection) to cover all the required training materials, in addition to being in the real workplace. iMET complies with Kolb (1984) experiential learning theory four elements (Concrete experience, Reflective Observation, Abstract Conceptualisation and Active experimentation).

Moreover, iMET application aligns with Kolb (1984) six main characteristics of experiential learning, as the proposed iMET application has a holistic process that is adapted within a learning environment represented in the real workplace, also iMET involves a transaction between the student/ cadet and the surrounding environment, moreover the training through iMET is a process grounded in experience, that is carried out in groups, so the process of creating knowledge will be a result of a transaction between social knowledge and personal knowledge.

2.11 Online and Mobile Learning

This section discusses online learning and mobile learning, aiming to integrate the previous literature review regarding learning style in to personalised online e-learning application in a mobile learning context, to be tailored for maritime education and training phase on-board the academy training ship, in this section the terms e-learning and online learning will be used interchangeably, as the proposed iMET system is an e-learning one, on-board the training ship, that it is connected to an internal local network on-board the ship, while it connects and synchronies with the AASTMT headquarter overseas occasionally, whenever internet connection is available within the ship's route as described in chapter 5.

Online learning has grown in the recent years. Where, online and e-learning instruction continues to evolve, considerations for designing an online or e-learning instruction tool that supports learners in their learning or training, in the context of mainly marine cadets as the focus group in this study. In order to address a tool that will be able to work effectively and efficiently and to be competitive in the current age of developing technology and knowledge is a critical challenge, especially when combining learning styles and learner-centred e-learning program design to support the practical maritime on-board training, however in the Maritime Education and Training such technological tools are not existed till now.

E-learning systems generally have several names: Virtual Learning Environment (VLE), Learning Management System (LMS), Course Management System (CMS), Learning Content Management System (LCMS), Managed Learning Environment (MLE), Learning Support System (LSS) and Learning Platform (LP). In Europe the term VLE is mostly used, but in United States the term CMS is favoured over others (Kanninen, 2009).

Today's learners are capable to use different methods to learn and gain the required knowledge. One of these methods is e-learning as a technology based tool is inclusive of using of personal computers, handheld devices and Internet or within a local area network. The attractive side of online learning or e-learning is that education or training services comes to the learner within a flexible usage of it. The ability of online learning to perform an efficient instructional and training design is getting more challenging and difficult nowadays, if the intended e-learning tool will consider the learners learning preferences, while learners' learning characteristics are not being known.

However, to bring an effective learning for the learners in e-learning or online learning environments, needs and expectations of the learners in these environments are comprehended as discussed in chapter 4 and development of convenient environments as presented in the development on iMET tool in chapter 5, which are adequate for different learning styles are required. Technology density environments cause a change of learning styles of the learners and bring up a concept that is “online learning style” to the agenda (Dağa & Geçerb, 2009).

In the literature, the discussion of the online learning has been used different terminologies. Accordingly, makes it difficult to develop a generic definition. Terms that are commonly used in the literature includes terms such as, e-learning, Internet learning, distributed learning, networked learning, tele-learning, virtual learning, computer-assisted learning, Web-based learning, and distance teaching.

In the literature, there are many definitions that are reflecting the diversity of existing practices and incorporated technologies of e-learning and online learning. While some researchers are defining online learning as an educational material that is presented on a personal computer, other researchers defines online instruction as an innovative approach for delivering instruction to a remote audience, using the Web as the medium.

Kanninen (2009) presented online learning as the learning that takes place in a network; such network could be the Internet, or just a school’s or institute’s internal closed network. Ally (2004) stated 6 synonyms used for online learning: e-learning, Internet learning, distributed learning, networked learning, tele-learning, virtual learning, computer-assisted learning, web-based learning, and distance learning. Consequently, in online learning the learner is at a distance from the instructor and the learner uses forms of technology to access the learning materials through a personal computer.

According to (Ally, 2004) online learning can be divided into three classes:

- Contact learning supported by the net
- Multiform learning in the net
- Self-studying in the net

2.11.1 iMET Online Learning

Online learning sometimes referred to as e-learning or distance learning. In this study were the researcher is proposing iMET technological online tool as a generic application for marine cadets training on-board a training ship, in this research online learning adopted the ASTD (American Society for Training & Development) definition, which describes it as education which is facilitated and supported via information and communications technology (ICT) (Franetovic, 2012). ASTD states that e- learning is:

“A broad set of applications and processes that include web-based learning, computer- based learning, virtual classrooms, and digital media. These applications and processes are delivered via the Internet, intranet, audio, satellite broadcast, interactive TV, and CD- ROM. The definition of e-learning varies depending on the Organisation and how it is implemented, but basically it involves electronic means of communication, education, and training” (Franetovic, 2012).

Moreover, McGill and Hobbs (2007) mentioned that a virtual learning environment (VLE) is an information system that facilitates e-learning. In this study the training ship will be a virtual learning environment for the marine cadets on-board, during their practical training phase. Where, VLEs process, store and disseminate educational/ training material and support two ways communication associated with teaching, learning and training. Virtual learning environments (VLEs) are widespread in higher education today, typically used to deliver instructional materials and facilitate communication within a course.

Briefly, we can define online learning in this thesis as an approach to a TEL (Technology Enhanced Learning), in a self-regulated method, which utilises ICT to maximise the acquisition and processing of the knowledge within a VLE (Virtual Learning Environment) as a learner centred educational framework.

Our conception of education is that it should help cadets/ students to develop their personalities and to cope with the tasks and challenges that arise from their virtual learning environments. More formally, education should assist young people in developing meaningful goals and provide them with the knowledge and skills to achieve these.

To the extent that they manage to monitor and control the activities to reach their goals, they are said to self-regulate these activities (Steffens, 2006).

The online environment calls for students to demonstrate self-regulated learning (Ally, 2004). Dabbagh (2007) characterised successful online learners by those who exhibited self-directed learning skills. Self-regulated learning has been framed in the online education context by Carson (2012) research as an active, constructive process whereby learners set goals for their learning/ training, and then to monitor, regulate and control their cognition, motivation and behaviour, guided and constrained by their goals in their environments (Bandura, 2001; Pintrich & De Groot, 1990; Schunk, 2005; Zimmerman, 2002). The processes of self-regulation as a reciprocal cycle consisting of forethought, performance and self-reflection (Figure 2-4). iMET application proposed in this study had considered that each of the phases consists of sub processes that play a greater or lesser part in learning depending on the task, the learner, and the environment (Carson, 2012).

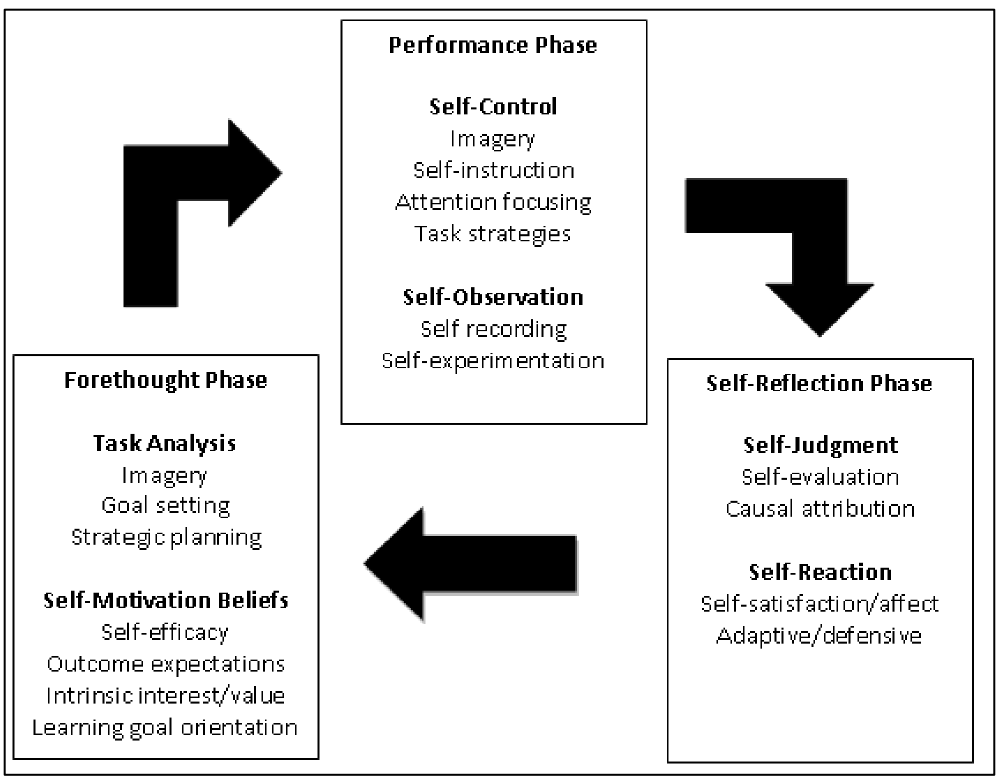


Figure 2- 4: Phases and Sub-processes of Self-regulation (*Source: Zimmerman & Campillo, 2003)*

Manochehr (2006) supported iMET technological tool development concept, through his study where he compared "the effects on e-learning versus those on traditional instructor-based learning, on student learning, based on students learning styles". The result was that learning style in traditional learning was irrelevant, while in e-learning it was very important. The study showed that learners with an assimilating or converging learning style achieved better learning results in e-learning.

Moreover, Dağa & Geçerb (2009) supported the concept of incorporating the learners' learning preferences in an online tool, which is considered within iMET proposed tool in this study, as recent developments of the online learning are also related to Adaptive educational Hypermedia Systems (AEHS). An AEHS aims to build a model of the goals, preferences and knowledge of each learner and use this model throughout the interaction with the leaner, in order to adapt learning content to the needs of the learner's (Brusilovsky, 1996).

AEHS can support learners in their navigation by limiting browsing space, suggesting most relevant links to follow, or providing adaptive comments to visible links (Brusilovsky, 2003). AEHS researches are centred on learning style based personalisation researches (Brown, Stewart, & Brailsford, 2006; Paredes & Rodriguez, 2004; Piombo, Batatia, & Ayache, 2003; Graf, 2007).

2.11.2 Mobile Learning

We are living now in the Mobile age, where users want to be connected everywhere all the time through affordable devices (De Waard, 2014). Mobile devices support students' continues communication and support the ability to access information inside and outside students' learning environment (Cristol & Gimbert, 2013). Mobile learning is very flexible as it can be anytime, anywhere learning and supports learner-centred education (Haghshenas & Jeddi, 2013). The increasing availability of full featured mobile devices and smart phones with high speed internet connectivity will change the student access inside and outside the university/ academy.

The questionnaire survey that had been conducted to students/ cadets during their training semester on-board the training ship revealed that 100% of the cadets own at least one of these smart mobile devices, noticeably more cadets are using their smartphones and tablets for academic or training purposes, that aligns with Dahlstrom and Jacqueline (2014) where the increasing usage of smartphones and tablets by students was noticed in the academic purposes when instructors encourage their usage in class.

Usage of personal smartphones and mobile devices in learning exist in the literature and it became accepted by education community (Santos, 2013; Wang et al., 2009; Haghshenas & Jeddi, 2013). Due to the increasing usage of mobile devices in learning and training, universities, policy-makers and specialists are responding to this pressure and rising interest by development of systems and applications, to merge the mobile devices learning with the main stream that is known as e-learning, where attention towards mobile learning is based on devices owned by learners (Traxler & Wishart, 2011).

Using mobile devices in the learning process can support learning experience and students' engagement, in addition to reinforcing difficult learning concepts (Foti & Mendez, 2014). Moreover, usage of mobile devices in the education process will enable students' access to information, and raise peer-to-peer collaboration without location or time restrictions (Lauricella & Kay, 2010; Sarkar, 2012).

While on the other hand, researches stated that mobile devices can distract students (Fried, 2008; Lauricella & Kay, 2010), McCoy (2013) mentioned that if the students were given the opportunity to use their mobile devices, nearly all of them will use their devices for non-instructionally purposes during class. The counter argument of these point of views, that negative effects of using technology take place when replacing manual activities rather than applying technology in a meaningful and interactive way, to engage the student in the learning process, which is the philosophy used in this research in developing a generic interactive maritime education and training tool iMET, that aligns with Dahlstrom and Jacqueline (2014) who stated that mobile devices can be used in methods that will enhance learning and engagement rather than detract from the learning process.

Studies showed that using mobile devices owned by the student will be more comfortable and student will be more confident when using his own mobile in the learning process, rather than using a borrowed one or the institution device (Murphy et al., 2014). Using personally owned mobile devices will support students to adapt the education materials into their learning style (Foti & Mandez, 2014).

Major findings of his section reveal that technology is deeply rooted in the environment, students consider themselves sophisticated and they are deeply involved in the information technology. Accordingly, the institutional support towards usage of technology and mobile learning utilisation became an integral part of undergraduate students; the link between technology and students has to be developed in order to enhance students' engagement and academic development.

2.12 Summary

The first theme discussed in this chapter is Maritime Education and Training (MET) which is combining theory and practice, educating knowledge and training skills in order to produce a competent quality seafarer, the importance of MET is achieving seafarer with a better proficiency, efficiency, safe and prevention of marine disasters, MET is standardised, globally, through STCW international convention since 1978, STCW regulations are general requirements setting the minimum required topics to be conducted to officers in a navigation watch, stating competence requirements but not in details and further needs required concerning skills, training, English language, selection, instructions and supervision. STCW convention was subject to several amendments were in 2010 was the last comprehensive review and amendment for STCW convention, in spite of the recent year of the last amendment STCW 2010 did not include any detailed term that reflects online learning or any technology enhanced learning method, except the simulators that trains cadets in the areas limited to navigation, communications and some specific cargo handling operations.

Also, many EU projects had been initiated in order to harmonise MET and upgrade MET had been discussed to develop seafarers' general proficiency, improve their maritime English language, and upgrade training competence in addition to enhancing general safe operations.

More efforts are active after BIMCO/ISF (2010) report: The Worldwide Demand for and Supply of Seafarers in 2010 about a significant existing and predicted shortage in skilled seafarers in the global shipping market, accordingly joint efforts increased to improve seafarers' quality and to harmonise curriculum contents in order to raise quality of student, staff, programs and facilities.

Furthermore, due to the increased technology in ship operations, MET moved towards changing its teaching methods to bring MET to shipboard reality, through using simulators which is a high cost solution, due to its high initial cost, maintenance and frequent upgrading, as discussed in this chapter marine simulators does not cover all required training aspects in a shipboard reality, practical aspects like seaman ship training, deck work and maintenance, safety systems management, shipboard maintenance and inspection routine training, in addition to familiarisation with shipboard parts are not covered by simulators, moreover, skills like enhancing maritime English language and enhancing management proficiency are not available in simulators training.

The on-board training which is a job-oriented training is the most effective part of MET, where cadets combine theory with practice on-board, through introducing knowledge and training skills in the real workplace. Unfortunately, training cadets on-board ships have not been taken seriously by most of ship's staff, so learning/ training outcomes cannot be predicted (Lewarn, 2001).

The need of a quality seafarer in the context of globalisation in shipping industry derived the need of this research, to develop a technological intervention to standardise training on-board and to fulfil the present training gaps which is not covered by simulators.

The second theme discussed in this chapter is personalised learning/ training, as it was found thought reviewing literature an important and effective method to adapt educational materials to adapt individual needs, including mentoring programs in a personalised self-regulated manner, it was detected a confusion in the literature about elements to include in personalised learning.

In order to identify required elements for personalised learning and to achieve an individually adapted learning/ training application, the literature reviewed in details different common learning styles, in addition to arguments and critique addressed to learning styles, and methods of measuring individual learning style, moreover many definitions defined learning style. In spite of clear implications of learning styles in education, but it had been found through reviewing literature that adopting learning styles will reflect in a positive way to make learning easier and will increase learning/ training efficiency.

However, the debate and criticism of learning styles show challenges in the field, in addition to the lack of any previous studies about applying learning styles in the practical phase of MET process. This thesis is an intervention that tackles some of the existing marine training challenges and introduces a new interactive TEL approach, which contributes to get closer to solve some of the mentioned problems in the Maritime Education and Training, and to be a first step in order to initiate further researches about applying learning styles within a VLE for marine cadets.

After reviewing literature findings, researcher planned a holistic model inspired by Felder-Silverman learning style model (FSLSM), were the four dimensions in FSLSM that were covered in the technological tool that integrates all relevant aspects of learning styles, and a proposed iMET prototype had been developed accordingly and described briefly in chapter 5. In order to avoid many confusing points as learning style is multifaceted and although lot of researches had been conducted, important questions are still unanswered and debatable issues are under debate. The proposed iMET tool did not develop a model to measure cadets learning styles prior to their usage to the developed technological intervention iMET, due to arguments in the literature reviewed concerning measuring individual learning style accuracy and reliability as a crucial issue.

The third theme reviewed in literature is online learning that has grown usage globally, in addition to online instruction continues development in various fields, the aim of reviewing literature from this perspective is to develop a learner centred e-learning program, in the context of on job training for maritime education and training in a technology based environment within a personalised manner. Many terminologies and definitions were found for online learning and e-learning that reflects diversity of practice and different technologies associated with online learning.

Online learning frame in this research is “an approach to personalised adaptive handheld TEL solution in a self-regulated method, within a virtual learning environment on-board a training ship”.

After reviewing this section in the literature concerning online learning definition in this research, literature reviewed found supporting technology enhanced self-regulated learning, were, self-regulated learning has been framed in the online education as an active, constructive process, as learners set goals for their learning/ training, then they attempt to monitor, regulate and control their cognition, motivation and behaviour. Moreover, concerning adaptivity, literature review supported incorporating learning style adaptivity in principle within an e-learning system, which had been stated and concluded in previously this chapter. Moreover, after reviewing types of Technology Enhanced Learning (TEL), which is available in different learning situations, the proposed technological intervention in this research, will provide a flexible learning/ training application that can act as Asynchronous learning or synchronous learning, however it gives the student/ cadet additional time for reflection, collaboration among his/her colleagues and interaction with instructors (Yamagata-Lynch , 2014).

As this research proposes a new generic intervention to enhance the practical on-board maritime education and training by using iMET application, through handheld devices which is either smart mobiles or tablets, last part of literature review had reviewed mobile learning.

Mobile learning exist in literature as an accepted tool in education in a flexible way, as it can be used anytime and anywhere in a flexible way, also the increased availability of mobiles was found, where students were found more comfortable and confident when using their own mobiles in the education rather than using a borrowed or the institution ones (Murphy et al., 2014). Moreover, using personally owned mobile devices will support students to adapt the education materials into their learning style (Foti & Mandez, 2014), which aligns with this research proposed technological solution.

Findings of this chapter reflect that technology is deeply rooted in the environment, and this research aligns with institutional rising trends of utilising technology and supporting its usage.

The next chapter will discuss the theoretical framework of the model used in this research and methodology of the current research.

CHAPTER THREE

Research Methodology

3.1 Introduction

A mixed methodology approach was utilised in this study, to analyse the manner in which marine cadets are being trained on-board have accepted learning with the aid of the proposed technological intervention, and how the online environment influenced this training process, while unstructured interviews reflected participants' perceptions of their experiences, this research involved a quantitative analysis supplemented with a qualitative one, were a predominant quantitative approach is adopted as the primary research tool supplemented by qualitative data.

The first section of this chapter is discusses the theoretical framework and the approach to the model used in this research, to test the research hypothesis in addition to predicting the technology acceptance factors for the proposed generic iMET tool, moreover to measure the cadets' perception towards using the iMET tool. While the second section of this chapter is presenting the methodology of the current research including the research design, and approach. It also includes a description of the research target population and sample. In addition, the current chapter includes data collection methods and statistical tools that will be used in the next chapters to achieve the research findings and results through the empirical study.

The aim of this study is to introduce, asses and validate a generic maritime training application, through investigating the Deck cadets' perceived usefulness, perceived ease of use, perceived resources, attitude towards using and behavioural intention towards actual usage of iMET technological tool, on-board the training ship AIDA IV during the students' fifth semester where the student act as a cadet on-board.

iMET tool is a generic information technology based tool for the Maritime Education and Training, in the context of a personalised on-board practical training. This research will measure the maritime stake holders' perception towards actual usage of iMET tool in order to validate the iMET application in the on-board training phase in the training ship AIDA IV.

Triangulation in this study was based on measuring the feedback of the stakeholders affiliated with iMET tool implementation. Accordingly a questionnaire survey was conducted involving the deck cadets on-board the training ship. While a semi structured interview was conducted with the following:

- Ship operators and fleet technical managers; representing the Shipping industry and the future employers of the maritime graduates.
- Marine instructors on-board the training ship; who will use the iMET in conducting the practical training on-board the training ship, also they are very well experienced in the Maritime practical training.
- College of Maritime Transport and Technology faculty staff, representing the Maritime Education and Training experts, also they are very well experienced in Maritime Education and Training, in addition to their relevance to maritime international conventions and different teaching methods.

3.1.1 Theoretical Approach to the Model Used

The information technology acceptance and its use became an issue that grabbed the researchers' attention. This was driven from the rising excessive use of technology generally. Successful utilisation of the technology in order to be accepted by the intended users is a main objective, while failure in its utilisation to achieve the required targets will lead to negative consequences and a financial loss in addition to dissatisfaction at the intended users' side.

Since any information technology system that is effective will not be used unless the user has the intention to use it actually based on accepting the technological application, regardless to its technological and technical excellence. Accordingly, it is very important to understand how the targeted users will decide whether the proposed system will be accepted or not. The targeted users perception towards the intended technological application have to be measured, in regard to the system's usefulness, resource richness, flexibility and being a user friendly, in order to influence targeted users represented in cadets towards actually using the system.

The following section will represent the academic approach in order to adapt a model from the existing technology acceptance models; in order to fit this research objectives and hypothesis, the adapted model will be used in chapters 4 and 6, for evaluating and validating iMET tool acceptance, through assessing cadets' behavioural intention towards the proposed system actual usage

3.1.2 New Technology Implications

Implementing a new technology in real workplace may face implications and challenges as stated by Klein and Knight (2005), that there is six reasons that may cause a sort of implications, when introducing a new technological, the six reasons are as follows:

- Unreliability and imperfect design of new technology
- User's requirement of new technology knowledge and skills
- Decision for adoption and implementation not taken by targeted users
- Change in tasks and practices requirement by individuals
- Time consuming, expensive, and reduced initial performance
- Organisations' failures in the role as stabilizing power

Proper understandings for the real workplace environment, where the new technology will be implemented, in addition to measuring the end users and beneficially stakeholders' perception in regard to the new technology, are vital inputs in order to achieve a positive acceptance and actual usage to derive a new sustainable technological tool.

3.1.3 Introducing New Technology

Prior to introducing a new technology, researcher is required to identify the factors affecting the individuals' behavioural intention towards actual use of the proposed new technological tool, in order to predict the intended users' behaviour towards using the new technological tool.

The following section of this chapter will present models that can be helpful is assessing the acceptance of new technology tools, these models used mainly to predict users' behaviour in computer and information technologies, especially in the field concerning online learning. A suitable model will be selected and later will be applied to the proposed iMET technological tool in subsequent chapters.

3.1.4 Theory of Reasoned Action (TRA)

The theory of reasoned action (TRA) was originally developed by Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980) aiming to examine individuals relationship between attitudes and behaviour. TRA considered behavioural intentions rather than attitudes as the main predictors of behaviour.

TRA assumes that individual's behaviour is determined by his intention to perform the behaviour, that means that intention to do an action will be formed according to the individual's positive or negative feelings about performing a specific action, in addition to subjective norms surrounding the action, where the subjective norm is how the individual thinks about how other people would view him if he performed such action (Ajzen and Fishbein, 1980).

The attitude towards performing the behaviour is according to the individual's beliefs about the anticipated outcome on performing the behaviour, while the individual's opinion about the normative beliefs will affect his or her to perform such behaviour.

Accordingly the individual's perception about his own beliefs, surrounding environment are the factors influencing his or her attitude and subjective norms, which influence individual's behaviour.

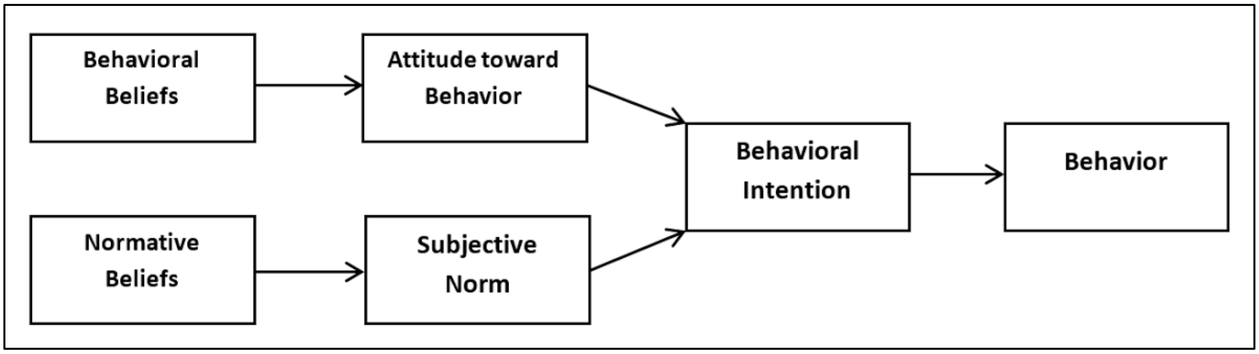


Figure 3- 1: Theory of Reasoned Action Model (*Source: Fishbein and Ajzen, 1975)*

TRA four variables are defined in the following section (Fishbein and Ajzen, 1975; Fishbein and Ajzen, 1980; Ajzen, 1991; Ellis and Arieli, 1999; Taylor & Todd, 1995)

Attitude is defined as the individual's perception whether positive or negative, towards performing a specific behaviour, according to the outcomes of the specific behaviour. Attitudes are determined by salient beliefs about advantages and disadvantages of performing behaviour, which are also called behavioural beliefs. The attitude is the summation of individual consequence, multiplied by desirability assessment for all expected consequences of the behaviour. While, **subjective Norm** is the individual's perception about the opinion of other people surrounding him/ her concerning the behaviour performed. Opinion of other people will affect the individual's willingness to comply with those peoples' thoughts, which is considered as a social pressure from the important people in the individual's environment. **Intention** is the factor that influences individual's behaviour to perform a specific behaviour; it shows the degree of willingness to perform the behaviour, intentions is the predictor of performing the behaviour according to the individual's opinion. **Behaviour** is the transmission of intention into an action, which is the actual use by the individual.

3.1.5 Technology Acceptance Model (TAM)

TAM is driven mainly from the Theory of Reasoned Action (TRA) that was introduced by Ajzen and Fishbein (1980). According to TRA, the behaviour under the current research, in the case of Maritime Education and Training information system acceptance, is influenced by individuals represented in deck cadets' perception and attitude, and their acceptance to the proposed technological system in reference to, the Technology Acceptance Model (TAM), as developed by Davis, F. (1986), as an extension of the TRA theory.

TAM was designed to explore the underlying factors linking different external variables to technology acceptance and hence will lead to its actual use. TAM assumes that individuals may be motivated to use an information system because of factors, like perceived usefulness, perceived ease of use and attitude towards using the system.

TAM is a popular model for explaining the behaviour of technology users, towards accepting a certain technological tool (Van der Heijden, 2003). While, Pan (2003) expanded the TAM model to include computer self-efficacy and subjective norms to measure end users' acceptance towards using technology.

Based on the perceived usefulness and perceived ease of use, attitude towards using the system can be predicted, in the context of user's desirability of his or her perception towards using the system.

The TAM model consists of four variables of behaviour, behavioural intention, perceived usefulness, and perceived ease of use. Behaviour and intention had been defined previously in the research in the TRA model. Concerning perceived usefulness and perceived ease of use definitions as follows:

3.1.5.1 Perceived Usefulness

Perceived usefulness identifies the end user's perception concerning improving his or her workplace performance (Davis, Bagozzi, & Warshaw, 1989). Accordingly, the user has a perception about how useful using the technological application in adding value to his/ her required tasks, in addition to time needed for carrying out a job, efficiency and accuracy of the system. Moreover, it is defined as "the degree to which a person believes that using a particular technology will enhance his or her job performance" (Davis, 1985). Davis, Bagozzi, and Warshaw in 1989 stated that perceived usefulness refer to the end users' perceptions regarding the anticipated outcome of an experience. While, within a Maritime Education Organisation context, students or cadets can be oriented about the positive educational outcomes of the system in regard of knowledge and skills enhancement; however students are generally reinforced for good performance by bonuses or other rewards.

Individuals tend to whether use or not to use an information technology system to the extend they believe it will develop their job performance (Davis, Bagozzi, & Warshaw, 1989).

3.1.5.2 Perceived Ease of Use

Perceived ease of use is defined as "the degree to which an individual; believes that using a particular system would be free or with a minimum from physical and mental effort" (Davis, 1993). The definition of the term "ease" is "freedom from difficulty or great effort". Effort can be expressed as a limited resource that an individual may allocate to the various activities he or she is responsible for (Radner & Rothschild, 1975). Individuals tend to use a user friendly application that is perceived to be easier than another.

Perceived ease of use explains individual's perception towards the amount of effort will be made to utilise the system; or the end user's believes that using a particular technological application will be effortless (Davis, Bagozzi, & Warshaw, 1989). Perceived ease of use has an influence on user acceptance and hence on usage behaviour (Igbaria & Livari, 1995).

Perceived ease of use consists of: easy to use, easy to read, understandable, easy browsing and navigation through the different pages and includes support.

Vankatesh and Davis in (2000), mentioned that the perceived ease of use 'describes the individual's perception of how easy the innovation is to learn and to use'. Perceived ease of use reflects the individual's perception and potential difficulty to use technological as a learning tool, it also reflects the individual's perception and potential difficulty to learn how to use such technology.

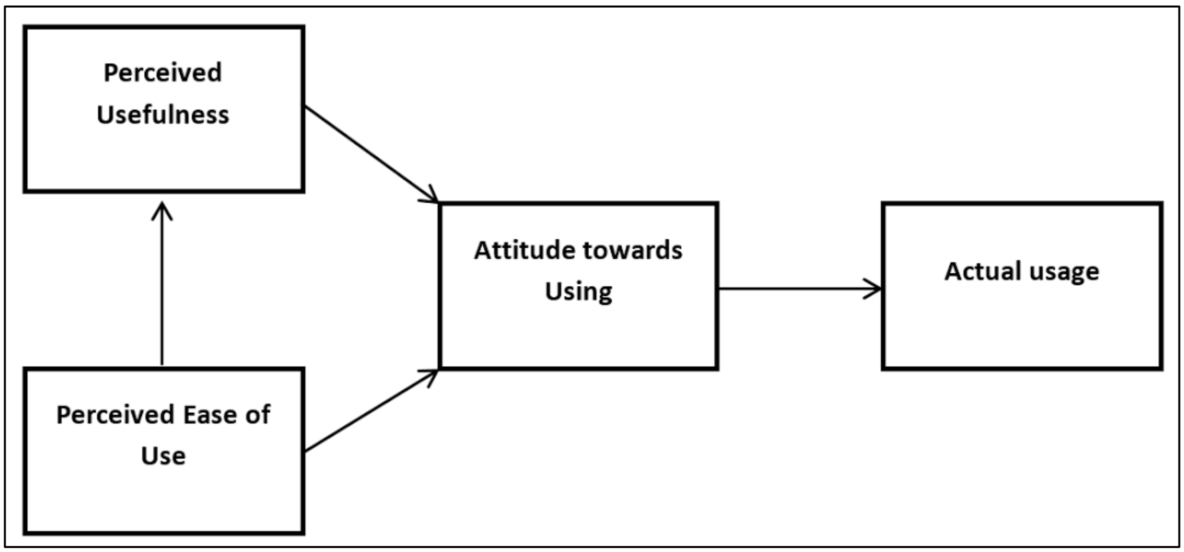


Figure 3- 2: Technology Acceptance Model *(TAM) (Based on Davis, Bagozzi, & Warshaw, 1989)*

The combination of perceived usefulness and perceived ease of use is the factor that will influence the individual's behaviour intention towards technology acceptance, and the actual usage of a specific technology. It is very important to highlight that the influence of each of the two factors might vary. An individual might use new technological system even if his or her perception on the ease of use is not very positive, but he or she believes in its advantages and useful outcomes on the person's job and required tasks. Perceived usefulness of a new technology to some extent is influenced by the perceived ease of use as shown in the Technology Acceptance Model shown in figure 3-2.

3.1.6 Extension of Technology Acceptance Model – TAM2

Regarding the external variables towards perceived ease of use and perceived usefulness (Davis, 1993), Venkatesh and Davis (2000) proposed TAM2 as a revised version of TAM, where TAM2 proposed factors from two extra categories: Social influence processes and cognitive instrumental processes. Definitions of the social influence processes and cognitive instrumental processes factors according to Chismar and Wiley-Patton (2002) and Venkatesh and Davis (2000) as follows:

Social Influence Processes

Subjective Norm: Subjective norm is the individual's perception about what people who are important to him or her think in regards of should or not use the technology

Voluntariness: Voluntariness is the degree in which the individual perceives the use of a technological tool as a mean of enhancing his or her status within a social context

Image: Image is the individual's perception on the degree to which his or her status is enhanced within a social context through accepting and using a new technological system

Experience: Experience is the individual's increase of knowledge and/or skills through involving the use of new technological system.

3.1.7 Cognitive Instrumental Processes

Job Relevance: Job relevance is the individual's perception regarding the new technology percentage of applicability with his or her job duties and tasks.

Output Quality: Output quality is the individual's perception regarding how far the tasks performed by the new technology is necessary or a value added to his or her job

Result Demonstrability: Result demonstrability is the individual's perception regarding the tangibility of the results when using a new technology

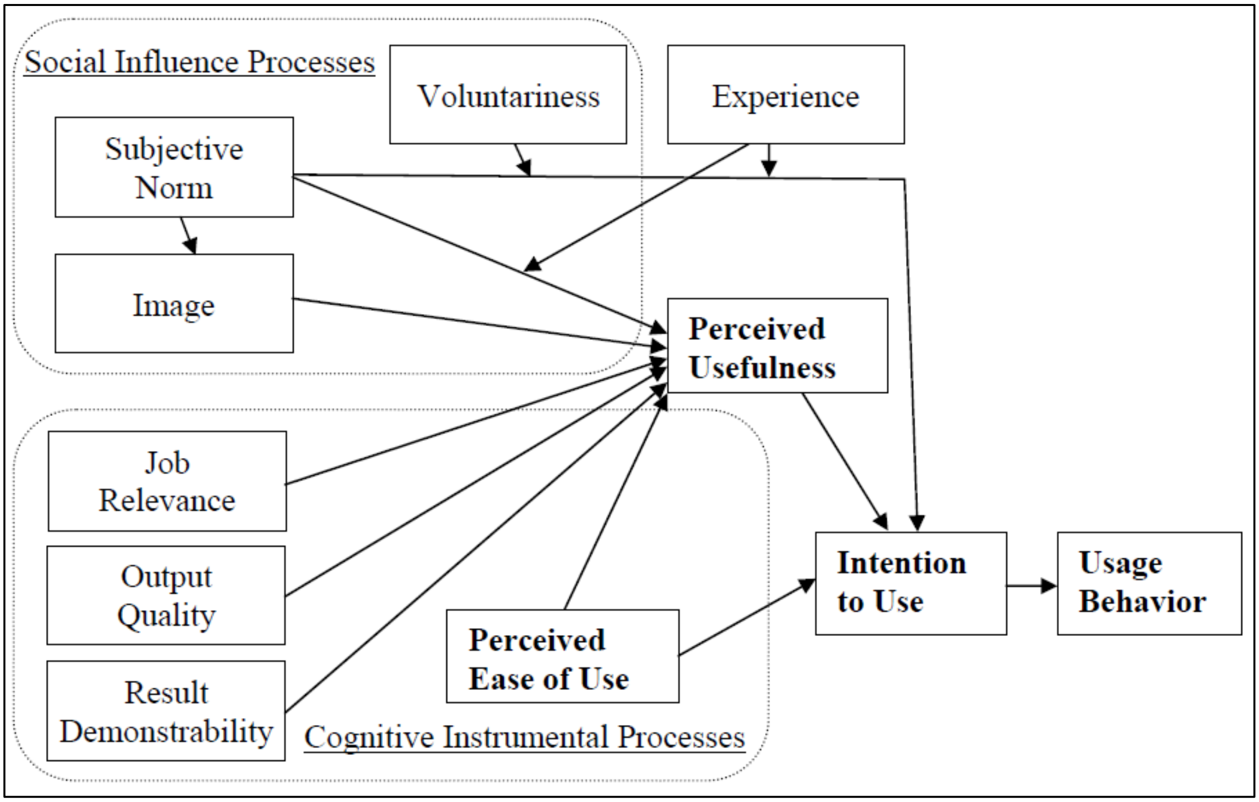


Figure 3- 3: Extension of Technology Acceptance Model – TAM2 (*Source: Venkatesh & Davis, 2000)*

However, both social influence processes and cognitive instrumental processes showed a consistent effect on the individual's perceived usefulness, intention to use and behaviour to actual use (Venkatesh & Davis, 2000). Moreover, Chismar & Wiley-Patton (2002) conducted a study that founded a significant effect on perceived usefulness from the cognitive instrumental processes such as job relevance and result demonstrability.

Furthermore, the role of the social influence was found important only in the initial stage of using a new technology. Also; increasing experience overtime provides more instrumental basis rather than the social one, for the users' behaviour when using a new technology.

Additionally, influential effect of social processes can be ignored overtime; on the other hand, the influence of the cognitive instrumental processes increases overtime (Venkatesh et al., 2003).

3.1.8 Extended Technology Acceptance Model – Perceived Resources

Perceived resources is the individual's perception of the availability of perceived resources in the technological tool, researchers have found that educational resources are one of the important factors affecting learning effectiveness (Mathieson, Peacock, & Chin, 2001; Oh, Ahn, & Kim, 2003).

Information systems users are strongly motivated when they perceive the availability of the essential resources, which will lead to a better learning performance (Cheney & Dickson, 1982; Gable, 1991). Ajzen (1991) stated that the presence of the essential resources had a direct effect on the individual's acceptance of technology. Moreover, Mathieson, Peacock, & Chin (2001) asserted that the use of information system is optional, which means that if an individual decides to use a specific information system; there are no barriers that would prevent him or her from doing so, in a volitional way. Moreover he proposed an extended TAM with the constant "Perceived Resources".

The concept of perceived resources can be divided into reflective resources and formative resources. Reflective resources represent the perception of the resources availability. Formative resources represent specific barriers such as the knowledge, hardware, software, and financial support of using the system (Mathieson, Peacock, & Chin, 2001). The assumption that might limit implementations of TAM in practicality where individuals often face resource constrains (Oh, Ahn, & Kim, 2003). Mathieson, Peacock, & Chin (2001) commented that future researchers should adopt different resource factors according to the requirements of a specific technology, and Lee (2008) further suggested that perceived resources could lead to better online learning adoption.

Accordingly, this study will consider perceived resources factor within the proposed iMET technological tool acceptance model, as the maritime education and training anticipated outcomes are a vital factors that might affect technology acceptance by students/ cadets being trained on-board the training ship.

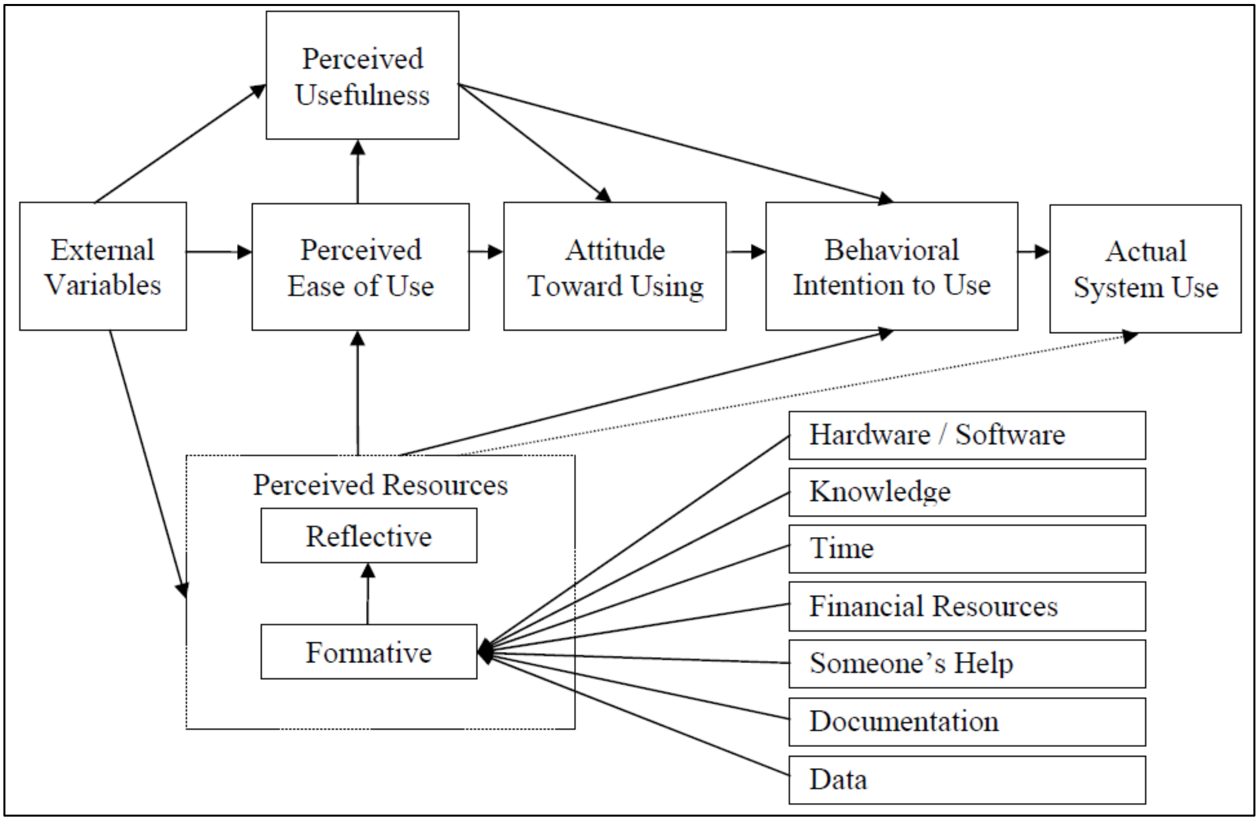


Figure 3- 4: Extended Technology Acceptance Model (*Source: Mathieson, Peacock, & Chin, 2001)*

Reference to figure 3-4, this research will exclude the formative factors, as this research focuses only limited to the learning and education aspect for a Deck cadet/student on-board a training ship, from a perspective of the availability of the educational resources in a personalised manner, that will enhance the individual's job skills and knowledge to be a competent marine officer. Moreover, the proposed technological tool will be used through the individual's owned handheld devices (smart phones, mobile, tablet, iPad and windows tablets) which will cost no additional fees for the end users, as everyone on-board the training ship has a handheld device or modern mobiles that is ready for usage without any further software's installations, moreover no need for internet connectivity as the required connection in the proposed iMET technological tool is available on-board the training ship, through the internal wireless network.

3.1.9 Motivation and Acceptance Model – MAM

Based on TAM, Siegel (2008) adopted the Motivation and Acceptance model (MAM), where the assumption that the actual usage will be determined by perceived ease of use, perceived usefulness, attitude towards using and Organisational support. Furthermore, perceived usefulness and attitude towards using a technological tool will be affected by perceived Organisational support.

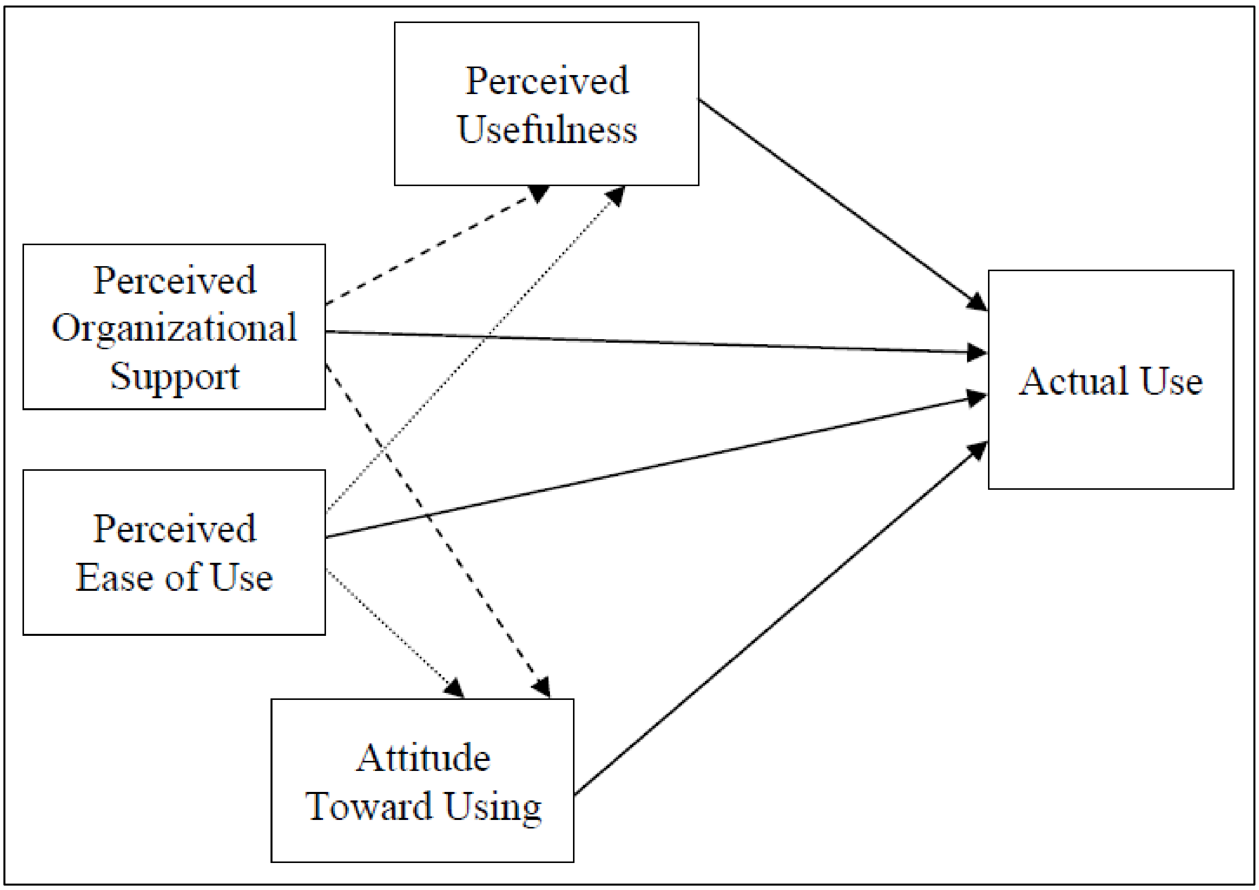


Figure 3- 5: Motivation and Acceptance Model *(Source: Siegel, 2008)*

MAM findings are, perceived ease of use, perceived usefulness, and attitude towards using have a direct effect on the system actual usage. Perceived ease of use influenced the perceived usefulness. However, the perceived Organisational support did not show the significant effect on actual use, perceived usefulness, and attitude towards using.

3.1.10 iMET Acceptance Model

The iMET can play an important role in enhancing the cadets' required job skills and knowledge, by conducting the Maritime Education and Training (MET) process through the cadets' owned handheld devices. The role of the end users of the iMET tool appears to be an imperative influence on factors affecting successful application of iMET tool in MET activities on-board the training ship, which will affect the end user/ cadet acceptance or rejection to use the proposed technology.

The end users acceptance to the iMET technology tool is assessed through iMET acceptance model shown in figure 3-6, which had been adapted from Motivation and Acceptance Model (Siegel, 2008) and Extended Technology Acceptance Model (Mathieson, Peacock, & Chin, 2001).

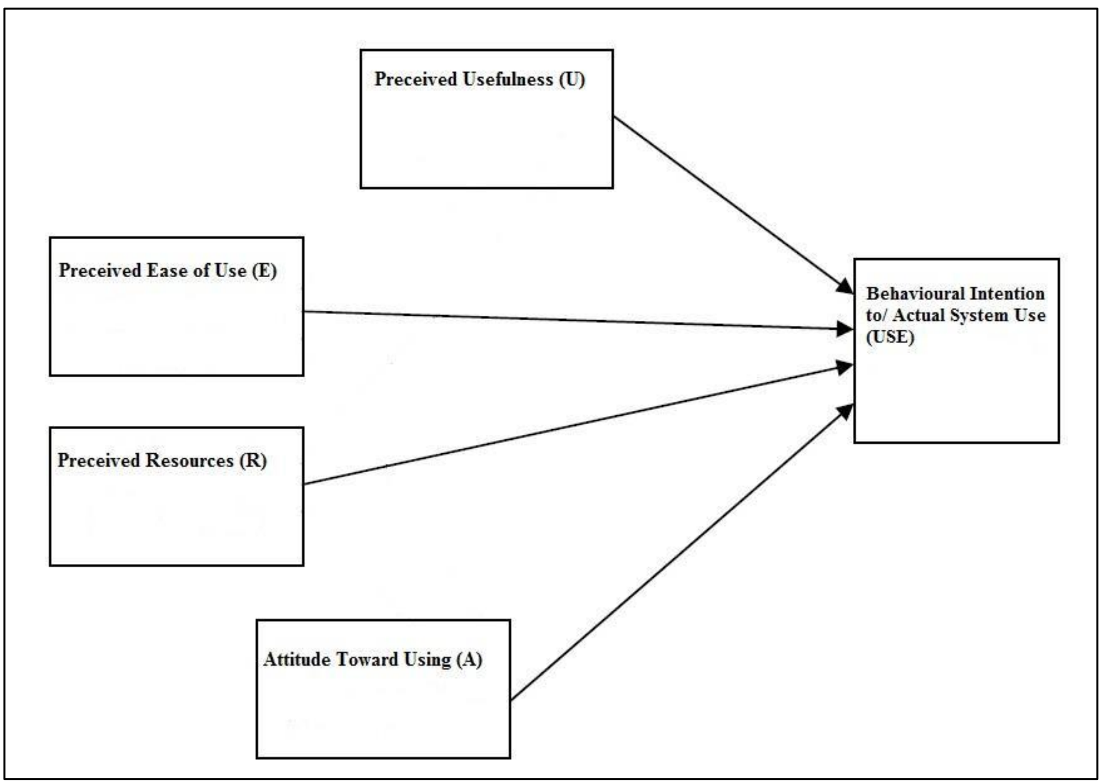


Figure 3- 6: Adapted iMET Acceptance Model (*Adapted from Mathieson, Peacock, & Chin, 2001; Siegel, 2008)*

The research model was adopted from previous research studies (Davis, Bagozzi, & Warshaw, 1989; Davis, 1993; Mathieson, Peacock, & Chin, 2001; Siegel, 2008; Lee, 2008; Ku, 2009) that have shown reliability and validity evidence. Mathieson, Peacock, & Chin (2001) and Ku (2009) assumed the direct influence of the perceived resources variable towards the individual's behavioural intention to use and the actual system use of a technological tool. As discussed earlier in this chapter that the perceived resources is an important factor that affect the individual's perception towards using an information system tool (Cheney & Dickson, 1982; Gable, 1991; Ajzen 1991; Mathieson, Peacock, & Chin, 2001; Oh, Ahn, & Kim, 2003; Lee, 2008; Ku, 2009) that derived the researcher to incorporate perceived resources factor within MAM model, in order to adapt the model to achieve this research objectives.

This model dropped the collinearity and inter-relations between PRATAM model variables and the perceived Organisational support variable of the MAM model has not been taken into account. However, the objective of this research is focusing on assessing the cadets' behaviour towards the actual use of the iMET tool through measuring the direct influence of the following factors:

- Perceived usefulness direct influence towards the behaviour of actual system use,
- Perceived resources direct influence towards the behaviour of actual system use,
- Perceived ease of use direct influence towards the behaviour of actual system use
- Attitude direct influence towards the behaviour of actual system use.

The MAM model perceived Organisational support factor and the formative aspect of the PRATAM perceived resources variable were dropped as the hardware used for the iMET tool is the cadet's personal handheld device/s, the required knowledge is aimed to be fulfilled by the frequent usage of the handheld devices by the end users, moreover no further financial resources will be required. Accordingly the formative aspect had been dropped, while the reflective aspect of the perceived resources variable will be considered and assessed due to its importance as a main factor in the education and training process.

Finally, the objective in this research is assessing a proposed technological educational tool with the aid of the iMET acceptance adapted model; through predicting the acceptance of iMET tool by the end users as discussed in chapter 4, moreover measuring acceptance of iMET tool by the end users as discussed in chapter 6. The adapted model will be applied to analyse the iMET questionnaire and the semi structured interview.

3.2 Research Philosophy Design

This research philosophy is a pragmatic research approach; research methodology is the philosophical overview that highlights the research style (Sapsford & Jupp, 2006). In other words Collis and Hussey (2014) and Creswell (2014) stated that research methodology is the approach to design the research process, research philosophy is affiliated with how things are viewed in the world, research philosophy reflects research chosen methods, in addition to researcher practical experiences, knowledge and real life situations developments (Saunders, Lewis, & Thornhill, 2009).

The Pragmatic assumption had been applied in this study through applying mixed methods that fits the research aim and objectives, this research uses mixed methods and different data sources for triangulation as it employs quantitative approach supplemented by a qualitative one, in order to conduct an in depth research in addition to a considerable breadth as shown in figure 3-7.

Figure 3-7 represents the triangulation conducted in this research among the 3 stakeholders affiliated with maintaining a quality practical on-board MET, who are maritime faculty, maritime industry (ship operators/ owners) and marine cadets.

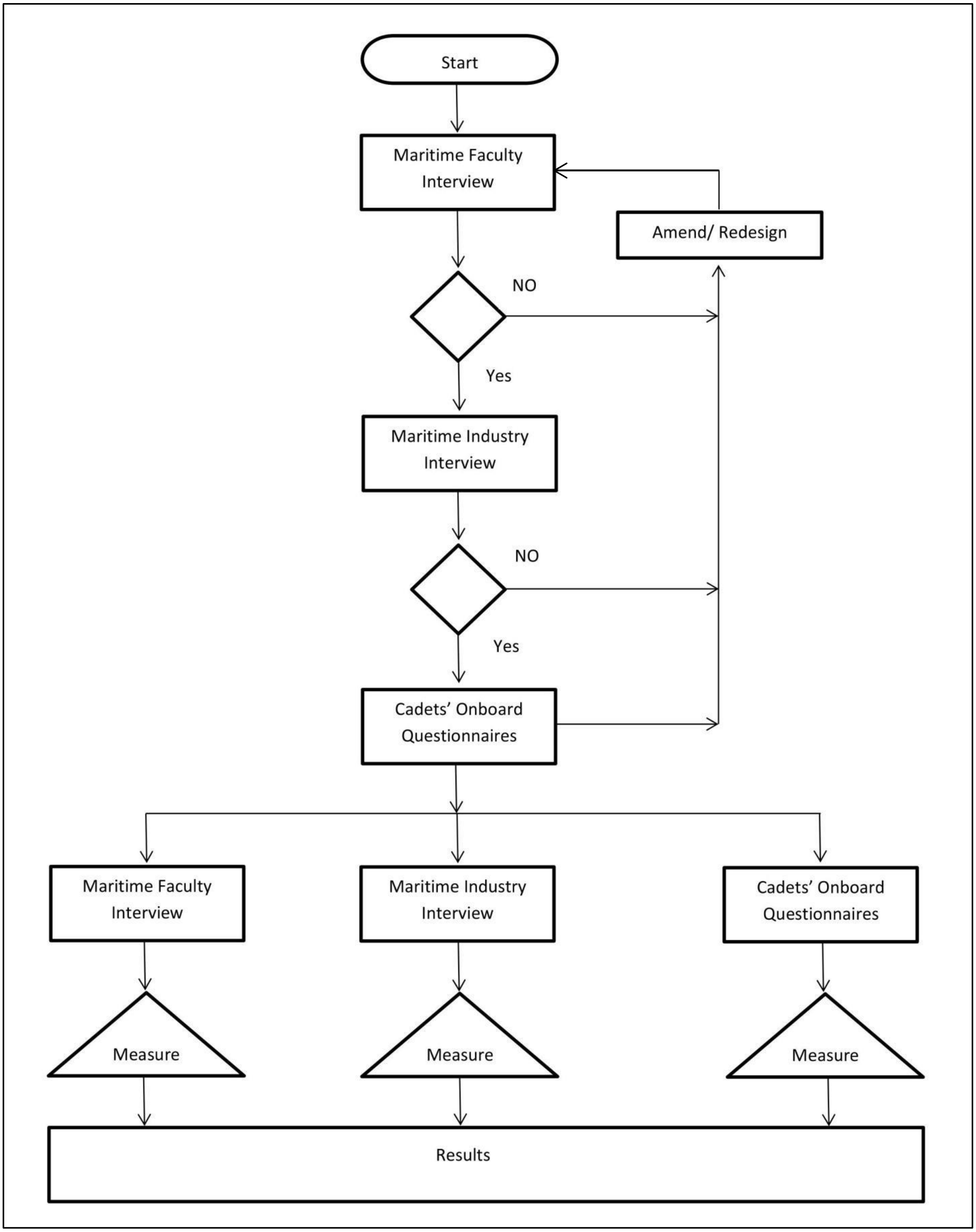


Figure 3- 7: Data Sources for Triangulation

Creswell and Plano Clark (2011) added that mixed methods through using quantitative and qualitative analysis will provide better understanding of the research problem. Accordingly, to get a better questionnaire and semi structured interview instruments as shown in figure 3-7 had passed through a review by expert judgement in the Maritime College and Shipping companies, in order to derive survey instruments that can achieve clear and understandable tools for the research objectives.

This research had been conducted within a context of a case study for cadets training on-board a training ship during their on-board training. Yin (2014) stated that case study investigates a phenomenon in a real-life context. Moreover, Oates (2006) presented aspects of a case study in a research in the following points:

1. Focusing in depth not in breadth
2. Study is conducted in its natural real-life setting not in laboratory
3. Employing different sources and methods

As a result, the methodology influenced this research is the pragmatic one based on inductive and deductive reasoning, in order to be able to tackle the research problem and objective, the rationale of choosing the pragmatic approach is the research questions, where using only quantitative approach or a qualitative approach will not fulfil the research problem and objective, while the combination of the two approaches will be able to achieve this goal (Creswell & Plano Clark, 2011). The pragmatic research as a theoretical perspective focuses on the research problem and tries to adopt a practical solution with the aid of mixed methods. As the pragmatic approach is a better method to answer “what”, “why”, and “how” research questions (Saunders, Lewis, & Thornhill, 2009).

A predominant quantitative approach is adopted as the primary research tool supplemented by qualitative data. Onwuegbuzie and Leech (2005) further assert that the choice of research methodology should be dependent upon the research questions. Researchers who consider themselves pragmatists advocate integrating methods within a single study (Creswell, 1994).

A mixed methodology approach will be utilised with the aid of a questionnaire to analyse the manner in which course participants learned and how the online environment influenced this process, in addition to a semi structured interviews (See Appendix B) were used to reflect all maritime stakeholders' experience and perceptions (Lebec & Luft, 2007).

An ethical approval had been obtained as per Liverpool John Moores University regulations, then a quantitative approach had been conducted through introducing a questionnaire, that had been adopted in order to achieve the research aims and objectives, concerning measuring the cadets' as end users' perception, and identifying their needs in order to be considered while developing the proposed interactive self-study technological intervention. Moreover, evaluating and validating the proposed technological intervention as a part of the cadets' training on-board in addition to predicting the cadets' acceptance to actual usage of the proposed interactive self-study technological intervention iMET.

The same questionnaire had been introduced to the same cadets in the iMET pre-intervention phase, before using the iMET and post iMET intervention after using iMET, in order to measure the cadets' perception before and after using iMET, to be able to measure change of their perception towards actual usage of iMET, after the real usage of the developed prototype.

Furthermore, a quiz had been introduced to assess cadets' knowledge two time, first time before cadets' actual usage of iMET application and a second time after the cadets' actual usage of the iMET intervention prototype through their own handheld devices. The research introduced a quiz that had been applied for two training topics included in the prototype, which are; Emergency Position-Indicating Radio Beacon (EPIRB) and search and rescue transponder (SART), two groups each consisting of twenty cadets/ students are randomly selected to do the quiz for each subject.

Each group did the test two times; the pre-intervention and the post-intervention time. So, both groups are subjected to the same quiz twice. The scores are calculated for each subject in the pre and post intervention states and the mean scores are calculated and analysed in order to be able to measure the impact of using iMET on the cadets' knowledge.

As no research interview lacks structure, most of the qualitative research interviews are semi-structured, lightly structured or in-depth (Mason, 1994). This research adopted a semi-structured interview as a qualitative method of inquiry, which combines a pre-determined set of open questions that prompt discussion with the opportunity for the interviewer to explore particular themes or responses further.

The semi structured interview had been adopted in order to achieve the research aims and objectives concerning maritime experts and professionals requirements, in addition to their perception towards accepting and developing the proposed iMET interactive self-study technological intervention, accordingly semi structured interview driven themes will be considered during the iMET developing, in order to cope with the shipping industry requirements, according to the maritime industry interviewed personnel and Maritime Education requirements represented in the maritime faculty interviewed personnel.

The main objective of mixing the quantitative and qualitative analysis is triangulation through measuring the perception of the main three stake holders of the maritime industry affiliated with seagoing careers represented in cadets as the iMET users, ship operators/ owners as the cadets' employer after graduation in addition to maritime education and training professionals as the cadets instructors.

The area of the research is on board the Arab Academy for Science, Technology and Maritime Transport (AASTMT) training ship "AIDA IV", while a generic prototype iMET tool had been developed and applied to the teaching topics for "Emergency Position Indicating Radio Beacon (EPIRB)" and "Search and Rescue Transponder (SART)" as a proof of concept.

3.2.1 Research Anticipated Outcomes

Firstly, measuring the maritime stakeholders' needs and expectations through analysing the questionnaire and semi structured interviews, in order to tailor a generic information technology based iMET tool accordingly, in order to provide the deck cadets with the required knowledge and skills needed.

Secondly, developing a prototype as a proof of concept of the proposed generic training tool iMET, that cope with literature review and the requirement of the maritime stakeholders by considering their perceptions in designing the proposed iMET intervention and predicting its acceptance by cadets on-board the Academy's training ship AIDA IV, as follows:

- Driving inputs from reviewing literature, in the areas related to MET and personalised learning, in order to develop a personalised technology enhanced learning tool accordingly.
- Validating the proposed technological intervention with the aid of a quantitative analysis, through measuring the iMET tool acceptance as a technological tool, for on-board training, and measuring it's compliance as a source of Maritime Education and Training on-board the training ship as follows with the aid of statistical analysis as follows:
  - Measuring cadets' perception of iMET tool Perceived usefulness
  - Measuring cadets' perception of iMET tool Perceived ease of use
  - Measuring cadets' perception of iMET tool Perceived resources
  - Measuring cadets' perception of iMET tool Attitude towards using it
  - Measuring cadets' perception of iMET tool Intention towards actual usage
  - Measuring cadets' change of perception toward iMET tool before and after using the developed prototype

- Analysing thematically the semi structured interview feedback from the maritime industry and maritime professionals in a qualitative manner, as a supplementary tool to support the quantitative analysis.

Thirdly, validating iMET training tool actual usage with the aid of a model that was adapted from PRATAM and MAM extensions of the Technology Acceptance Model, as previously discussed in the first section of this chapter, in order to observe the cadets' beliefs in using iMET tool, via quantitative analysis in pre and post iMET intervention prototype usage on-board the training ship for the deck cadets, during the summer semester in 2015. The quantitative analysis will be supplemented by a semi structured interview that is addressed to the maritime academic staff, training ship staff and ship operators, to achieve the intended triangulation for the MET affiliated stakeholders.

Therefore, this current research considered the relationships between perceived usefulness, perceived ease of use, perceived resources, attitude towards using and intention towards actual usage of iMET training tool. The relation between variables in the Technology Acceptance Model was adapted from PRATAM and MAM.

The five variables (i.e., perceived usefulness, perceived ease of use, perceived resources, attitude towards using and intention towards actual usage) were measured as a scale based on the sum of corresponding items. For example, perceived ease of use variable was the total of the sum of seven measurement items from the questionnaire survey (i.e., E1, E2, E3, E4, E6, and E7). While perceptions and themes gathered from the semi structured interview will be gathered and classified according to its themes.

Fourthly, testing cadets knowledge in two training topics related quiz, before and after iMET usage, in order to measure the influence of using the proposed iMET tool on their knowledge enhancement, for the purpose of assessing and validation from an additional independent perspective, as a supplementary tool for validation, as an additional to the technology acceptance model perspective, which is the main validation tool in this research.

3.3 Research Framework and Model

The current research framework in figure 3-8 as discussed in the first section of this chapter:

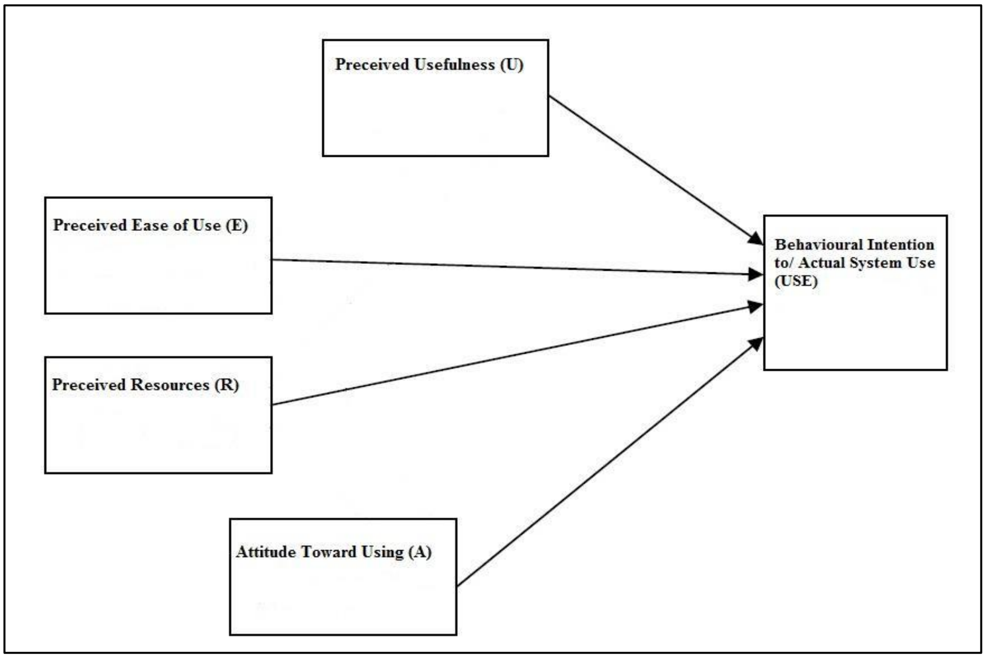


Figure 3- 8: IMET Acceptance Model (*Source: Adapted by the researcher from Mathieson,* Peacock, & Chin*, 2001; Siegel, 2008)*

According to the above model, the research questions and hypotheses are shown in the following sections.

3.3.1 Research Questions

Research questions are controlling the iMET tool acceptance, by cadets on-board the training ship cadets and other maritime stakeholders. The research addresses the following questions:

1. What are key stakeholders' (Student/Cadet, Trainer/Professors and Ship owners/operators) perceptions towards accepting iMET?
2. To what extent are the key stakeholders' requirements and expectations are met in iMET?

3. To what extend are the portable iMET tool educational resources fulfilling students/ cadets different training topics?
4. Do the perceived usefulness, perceived ease of use, perceived resources, resources richness and attitude towards using of the iMET tool stakeholders have positive effect on the behavioural actual usage of the system?
5. Does iMET tool has a positive impact on enhancing students/ cadets knowledge after using it

3.3.2 Research Hypotheses for iMET Technology Acceptance

This research hypothesis is that the cadets' MET practical training experience can be enhanced through a technological "system design" approach, that is directly relevant to the Maritime Education and Training application in a personalised training context, that is inspired by a learning style theory. This study focuses on the identification of individual learning needs on-board a training ship and how they can best be addressed through personalised TEL tool.

It seeks to develop with design synthesis and system validation while considering the complete problem, which is maintaining a standard quality on-board training on-board the academy training ship, that accommodates up to 160 cadets on-board and fulfilling requirements of the shipping industry, in order to achieve a quality practical knowledge based on job training, the widely recognised skills shortage of the marine fresh graduates and the lack of implementing the Technology Enhanced Learning (TEL) in the Maritime Education and Training (MET). The following hypotheses are to be tested:

H_1: There is a significant positive relationship between iMET tool Perceived Usefulness and Behaviour Intention towards actual iMET tool usage.

H_2: There is a significant positive relationship between iMET tool Perceived Ease of Use and Behaviour Intention towards actual iMET tool usage.

H_3: There is a significant positive relationship between iMET tool Perceived Resources and Behaviour Intention towards actual iMET tool usage.

H_4: There is a significant positive relationship between iMET tool Perceived Attitude and Behaviour Intention towards actual iMET tool usage.

H_5: There is a significant positive change in the research dimensions; (Perceived Usefulness, Perceived Ease of Use, Perceived Resources, Perceived Attitude and Behaviour Intention towards actual usage of iMET tool) between Pre and Post iMET intervention prototype actual usage.

3.3.3 Research Variables

The questionnaire survey instruments was adopted to fit the fifth semester marine/ deck cadets' being trained on-board the training ship, after reviewing questionnaire survey instruments in previous research studies (Davis, Bagozzi, & Warshaw, 1989; Davis, 1993; Mathieson, Peacock, & Chin, 2001; Siegel, 2008;Lee, 2008; Ku, 2009) that have shown reliability and validity evidence.

A total of twenty four question items that used for the quantitative statistical analysis used included: (1) perceived usefulness; (2) perceived ease of use; (3) perceived resources; (4) attitude towards using; and (5) intention towards actual usage. Each of the five instrument categories is illustrated in the following section.

- **Perceived Usefulness (U) Instrument**

  The perceived usefulness instrument measures the cadets' perception of iMET tool serviceability usefulness. It is defined as "the degree to which a person believes that using a particular technology will enhance his or her job performance" (Davis, 1985). Davis, Bagozzi and Warshaw (1989) stated that perceived usefulness refer to the consumers' perceptions regarding the outcome of an experience.

The research measured perceived usefulness using 5 items from the questionnaire on a 5 point Likert scale with 1 as “Strongly Agree”, 2 as “Agree, 3 as “Uncertain/ Not Applicable”, 4 as “Disagree”, and 5 as “Strongly Disagree”.

Items used to measure Variable (U) Perceived Usefulness as follows:

U1) Do you think the implementation of iMET tool would be beneficial for training on-board
U2) iMET will be an added value for OOW duties training
U3) iMET will enhance gaining required practical skills on-board
U4) iMET will help understanding theoretical aspect of MET
U5) iMET will support putting theoretical knowledge into practical one

- **Perceived Ease of Use**

The perceived ease of use instrument measures the cadets’ perception of the easiness of using iMET tool according to their technological capabilities, it is defined as “the degree to which an individual; believes that using a particular system would be free from physical and mental effort” (Davis, 1993). The research measured perceived ease of use using 5 items from the questionnaire on a 5 point Likert scale with 1 as “Strongly Agree”, 2 as “Agree, 3 as “Uncertain/ Not Applicable”, 4 as “Disagree”, and 5 as “Strongly Disagree”.

Items used to measure Variable (E) Perceived Ease of Use as follows:

E1) Do you think that technology is essential for you
E2) Are you a frequent user of mobile applications
E3) Are you a frequent user of Marine mobile applications
E4) Are you a frequent user of Microsoft office
E5) Do you play video games frequently

- **Perceived Resources (R) Instrument**

The perceived resources instrument measures the cadets’ perception of iMET tool richness of required educational resources concerning practical training on-board. Information systems users are strongly motivated when they perceive the presence of the essential resources, which will lead to a better learning performance (Cheney & Dickson, 1982; Gable, 1991).

The research measured perceived resources using 7 items from the questionnaire on a 5 point Likert scale with 1 as “Strongly Agree”, 2 as “Agree, 3 as “Uncertain/ Not Applicable”, 4 as “Disagree”, and 5 as “Strongly Disagree”. The research explored technical topics of the educational resources in order to investigate the survey’s feedback concerning the specific points of strength in iMET tool resources richness especially from the structured questionnaire.

Items used to measure Variable (R) Perceived Resources as follows:

R1) iMET will improve your Lifesaving and Firefighting equipment training
R2) iMET will improve your seaman ship training
R3) iMET will improve your Engine room familiarisation training
R4) iMET will improve your Stability and Cargo calculations training
R5) iMET will improve your Safety behaviour on-board
R6) iMET will improve your Maritime English
R7) iMET will improve your self-reliance, rationality and sense of responsibility

- **Attitude Towards Using (A) Instrument**

The Attitude towards using instrument measures the cadets’ perception towards his/ her desirability to use iMET tool. The attitude towards performing certain behaviour is based on the individual’s beliefs about the outcome, hence performing the behaviour, while the individual’s opinion about the normative beliefs will affect his/ her to perform such behaviour (Alcalay & Bell, 2000).

The research measured Attitude towards using 3 items from the questionnaire on a 5 point Likert scale with 1 as “Strongly Agree”, 2 as “Agree, 3 as “Uncertain/ Not Applicable”, 4 as “Disagree”, and 5 as “Strongly Disagree”.

Items used to measure Variable (A) Attitude towards using as follows:

A1) I would be able to use Technology Enhanced Learning on-board AIDA IV
A2) Are you willing to use iMET for you as a main training guide
A3) Are you willing to increase your usage of Marine educational software’s

- **Behavioural Intention to Actual System Use (B) instrument**

  The Behavioural Intention to Actual System towards using instrument measures the cadets' perception towards taking his/ her decision to use iMET tool. The research measured Behavioural Intention to Actual System using 3 items from the questionnaire on a 5 point Likert scale with 1 as "Strongly Agree", 2 as "Agree, 3 as "Uncertain/ Not Applicable", 4 as "Disagree", and 5 as "Strongly Disagree".

  Items used to measure Variable (B) Behavioural Intention to Actual System as follows:

  B1*) Do you personally intend to use your handheld device for self-tutoring*
  B2) Do you intent to use iMET as training tool on-board AIDA IV
  B3) Cadets ***(your colleagues)*** *will use the handheld device for self-tutoring on-board AIDA IV*

3.4 Data Collection

A pilot questionnaire had been conducted to the fifth semester deck cadets on-board the training ship AIDA IV, during the summer semester in 2014, in order to test the reliability of the questionnaire, accordingly the questionnaire questions and layout had been slightly modified in order to be clearer to the cadets and to fulfil the research aims and objectives. The questionnaire population was all the 120 cadets registered on-board the training ship AIDA IV during the 2015 spring semester.

After consulting the lecturers and trainers on-board the training ship about the questionnaire survey contents and its anticipated deliverables, the questionnaire questions had been grouped in a recommended manner, to be conducted in a classification and order that matches the cadets in the undergraduate phase attending the fifth semester during their on-board training phase. After data collection, the questionnaire outcomes were processed to be validated with the aid of the research adapted iMET acceptance model.

The total numbers of cadets on-board were 120 deck cadets from Comoro Islands, Egypt, Eritrea, Kenya, Lebanon, Nigeria, Saudi Arabia, Sierra Leon and Syria. Since answering the questionnaire was voluntarily, the total numbers of cadets who accepted participation was 106 cadets. Selected respondents (N) are 106 in order to represent a fairly suitable study.

The semi structured interview had been conducted to a sample representing all maritime stakeholders, from different segments of the maritime industry, whom are affiliated with enhancing the practical skills of the seagoing calibre, participants of the semi structured interview were all the lecturers on-board the training ship, who will use iMET tool, in addition to a sample of the International and regional shipping companies to measure the iMET application’s compatibility with the shipping industry competency requirements, the semi structured interview population was 26 Maritime professional, representing 18 Maritime Education and Training professionals and 8 Experts from the Maritime Industry. The profile of the interview participants presented in chapter 5.

Moreover, an additional quantitative interview questions had been selected, in order to measure specific points of strengths and weaknesses in the iMET tool, hence; to be able to compare it with the cadets’ questionnaire outcomes, as there a common questions aiming to measure the iMET perceived usefulness, ease of use, resources richness, attitude towards usage and behavioural intention to actual system usage. While open ended questions were selected in order to get the whole picture, comments and the points of concern driven from each interviewed personnel own perception.

Additionally, a one on one power point presentation preview and discussion was carried out, on Friday, 23rd of January, 2015 with IMO Secretary-General, Mr. Koji Sekimizu, during his official visit to the Arab Academy for Science, Technology and Maritime Transport in Alexandria. The discussion took place with Mr. Koji Sekimizu after presenting 20 minutes power point presentation about iMET technological intervention concept and its anticipated application.

3.4.1 Data Collection Procedure

After obtaining ethical approval in accordance to Liverpool John Moores University regulations, cadets' participation in the survey was voluntary; the questionnaire was conducted during the sea service semester on-board the training ship, where announcement was made to all cadets about the time and location of the questionnaire that was held two times on-board during the same training trip, in order to be convenient to the cadets' different training schedule. Questionnaires collected have neither identifiable markings nor names to indicate who had taken the survey.

A semi structured interview had been conducted to Ship operators and maritime academic staff through one on one meetings with the researcher. In order to measure their perception towards iMET as professionals as a representatives of the two main arms of the maritime industry, as maritime academic stuff are fully aware of the Maritime Education and Training present status and needs, so their perception is a plus to this research, in order to be accepted as a training tool, while the ship operators are the future employers of the maritime graduates, accordingly their perception towards iMET is vital, in order to introduce an iMET training tool that cope with the shipping industry market requirements. Interview participants accepted revealing their profile and their perceptions towards iMET, in order to help on developing the Maritime Education and Training.

3.5 Statistical Tools

After collecting the questionnaire surveys, that data were entered to SPSS version 22 to perform statistical descriptive analysis, and to perform further statistical analysis to the instruments used that were adapted from the literature to pre intervention survey and post intervention survey.

Accordingly, the statistical tools used are described in the following sections:

3.5.1 Data Testing using Validity and Reliability

Validity and Reliability of the data under study are two important conditions that have to be satisfactory, in order to start using the data available in responding to the research hypotheses. Aiming at creating a reliable and valid questionnaire statistical analysis, in order to enhance the accuracy of its outcomes.

Validity and reliability are two fundamental factors in the evaluation of a measurement instrument. Validity is concerned with the extent to which the variables are intending to measure. Reliability is concerned with the ability of achieving a consistent measure. An instrument cannot be valid unless it is reliable.

3.5.1.1 Validity Testing

Validity means the extent to which an instrument measures what it supposes to measure correctly (Sekaran & Bougie, 2010). The convergent validity of the measurement model can be assessed by the Average Variance Extracted (AVE). The researcher used convergent validity test by applying factor analysis.

Convergent validity tests the data using factor analysis (multivariate technique), that confirms whether or not the theorized dimensions are applicable (Sekaran & Bougie, 2010). Convergent validity was essential to ensure that the items measuring the same construct are highly correlated (Hair, et. al, 2003).

In order to test the convergent validity, the average value extracted for each of the scales should be calculated, which represents the average community for each latent factor. In an adequate model, AVE should be greater than 0.5, which means that the factors should explain at least half the variance of their respective indicators (Garson, 2015; Hair, et. al, 2003).

3.5.1.2 Reliability Analysis

For the purpose of evaluation of measures of concepts, any multidimensional scale should be reliable and valid. In order to test reliability of the study, Cronbach's Alpha, as the most commonly used test of reliability, was applied. Cronbach's alpha is a measure of internal consistency, alpha coefficient ranges in value from 0 to 1, and may be used to describe the reliability of factors extracted from dichotomous (that is, questions with two possible answers) and/or multi-point formatted questionnaires or scales (i.e., rating scale: 1 = poor, 5 = excellent). The higher the score, the more reliable the generated scale is. It was indicated that 0.7 is an acceptable reliability coefficient but lower thresholds are sometimes used in the literature (Hair, Black, Babin, & Anderson, 2003).

3.5.2 Hypotheses Testing using Correlation and Regression Analysis

3.5.2.1 Correlation Analysis

The correlation matrix is a matrix giving the correlations between all pairs of data sets. It provides the Pearson’s Correlation Coefficient between variables under study and each other, to be able to evaluate the relationship between those two variables. Pearson's correlation is used to find a correlation between at least two variables. The value for a Pearson’s correlation can fall between 0.00 (no correlation) and 1.00 (perfect correlation).

Pearson correlation analysis and descriptive statistics were conducted in this study in order to analyse the constructs, and test direct relationship between independent variable and dependent variable (Foster et al., 2001). The correlation will be able to evaluate the relationship between each independent variable perceived usefulness instrument (U), perceived ease of use (E), perceived resources instrument (R) and Attitude towards using instrument (A) with the dependent variable behavioural intention towards actual usage of iMET (B).

3.5.2.2 Regression Analysis

Multiple regression analysis is an extension of simple linear regression. It is a statistical procedure that is widely used to predict the value of one dependent variable based on the value of two or more independent variables. It is also used to understand which variable among the independent variables is related to the dependent one, and to explore the forms of these relationships.

Regression analysis had been adopted in order to predict the effect of one independent variable upon the dependent variable, to assume which of those independent variables: perceived usefulness instrument (U), perceived ease of use (E), perceived resources instrument (R) and Attitude towards using instrument (A) does have an impact whether a positive or negative one on the dependent variable behavioural intention towards actual usage of iMET (B), in order to test the research hypotheses for iMET technology acceptance. It is a Likert scale data so it is a discrete data and a normal curve is produced.

Regression Analysis includes many techniques for modelling and analysing several variables, more specifically; it helps to understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the others are held fixed. It determines the overall fit (variance explained) of the model and the relative contribution of each of the predictors to the total variance explained. The estimation target is a function of the independent variables called the regression function (Aiken & West, 1991; Foster et al., 2001).

3.5.3 Testing Regression Assumptions for Ordinary Least Squares Method

3.5.3.1 Normality Test

It is verified to determine if a data set is normal or well-modelled. An assessment of the normality of data is a prerequisite for many statistical tests because it is an underlying assumption in parametric testing.

Two common methods are identified to check this assumption:

1. ***Kolmogorov-Smirnov test of normality:*** It tests the normality assumption for samples greater than 50 observations.
2. ***Skewness and Kurtosis:*** It claims that a variable is reasonably close to normal if its skewness and kurtosis have values between –1.0 and +1.0 (Kleinbaum, et al., 2008).

3.5.3.2 Autocorrelation Test

It means that the residuals should be independent. This is one of the important assumptions of ordinary least squares method used in regression analysis. To check residuals independence, Durbin Watson test for the models fit is conducted (Box, Jenkins, Reinsel, & Ljung, 2015).

3.5.3.3 Multicollinearity Test

It occurs when two or more predictors in a model are highly correlated with each other. This leads to problems with understanding which predictors contribute to the variance explained in the regression model. So, redundant information about the criterion are provided (O'Brien, 2007). The variance inflation factor (VIF) value should be less than 5 implying that the problem of multicollinearity does not exist.

3.5.3.4 Independent Samples T-test

A comparison is constructed between the research variables in the pre and post intervention models. The comparison is constructed using the t-test. The t-test for pre and post intervention variables is constructed to show if there is a significant difference in the research variables between the pre and post intervention and to show if there is any improvement due to the application intervention (Sekaran & Bougie, 2010).

The researcher constructed a quiz to be applied before and after the intervention of the application. The researcher introduced the quiz for two subjects; EPIRB and SART. Therefore, 2 groups, each consisting of 20 students were randomly selected to do the quiz for each subject. Each group did the test two times; the pre-intervention and the post-intervention time. So, both groups are subjected to the same quiz twice. The first time of quiz was before the intervention and the other time was after introducing the research application. The pair wise t-test is used as it tests the scores of the same group before and after the experiment of the application intervention (Sekaran & Bougie, 2010).

3.6 Summary

Implementing a new technology is considered as the important and crucial phase especially when introducing a generic technology application. Therefore, proper identification of the end users expectations and implications during the implementation process from different aspects could have a major impact on achievement of the new technology tool objectives.

The professionally accepted use of technology is an important issue as many commonly used theories and models predicting the end users perception and behaviour towards using a new technology. In order to measure the iMET end users perception especially the cadets, the iMET Acceptance Model was adopted, which is modified from MAM and PRATAM models as discussed previously in this chapter.

The iMET Acceptance Model will be used for assessing validity and reliability of the quantitative data collected in the questionnaire conducted to the 106 cadets and the semi structured interview that had been conducted to 26 maritime professional, 18 maritime educations and training professional and 8 experts from the maritime industry.

The next chapter will present the technological intervention iMET from theoretical and technical aspects and developing iMET application prototype as a proof of concept.

CHAPTER FOUR

Pre-Intervention Empirical Study for iMET Model Development

4.1 Introduction

This chapter presents a detailed analysis of the mixed approach resulting from the use of both; questionnaire and semi-structured interview through introducing the results of the statistical analysis and techniques used for the data collected under this research. Thus, this chapter objective is to determine whether to accept or reject the research hypotheses through applying the statistical techniques selected for the pre-intervention part of the research, aiming to measuring maritime stakeholders' perception and expectations in iMET application before initiating the software development.

To achieve this objective, the current chapter starts by displaying descriptive analysis for the research variables, including mean, minimum, maximum, variance, and standard deviation, as well as the frequency tables. Also, it presents the correlation and regression analysis between the research variables to find the corresponding relationships and effects.

In this research, the statistical package "Statistical Program in the Social Science", or SPSS – Version 22, will be used in the above mentioned analysis techniques, as it is the most widely used and comprehensive package in statistics.

Data was collected through a questionnaire designed for 106 observations, representing the whole population cadets on-board the Academy training ship for the pre-intervention part, as well as 106 observations, representing the same cadets after applying the post-intervention of the technological application provided in the current study. Moreover, data was collected through an interview for 26 observations, representing the instructors and ship operators of the pre and post intervention of the application.

Accordingly, the researcher will analyse the results obtained by both; the questionnaire and interview in the following sections for the pre and post intervention stages.

4.2 Pre-Intervention Results and Findings

In this chapter, the researcher will derive the results and findings for the stage of the Pre-Intervention part of the technological application introduced iMET in the current study. This will require the analysis of the questionnaire directed to the cadets, as well as the interview directed to the instructors and ship operators. For the questionnaire, the descriptive analysis (using frequencies) and data testing (using validity and reliability) will be applied. Also, correlation and regression analysis were conducted to test the research hypotheses for the pre-intervention phase. As for the interview, the descriptive analysis was applied to measure iMET perceived resources.

4.2.1 Descriptive Analysis for the Pre-Intervention Using Questionnaire

The descriptive analysis gives a brief summary about the research variables. The researcher in this part will introduce a descriptive analysis for the data obtained from the questionnaire.

Table 4-1 shows that around 77% of the questionnaire respondents agree on perceived usefulness. Also, around 81% of the sample under study agrees on perceived ease of use. In addition, around 72% agree on having perceived resources. Besides, around 94% of the questionnaire respondents agree on having perceived attitude. Finally, around 92% of the respondents have behavioural intention for actual use of iMET. This means that relatively higher percentage of the sample under study is in the zone of agreement (agree and strongly agree). Yet, there are still some respondents are not quite happy with the perceived usefulness, perceived ease of use, perceived resources, attitude towards using iMET, and Behaviour intention of iMET actual usage. Therefore, these percentages of disagreement are shown to be requiring some improvements.

Table 4- 1: Frequency Tables of Research Variables for Questionnaire Respondents for Pre-intervention

Variable	Items	Frequency	Percent
Perceived Usefulness (U)	**Disagree**	4	3.8
	Uncertain	20	18.9
	Agree	52	49.1
	Strongly Agree	30	28.3
	Total	106	100.0
Perceived Ease of Use (E)	**Uncertain**	20	18.9
	Agree	40	37.7
	Strongly Agree	46	43.4
	Total	106	100.0
Perceived Resources (R)	**Disagree**	6	5.7
	Uncertain	24	22.6
	Agree	48	45.3
	Strongly Agree	28	26.4
	Total	106	100.0
Perceived Attitude (A)	**Uncertain**	6	5.7
	Agree	64	60.4
	Strongly Agree	36	34.0
	Total	106	100.0
Behavioural Intention (B)	**Uncertain**	8	7.5
	Agree	30	28.3
	Strongly Agree	68	64.2
	Total	106	100.0

The following graphs show the same results obtained from table 4-2, where it could be shown that the largest areas are given for agree and strongly agree items. On the other hand, it could be observed that there are still some areas of disagreement which require some improvements.

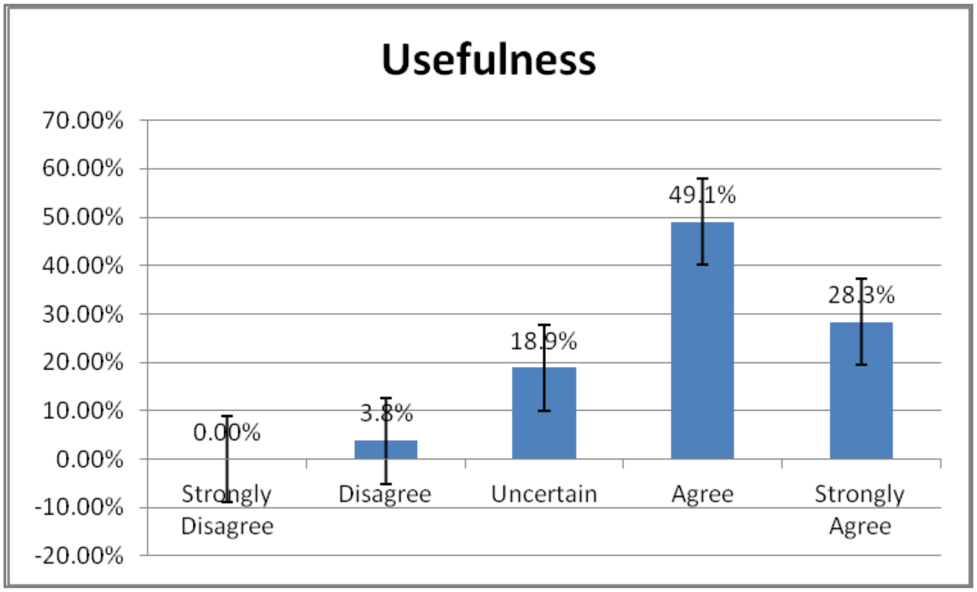


Figure 4- 1: Bar Chart of Perceived Usefulness for Questionnaire Respondents for Pre-Intervention

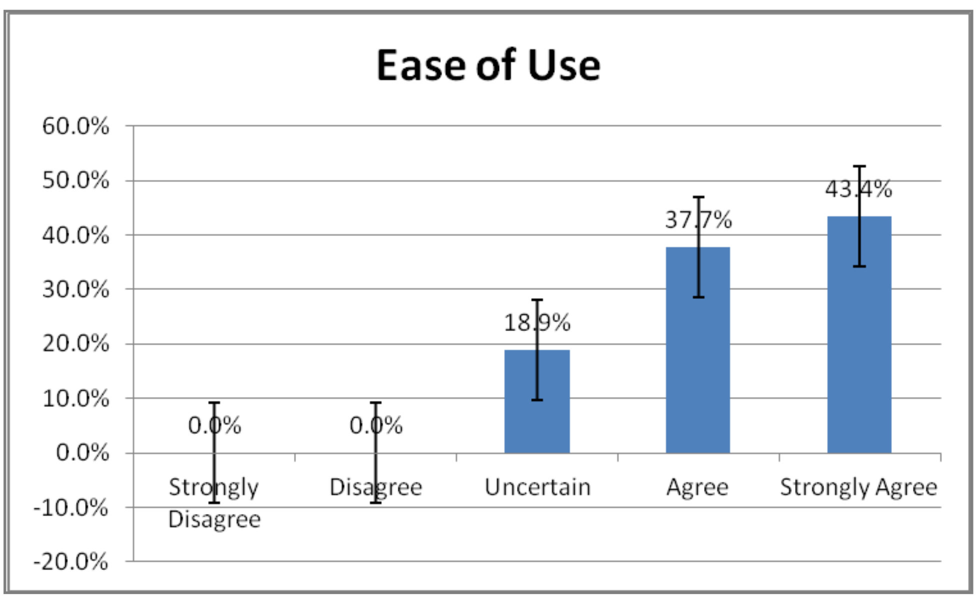


Figure 4- 2: Bar Chart of Perceived Ease of Use for Questionnaire Respondents for Pre-Intervention

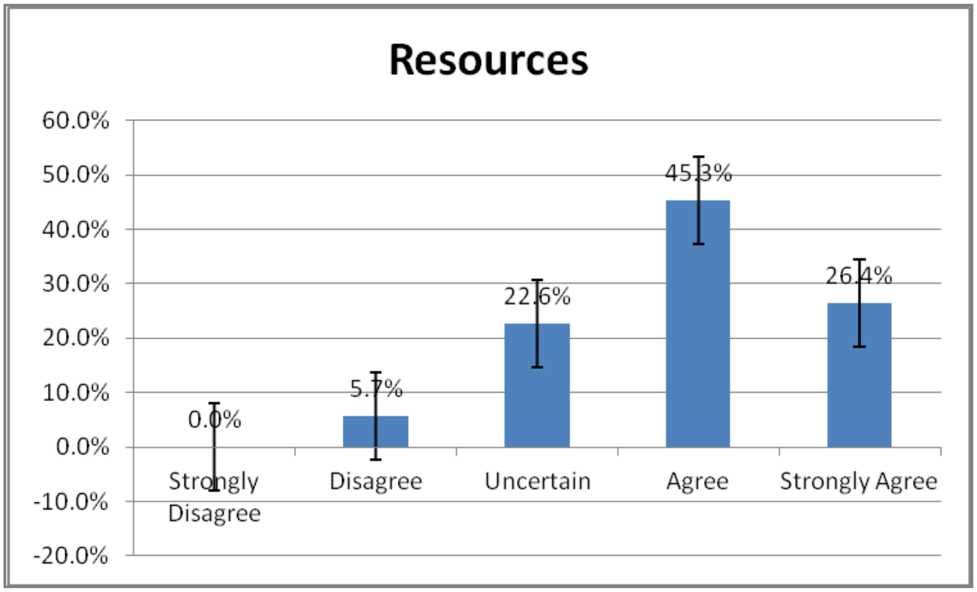


Figure 4- 3: Bar Chart of Perceived Resources for Questionnaire Respondents for Pre-Intervention

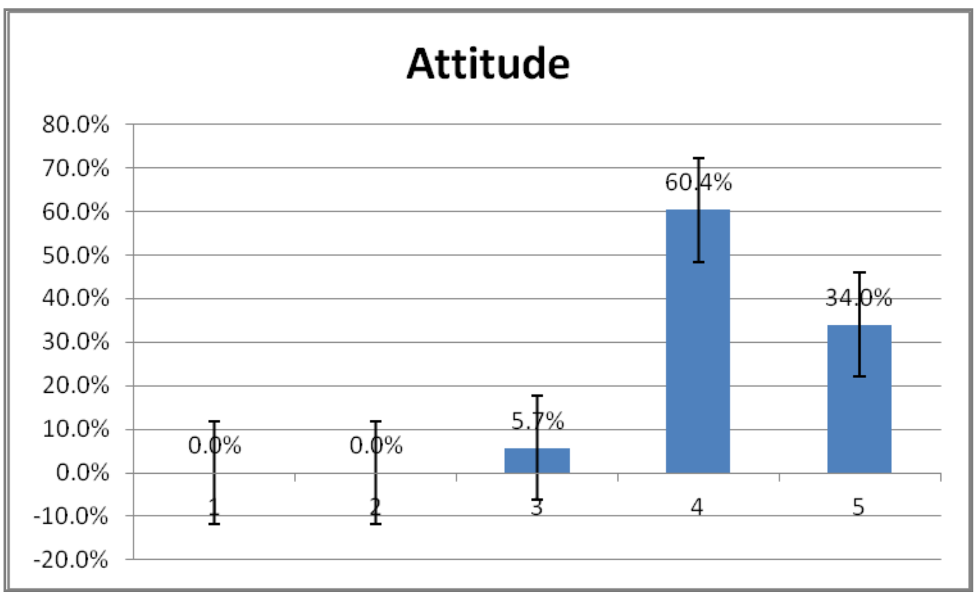


Figure 4- 4: Bar Chart of Perceived Attitude for Questionnaire Respondents for Pre-Intervention

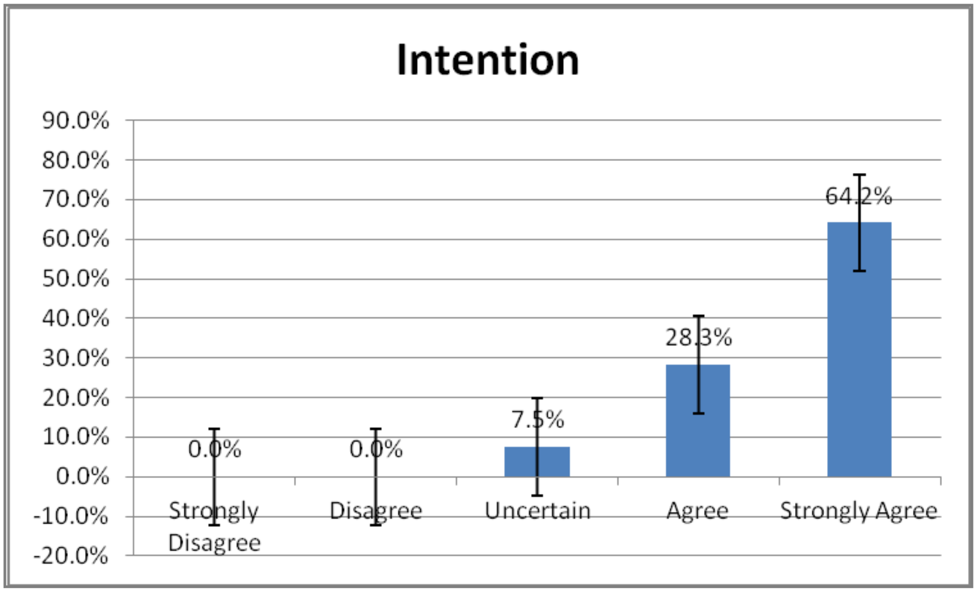


Figure 4- 5: Bar Chart of Behavioural Intention for Questionnaire Respondents for Pre-Intervention

Also, the researcher will present in Appendix C, Table (1) all the descriptive analysis of the breakdown of the research variables mentioned above.

4.2.2 Hypotheses Testing for the Pre-Intervention Using Questionnaire

In this section, the researcher will consider the results of testing hypotheses under study. Accordingly, the researcher will use the questionnaire responses to figure out whether to accept or reject the research hypotheses. As mentioned above, the questionnaire in the pre-intervention part was directed to 106 students and the results are presented below. Research hypotheses will be tested using correlation and regression analysis. Before testing hypotheses, the data under study should be tested for it reliability and validity, to be able to rely on the data collected and variables computed to test the research hypotheses.

4.2.2.1 Data Testing Using Validity and Reliability for the Pre-Intervention

Validity and Reliability of the data under study are two important conditions that have to be satisfied to start using the data available in responding to the research hypotheses. In this section, the reliability will be tested using Cronbach's alpha, while validity of the data under study will be tested using Average Variance Extracted (AVE) and Factor Loading (FL).

4.2.2.1.1 Validity Testing for Pre-Intervention

Validity means the extent to which an instrument measures what it supposes to measure correctly (Sekaran & Bougie, 2010). The researcher used convergent validity test by applying factor analysis.

Convergent validity tests the data using factor analysis (multivariate technique) that confirms whether or not the theorized dimensions are applicable (Sekaran & Bougie, 2010). Convergent validity was essential to ensure that the items measuring the same construct are highly correlated (Hair et al., 2003).

In order to test the convergent validity, the average variance extracted for each of the scales was calculated. The average variance extracted (AVE) represents the average community for each latent factor, and in an adequate model it should be greater than 0.5, which means that the factors should explain at least half the variance of their respective indicators (Hair et al., 2003).

The results of the factor analysis conducted on the current research constructs indicate that AVE values for all scales under study were found to be greater than 0.5 or 50%, after deleting some items in each variable of the ones under study.

Also, item reliability can be evaluated by the size of the loadings of the measures on their corresponding constructs. The loadings should be at least 0.400 or above (Sekaran & Bougie, 2010) indicating each measure is accounting for 40% or more of the variance of the underlying latent variable (Sekaran & Bougie, 2010).

Table 4-2 represents the deleted items and the corresponding factor loading, where it could be observed that the items shown to have low factor loading, or in other words, low contribution in their corresponding constructs (less than 0.4). For example, it is found that U3 and U5, which are items of the variable Perceived Usefulness, have a factor loading of 0.212 and 0.145 respectively. This means that the items U3 and U5 have weak contribution to the variable Perceived Usefulness and they should be deleted from the items considered in calculating the variable. The deleted items mentioned in detail are as follows:

U3) iMET will enhance gaining required practical skills on-board
U5) iMET will support putting theoretical knowledge into practical one
E1) Do you think that technology is essential for you
E5) Do you play video games frequently
R2) iMET will improve your seaman ship training
R3) iMET will improve your Engine room familiarisation training

In the same way, the items E1 and E5 have weak contribution in calculating the variable Perceived Ease of Use, as their corresponding factor loading are 0.324 and 0.261 respectively. Therefore, the items E1 and E5 should be deleted from the list of items used in calculating the variables Perceived Ease of Use.

In addition, the items R2 and R3 have weak contribution in computing the variable Perceived Resources as their corresponding factor loading are 0.115 and 0.217 respectively, which is less than 0.4. Thus, the items R2 and R3 should be ignored when considering the items for the variable Perceived Resources.

Table 4- 2: Factor Loadings of Deleted Items for Pre-intervention

Variables Under Study	**Factor Loading of Items**
Perceived Usefulness	
U3	**0.212**
U5	**0.145**
Perceived Ease of Use	
E1	**0.324**
E5	**0.261**
Perceived Resources	
R2	**0.115**
R3	**0.217**

Table 4-3 represents the remaining items considered with acceptable AVE and factor loading after deleting some items. This means that all dimensions under study have now convergent validity, the AVE and FL acceptable items for the pre intervention analysis are as follows:

U1) Do you think the implementation of iMET tool would be beneficial for training on-board
U2) iMET will be an added value for OOW duties training
U4) iMET will help understanding theoretical aspect of MET
E2) Are you a frequent user of mobile applications
E3) Are you a frequent user of Marine mobile applications
E4) Are you a frequent user of Microsoft office
R4) iMET will improve your Stability and Cargo calculations training
R5) iMET will improve your Safety behaviour on-board
R6) iMET will improve your Maritime English
R7) iMET will improve your self-reliance, rationality and sense of responsibility
R1) iMET will improve your Lifesaving and Firefighting equipment training
A1) I would be able to use Technology Enhanced Learning on-board AIDA IV
A2) Are you willing to use iMET for you as a main training guide
A3) Are you willing to increase your usage of Marine educational software's
B1) Do you personally intent to use your handheld device for self-tutoring
B2) Do you intent to use iMET as training tool on-board AIDA IV
*B3) Cadets **(your colleagues)** will use the handheld device for self-tutoring on-board AIDA IV*

Table 4- 3: Average Variance Extracted and Factor Loadings of Items for Pre-intervention

Variables Under Study	AVE in %	Factor Loading of Items
Perceived Usefulness		
U1	65.557%	0.696
U2		0.630
U4		0.640
Perceived Ease of Use		
E2	65.319%	0.622
E3		0.661
E4		0.677
Perceived Resources		
R1	56.752%	0.631
R4		0.535
R5		0.642
R6		0.565
R7		0.465
Attitude towards using Technology		
A1	50.520%	0.504

Variables Under Study	AVE in %	Factor Loading of Items
A2		0.439
A3		0.572
Behavioural Intention		
B1		0.579
B2	51.687	0.437
B3		0.499

Another type of validity that shall be tested is the discriminant validity. It is the type of validity which relies on the fact that constructs are considered as having adequate validity if they are discriminant from each other, which means that items of each variable should be correlated to each other and apart from other items of other variables in the model. This type of validity is achieved when the square root of their variances extracted (AVE) are greater than the correlations between the corresponding variable and other constructs.

Discriminant validity was tested as shown in the following table 4-4, where it could be noticed that square root of AVEs are greater than the correlations between the corresponding variable and other constructs. For example, the square root of AVE for Perceived Usefulness is 0.8097, which is greater than the Pearson correlations between Perceived Usefulness and other variables (0.247, 0.598, 0.626, 0.282).

Therefore, the items making up the variable; Perceived Usefulness have higher inter-correlation between each other than the correlation between perceived usefulness and other variables. This means that the items making up Perceived Usefulness could not be used to represent other variables. Same status is applied to the other four variables; Perceived Ease of Use, Perceived Resources, Attitude and Behaviour Intention, which means that the variables under study all have discriminant validity.

Table 4- 4: Discriminant Validity Between Variables

Pre-Intervention		Usefulness	Ease	Resources	Attitude	Intention
SQRT-AVE		**0.8097**	**0.8082**	**0.7533**	**0.7108**	**0.7189**
Usefulness	Pearson Correlation	1				
	P-value					
Ease	Pearson Correlation	.247*	1			
	P-value	.011				
Resources	Pearson Correlation	.598**	.298**	1		
	P-value	.000	.002			
Attitude	Pearson Correlation	.626**	.283**	.483**	1	
	P-value	.000	.003	.000		
Intention	Pearson Correlation	.282**	.185	.365**	.507**	1
	P-value	.003	.057	.000	.000	

* Correlation is significant when P-value < 0.05
** Correlation is significant when P-value < 0.01

4.2.2.1.2 Reliability Testing for Pre-Intervention

For the purpose of evaluation of measures of concepts, any multidimensional scale should be reliable and valid. In order to test reliability of the study, Cronbach's Alpha, as the most commonly used test of reliability, was applied. Alpha coefficient ranges in value from 0 to 1 and may be used to describe the reliability of factors extracted from dichotomous (that is, questions with two possible answers) and/or multi-point formatted questionnaires or scales (i.e., rating scale: 1 = poor, 5 = excellent). The higher the score, the more reliable the generated scale is. In some studies, it was indicated that 0.7 is an acceptable reliability coefficient but lower thresholds are sometimes used in the literature (Hair et al., 2003).

Therefore, if the items in a test are correlated to each other, the value of alpha is increased. However, a high coefficient alpha does not always mean a high degree of internal consistency. This is because alpha is also affected by the length of the test. If the test length is too short, the value of alpha is reduced (Streiner, 2003). In social science, 0.6 is an acceptable alpha value for reliability (Ghazali, 2008).

Cronbach's alpha coefficient was applied to estimate the reliability of studied variables. The results are shown in Table 4-5 below, the results showed that all alpha values revealed the reliability and the internal consistency between the selected items of the studied variables. It can be shown that the values of Cronbach’s alpha for the variables under study ranges between 0.5 and 0.8. This means that the reliability is accepted for the variables; Perceived Usefulness, Perceived Ease of Use and Perceived Resources.

Regarding Attitude and Behaviour Intention, it could be observed that they have smaller reliability coefficient, which might be referred to as the sample size (n=106) might be affecting the value of Cronbach’s alpha, which is in fact the whole population size as it represents the whole capacity of the training ship.

Also, those two variables are related to the individual attitude and behaviour of the cadets who might not be able to identify their perception regarding the application as it has not been developed yet. Thus, the researcher will take the risk of computing the two variables according to the available items and will count on the items after applying the post intervention, where the prototype will be developed and applied.

Table 4- 5: Reliability Test for Research Variables for Pre-intervention

Variables	**Number of items**	**Cronbach’s Alpha**
Perceived Usefulness	3	0.7
Perceived Ease of Use	3	0.7
Perceived Resources	5	0.8
Attitude towards using Technology	3	0.5
Behavioural Intention/ Actual Usage	3	0.5

According to validity and reliability testing, the items remaining after deleting items with low AVE and/or factor loading were used to compute the variables under study to be able to use in testing the hypotheses of the current research. Variables are computed by taking the round average of the items considered for each variable under study.

4.2.2.2 Hypotheses Testing Using Correlation and Regression Analysis for the Pre-Intervention

In this section, the researcher is perusing outcomes, after testing hypotheses using the correlation and regression analysis.

4.2.2.2.1 Pre-Intervention Analysis

To make it easier, the researcher will start with presenting a brief discussion of the results and findings of both, the correlation and regression analysis.

The Pearson's Correlation Coefficient is used to evaluate the relationship between two variables. It is represented with the symbol "r". The value for a Pearson's correlation can fall between 0.00 (no correlation) and 1.00 (perfect correlation). If the correlation (r) is insignificant, the P-value will be shown to be greater than 0.05, where P-value is the significance level, and vice-versa (Foster et al., 2001).

Regarding linear regression analysis, it is a statistical procedure that is widely used to predict the value of one dependent variable based on the value of one or more independent variables. It is also used to understand which variable among the independent variables is related to the dependent variable and to explore the forms of these relationships.

The regression coefficient (β) represents the amount of change that happens in the dependent variable due to a change in the independent variable by one unit. If the regression coefficient shows a significant impact of the independent variable on the dependent variable, then P-value should be shown to be less than the significance level (0.05 or 0.01).

The regression coefficients and p-values are computed for the impact of each independent variable (Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude towards using technology) on the dependent variable (Behavioural Intention for Actual System Usage).

The following discussion will represent a summary of the detailed findings that will be represented below. The summary of findings is displayed in tables 4-6, 4-7 and 4-8.

Table 4-6 presents the correlation and p-values found between Behavioural Intention and each of the research variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude towards using technology for the pre-intervention stage.

It was shown that there is a significant positive moderate relationship between behavioural Intention and each of perceived resources, Attitude towards using technology (r= 0.365 and 0.507 respectively, P-values = 0.000 < 0.05).

Also, table 4-6 shows that there is a significant positive but weak relationship between behavioural Intention and perceived usefulness (r= 0.282, P-value = 0.003 < 0.05). On the other hand, there is an insignificant relationship between behavioural intention and perceived ease of use as P-value = 0.057 > 0.05.

Table 4- 6: Correlation Matrix Between the Research Variables and Behavioural Intention for the Pre-Intervention

		Perceived Usefulness	Perceived Ease of Use	Perceived Resources	Attitude towards using Technology
Behavioural Intention/ Actual Usage	Pearson Correlation (r)	.282**	.185	.365**	.507**
	P-value	.003	.057	.000	.000

** Correlation is significant when P-value < 0.01

Table 4-7 shows a summary of the simple linear regression analysis results, where it was found that that there is a significant positive impact of perceived usefulness (β=0.225, P-value = 0.003), perceived resources (β=0.272, P-value = 0.000), Attitude towards using technology (β=0.568, P-value = 0.000) on Behavioural Intention, as all p-values are less than 0.05.

On the other hand, table 4-7 shows that there is an insignificant impact of perceived ease of use (β=0.156, P-value = 0.057) on Behavioural Intention as P-value is greater than 0.05.

Table 4- 7: Summary of Simple Regression Analysis Results of Research variables on Behavioural Intention for the Pre-Intervention

	β (Regression Coefficient)	P-value
Perceived Usefulness	.225**	.003
Perceived Ease of Use	.156	.057
Perceived Resources	.272**	.000
Attitude towards using technology	.568**	.000

** Regression is significant when P-value < 0.01

The above results could be summarised to figure out a response of the research hypotheses in the pre-intervention stage as shown in table 4-8. It could be observed that the first, third and fourth hypotheses are accepted, while the second one is rejected for the pre-intervention stage.

Table 4- 8: Summary of Research Hypotheses Response for the Pre-Intervention

Research Hypothesis	**Details**	**Results**	**Response**
Hypothesis One	Impact of Perceived Usefulness on Behavioural Intention	r=0.282, β =0.225 P-value = 0.003	Accept Hypothesis One: There is a significant impact of Perceived Usefulness on Behavioural Intention
Hypothesis Two	Impact of Perceived Ease of Use on Behavioural Intention	r=0.185, β=0.156 P-value = 0.057	Reject Hypothesis Two: There is an insignificant impact of Perceived Ease of Use on Behavioural Intention
Hypothesis Three	Impact of Perceived Resources on Behavioural Intention	r=0.365, β= 0.272 P-value = 0.000	Accept Hypothesis Three: There is a significant impact of Perceived Resources on Behavioural Intention
Hypothesis Four	Impact of Attitude towards using technology on Behavioural Intention	r=0.507, β=0.568 P-value = 0.000	Accept Hypothesis Four: There is a significant impact of Attitude towards using technology on Behavioural Intention

As per the above brief discussion, the following sections will present how such results are obtained in details. Each section will represent the findings of the correlation and regression analysis between each independent variable and the dependent variable.

4.2.2.2.2 Testing the First Hypothesis: The Relationship Between Perceived Usefulness and Behavioural Intention in the Pre-intervention

Table 4-9 shows the correlation analysis between Perceived Usefulness and Behavioural Intention. It could be observed that there is a significant positive but weak relationship between perceived usefulness and behavioural intention (r=0.282, P-value = 0.003 < 0.05).

Table 4- 9: Correlation Analysis Between Perceived Usefulness and Ease of Use for the Pre-Intervention

		Perceived Usefulness	Behavioural Intention
Perceived Usefulness	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.282**	1
	P-value	.003	
	N	106	106

Table 4-10 shows the regression analysis and the model fitted between Perceived usefulness as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 8%, which means that the model explains 8% of the variance in Behavioural Intention. The model as a whole is significant (P-value = 0.003 < 0.05). In addition, there is a significant effect of Perceived Usefulness (P-value = 0.003 < 0.05).

Table 4- 10: Regression Analysis for Impact of Perceived Usefulness on Behavioural Intention for Pre-Intervention

Model		Unstandardised Coefficients		Standardised Coefficients	t	P-value	R – Squared
		B	Std. Error	Beta			
1	(Constant)	3.660	.308		11.901	.000	0.080
	Usefulness	.225	.075	.282	3.002	.003	

4.2.2.2.3 Testing the Second Hypothesis: The Relationship Between Perceived Ease of Use and Behavioural Intention in the Pre-intervention

Table 4-11 shows the correlation analysis between Perceived Ease of Use and Behavioural Intention. It could be observed that there is an insignificant relationship between perceived ease of use and behavioural intention (P-value > 0.05).

Table 4- 11: Correlation for Perceived Ease of Use and Behavioural Intention for Pre-Intervention

		Perceived Ease of Use	Behavioural Intention
Perceived Ease of Use	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.185	1
	P-value	.057	
	N	106	106

Table 4-12 shows the regression analysis and the model fitted between Perceived Ease of Use as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 3.4%, which means that the model explains 3.4% of the variance in Behavioural Intention. The model as a whole is insignificant (P-value = 0.057 > 0.05). In addition, there is an insignificant effect of Perceived Ease of Use (P-value = 0.057 > 0.05).

Table 4- 12: Regression Analysis for Impact of Perceived Ease of Use on Behavioural Intention for Pre-Intervention

Model		Unstandardised Coefficients		Standardised Coefficients	t	P-value	R – Squared
		B	Std. Error	Beta			
1	(Constant)	3.905	.349		11.196	.000	0.034
	Ease of Use	.156	.081	.185	1.924	.057	

4.2.2.2.4 Testing the Third Hypothesis: The Relationship Between Perceived Resources and Behavioural Intention in the Pre-intervention

Table 4-13 shows the correlation analysis between Perceived Resources and Behavioural Intention. It could be observed that there is a significant positive moderate relationship between perceived resources and behavioural intention (r=0.365, P-value = 0.000 < 0.05).

Table 4- 13: Correlation for Perceived Resources and Behavioural Intention for Pre-Intervention

		Perceived Resources	Behavioural Intention
Perceived Resources	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.365**	1
	P-value	.000	
	N	106	106

Table 4-14 shows the regression analysis and the model fitted between Perceived Resources as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 13.3%, which means that the model explains 13.3% of the variance in Behavioural Intention. The model as a whole is significant (P-value = 0.000 < 0.05). In addition, there is a significant effect of Perceived Resources (P-value = 0.000 < 0.05).

Table 4- 14: Regression Analysis for Impact of Perceived Resources on Behavioural Intention for Pre-Intervention

Model		Unstandardised Coefficients		Standardised Coefficients	t	P-value	R – Squared
		B	Std. Error	Beta			
1	(Constant)	3.497	.274		12.780	.000	0.133
	Resources	.272	.068	.365	3.994	.000	

4.2.2.2.5 Testing the Fourth Hypothesis: The Relationship Between Attitude towards Using Technology and Behavioural Intention in the Pre-intervention

Table 4-15 shows the correlation analysis between Perceived Attitude and Behavioural Intention. It could be observed that there is a significant positive moderate relationship between perceived Attitude and behavioural intention (r=0.365, P-value = 0.000 < 0.05).

Table 4- 15: Correlation for Perceived Attitude and Behavioural Intention for Pre-Intervention

		Perceived Attitude	Behavioural Intention
Perceived Attitude	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.507**	1
	P-value	.000	
	N	106	106

Table 4-16 shows the regression analysis and the model fitted between Perceived Attitude as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 25.7%, which means that the model explains 25.7% of the variance in Behavioural Intention. The model as a whole is significant (P-value = 0.000 < 0.05). In addition, there is a significant effect of Perceived Attitude (P-value = 0.000 < 0.05).

Table 4- 16: Regression Analysis for Impact of Perceived Attitude on Behavioural Intention for Pre-Intervention

Model		Unstandardised Coefficients B	Unstandardised Coefficients Std. Error	Standardised Coefficients Beta	T	P-value	R – Squared
1	(Constant)	2.135	.409		5.220	.000	0.257
	Attitude	.568	.095	.507	5.994	.000	

4.2.3 Descriptive Analysis for Interview Responses for the Pre-Intervention

Table 4-17 shows that most of the interview respondents have perceived usefulness, perceived ease of use, perceived resources, perceived attitude, and behavioural intention.

Table 4- 17: Frequency Tables of Research Variables for Interview Respondents for Pre-intervention

Variable	Items	Frequency	Percent
Perceived Usefulness	**Yes**	26	100.0
	Total	26	100.0
Perceived Ease of Use	**Yes**	26	100.0
	Total	26	100.0
Perceived Resources	**Uncertain**	6	23.1
	Agree	15	57.7
	Strongly Agree	5	19.2
	Total	26	100.0
Perceived Attitude	**No**	1	3.8
	Somehow	1	3.8
	Yes	24	92.4
	Total	26	100.0
Behavioural Intention	**Somehow**	2	7.6
	Yes	24	92.4
	Total	26	100.0

4.2.4 Interview Results and Findings

An open discussion was conducted with the IMO Secretary-General, Mr. Sekimizu, on Friday, 23rd of January 2015, during his official visit to AASTMT, the interview was carried out after presenting iMET proposed application in 20 minutes with the aid of power point presentation, IMO secretary general interview and discussion was conducted as an additional tool to measure maritime officials perception towards iMET application.

The semi-structured interview was conducted as a supplementary to the quantitative analysis had been introduced to 26 maritime professionals where 18 of them are MET professionals from the College of Maritime Transport and Technology and Academy training ship AIDA IV whom are directly affiliated with delivering the hands on training on-board the ship, while 8 are representing the management level in different shipping companies representing the maritime industry. As most of the results in the interview responses were all agree, the researcher could not use its data to test the hypotheses under study.

The 18 personnel representing the faculty staff on-board in addition to the ship's Master and Chief Officer and the College of Maritime Transport and Technology management level as they are involved in the training process on-board as well, the 18 interviewed personnel representing a total of 197 years sea time on-board different types of vessels among the international well-known companies.

Regarding the iMET perceived resources; it is assessed in a quantitative method in the semi structured interview section, in order to measure the marine instructors, ship owners and ship operators' perception, based on their experience in the Maritime field, as their perception in this area will be much more accurate and reliable than the cadets, whom are still in their first phase of being onboard a ship. Table 4-18 shows the 18 interviewed MET professionals representing their profile in the seafaring and their qualifications:

Table 4- 18: MET Professionals and their Profile

Post	Special studies	Seatime years	Type of Vessel	Sailing Area	Marine rank
Lecturer Onboard	TOT, ICDL, ILETS	6	1 Type	Red sea, black sea, Arab gulf	Master
Lecturer Onboard	TOT, ICDL, Post graduate student	15	4 Types	Worldwide	Master
Lecturer Onboard	TOT, Post graduate student	15	1 Type	offshore Egypt	Master
Head of Deck Dept.	TOT, ICDL, IELTS, post graduate student	10	3 Types	Arab Gulf, Black sea, Far east	Master
Lecturer Onboard	TOT, ICDL, Post graduate student	7	3 Types	Worldwide	Master
Sea Training Dean	TOT, ICDL, IELTS, PgD, M.Sc	14	2 Types	Worldwide	Master
Vessel Chief Mate	ICDL, IELTS	9	1 Type	Mediterranean, red sea	Master
Navigation Officer	ICDL, IELTS	6	2 Types	Mediterranean, red sea	Master
Navigation Officer	ICDL, IELTS	7	2 Types	Mediterranean, red sea	Master
Navigation Officer	ICDL, IELTS	6	3 Types	Mediterranean, red sea	Master
Vessel Master	N/A	24	2 Types	Mediterranean, red sea	Master
College Dean	TOT, ICDL, IELTS, PgD, M.Sc, Ph.D	15	1 Type	Worldwide	Master
College Vice Dean	TOT, ICDL, IELTS, PgD, M.Sc	8	2 Types	Worldwide	Master
College Lecturer	TOT, ICDL, ILETS	6	1 Type	Red sea, black sea, Arab gulf	Master
College Lecturer	TOT, ICDL, Post graduate student	15	4 Types	Worldwide	Master
College Lecturer	TOT, Post graduate student	15	1 Type	Worldwide	Master
College Lecturer	TOT, ICDL, IELTS, post graduate student	10	3 Types	Worldwide	Master
College Lecturer	TOT, ICDL, Post graduate student	9	3 Types	Worldwide	Master

The 18 interviewed MET professionals have a total of 134 years teaching time in the Maritime studies where they conduct different types teaching objectives in order to maintain a quality education and training as the on job training is the main focus of the training scheme in the Academy training ship. It was observed that the 18 interviewed MET professionals are using technology generally in their daily life and they are utilising it in their training.

Table 4-19 shows the 18 interviewed MET professionals teaching profile, where it represents each teaching specialty and technology usage.

Table 4- 19: MET Professionals and their Teaching Profile

Teaching speciality	Teaching years	Technology usage	Technology in MET	Current training type
Seamanship, Navigation	11	Hi usage, Android	Power point and ehand outs	On job training, theorotical and practical
Seamanship	5	Hi usage, ios	Power point and ECDIS programs from internet	On job training, theorotical and practical
Navigation	5	Hi usage, Android	Power point	On job training, theorotical and practical
Seamanship, Stability, Cargo	6	Hi usage, Android	Power point	On job training, CBT
Seamanship	4	Moderate, Android	Power point and safety CBT	On job training, CBT
Navigation	14	Hi usage, Android	Power point	On job training, theorotical and practical
Navigation	4	Hi usage, Android	Power point and ECDIS programs from internet	On job training, CBT
Seamanship, Navigation	3	Moderate, Android	Power point	On job training
Seamanship, Navigation	3	Hi usage, Android	Power point	On job training
Seamanship, Navigation	2	Hi usage, Android	Power point	On job training
Navigation	15	Moderate, Android	Power point	On job training
Seamanship, Stability, Cargo	19	Hi usage, Android	Power point	Theorotical and practical
Electronic Navigation	10	Moderate, Android	Power point	Theorotical and practical
Seamanship, Navigation	11	Hi usage, Android	Power point and ehand outs	On job training, theorotical and practical
Seamanship	5	Hi usage, ios	Power point and ECDIS programs from internet	On job training, theorotical and practical
Navigation	5	Hi usage, Android	Power point	On job training, theorotical and practical
Seamanship, Stability, Cargo	6	Hi usage, Android	Power point	On job training, CBT
Seamanship, Stability, Cargo	6	Hi usage, Android	Power point	On job training, CBT

Concerning the 8 interviewed industry personnel they have been selected as they do recruit Academy graduates on-board their fleet, where 3 of the 8 interviewed industry personnel representing V-Ships Ship management company who is managing more than 1000 vessels and considered as one of the leading companies in the area of ship management/ operations.

In addition to a local shipping company “Mermaid” as it will represent the perception of the local ship owners. The 8 interviewed industry personnel have a total of 91 years’ experience on-board different vessels, moreover they are involved in the ships’ operations that includes crewing and training of their seagoing personnel serving on-board their fleet of more than 1420 vessels sailing around the globe from different types of vessels such as Dry Cargo vessels, Oil/ Chemical Tankers and LPG/ LNG Carriers.

Table 4-20 shows the 8 interviewed industry personnel posts and their special studies/ training they gained after graduation, in addition to company name, number of its fleet and the fleets' area of trade.

Table 4- 20: Industry Personnel Posts and their Studies

Post	Special studies	Seatime years	Type of Vessel	Sailing Area	Company Name	Fleet No.
Technical Manager	Survey, Management	23	5 Types	Worldwide	Oldendorff Carriers	400
Managing Director	Leadership, Management	25	4 Types	Worldwide	International Tanker Management	57
Managing Director	Leadership, MBA	2	2 Types	Worldwide	V-Ships	1000
Managing Director	Senior level leader, addressing media in crisis	17	3 Types	Worldwide	Red Sea Marine Services	8
MENA Business Develompment Director	TOT	6	2 Types	Worldwide	V-Ships	1000
Crew Manager	TOT	5	3 Types	Worldwide	V-Ships	1000
Ship Owner	Management	7	2 Types	Mediterranean, red sea	Mermaid Shipping Company	5
Ship Owner	MBA	6	1 Type	Mediterranean, Black sea	National Shipping Company	7

The 8 interviewed industry personnel had been selected with a marine background as the 8 of them worked on-board different vessels before joining the company management ashore.

Table 4-21 shows the 8 interviewed industry personnel marine background and their sea time, also representing if their companies are using the technology as main tool for conducting in house training type to the seagoing personnel serving on-board their fleet in addition to their personal usage of technology in their daily life.

Table 4- 21: Industry Personnel and their Sea Time

Seatime years	Marine rank	Company Name	Fleet No.	Technology usage	Technology in MET	Current training type
23	Master	Oldendorff Carriers	400	Hi usage, Android	CBT	On job training
25	Chief Engineer	International Tanker Management	57	Not interested	CBT	On job training
2	2nd Mate	V-Ships	1000	Hi usage, ios	CBT	On job training, Simulation
17	Master	Red Sea Marine Services	8	Hi usage, Android	CBT	On job training
6	2nd Mate	V-Ships	1000	Hi usage, Android	CBT	On job training
5	3rd. Engineer	V-Ships	1000	Hi usage, Android	CBT	On job training
7	Master	Mermaid Shipping Company	5	Hi usage, ios	N/A	On job training
6	Chief Engineer	National Shipping Company	7	Hi usage, Android	N/A	On job training

It was observed that 7 out of the 8 interviewed industry personnel are using technology in their daily life, also it was observed that international companies have already adopted an in house training scheme for their seagoing personnel based on technology represented in a CBT packages provide by Vediotel and Seagull companies, where such training is conducted to the seagoing personnel before joining the vessel and while they are on-board as well.

The types of training adopted by these companies are on job training while V-Ships is the only company that is using the simulation in addition to Vediotel CBT packages, although they have their own training policies but they were open for adopting more personalised technological training tool that is tailored for their company policies and fleet in order to develop their personnel technical skills, leadership and management skills.

While the local company "Mermaid" had adopted a non-technology based in house training focusing on the on job training, but they did not mind adopting a cost effective technological tool as long as it will be tailored for the company fleet and isn't a generic one.

4.2.4.1 Perception towards Academy Cadets

The 26 interviewed personnel were requested to state their own perception towards the Academy cadets according to their experience with them on-board different vessels, accordingly a list of points of weaknesses and strengths had been driven as follows:

Cadets' observed points of Strength are; Practical work familiarisation and good leadership skills, adaptability with different work environments, 4 ship operators stated that cadets' willingness to learn and practice is high in addition to remarkable eagerness for self-development, while 7 interviewed personnel highlighted bridge work and OOW duties, 2 ship operators acknowledged the cadets' Hand on skills, most of the interviewed personnel agreed on the cadets' self-motivation in addition to good Navigation Skills and strong theoretical background, while one ship manager stated that the main point of strength that they Speak up when don't know.

Cadets' observed points of weaknesses are; Seven of the interviewed personnel stated that one of the main points of weakness is the cadets' poor ability to Transforming theory into practice although they have a solid theoretical background, while 3 ship operators highlighted that they need to know themselves and a lack of self-confidence were observed, the maritime English was stated as a point of weakness in addition to logical skills and communication skills, also they were criticized for being too emotional and they need development in management skills and personal self-improvement.

4.2.4.2 Anticipated Training Outcomes:

In this section of the interview, the 26 interviewed personnel were requested to specify their perception regarding the expected outcomes of training in specific areas covering the main aspects of the training on-board the training ship.

The interviewed personnel were asked to select from a scale of 6 levels to grade their estimated outcomes of each training topic carried on-board as follows: (Excellent added value, very good added value, good added value, fair added value, no added value and negative added value) accordingly the outcome is expected to be positive or negative as the neutral feedback was not an option, due to the technical marine background of the interviewed personnel of total of 288 years of sea time on-board different types of vessels, 134 years involvement in MET and exposure to more than 1420 different types of vessels. Therefore, their perception outcomes have to be considered in the proposed application development.

- **OOW Duties Training**

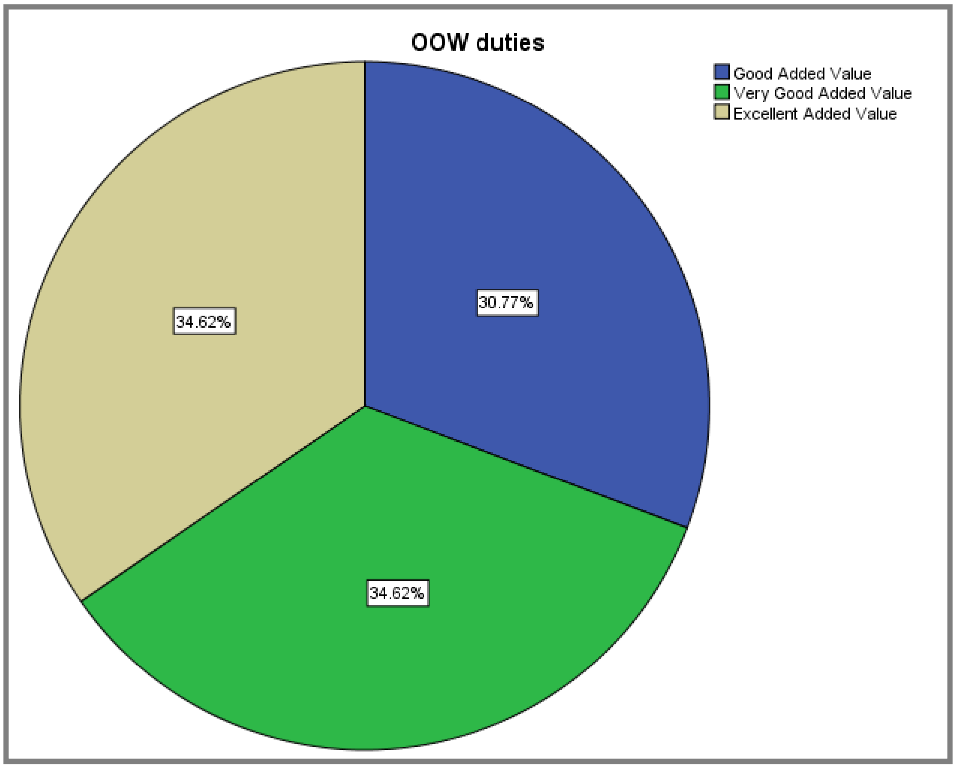


Figure 4- 6: Pie Chart of OOW Duties

Figure 4-6 shows that almost the interview outcome in OOW (Officer of Watch) training topic, varied between Excellent added value representing 34%, very good added value representing 34% and good added value representing 30%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in OOW training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources.

- **Stability and Cargo Training**

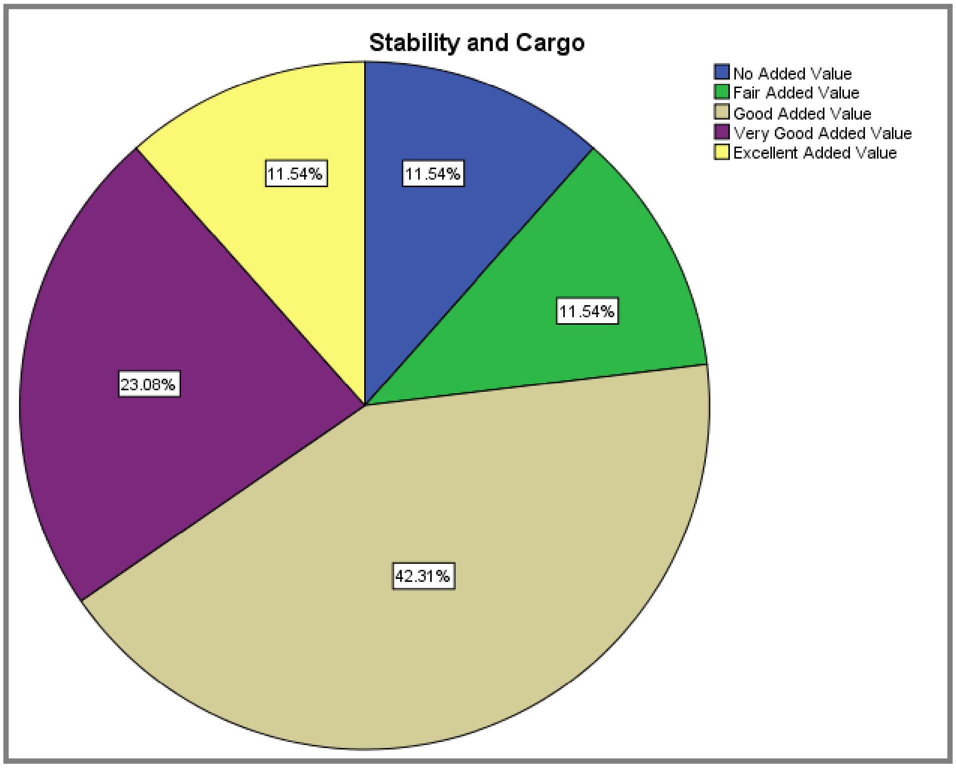


Figure 4- 7: Pie Chart of Stability and Cargo Training

Figure 4-7 shows that almost the interview outcome in stability and cargo training topic varied between excellent added value 11.5%, very good added value 23% and good added value 42%, while, fair added value 11%, no added value 11.5%, and finally negative added value were not selected by any of the interviewed personnel.

The interviewed personnel feedback in Stability and cargo training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources.

- **Practical Training**

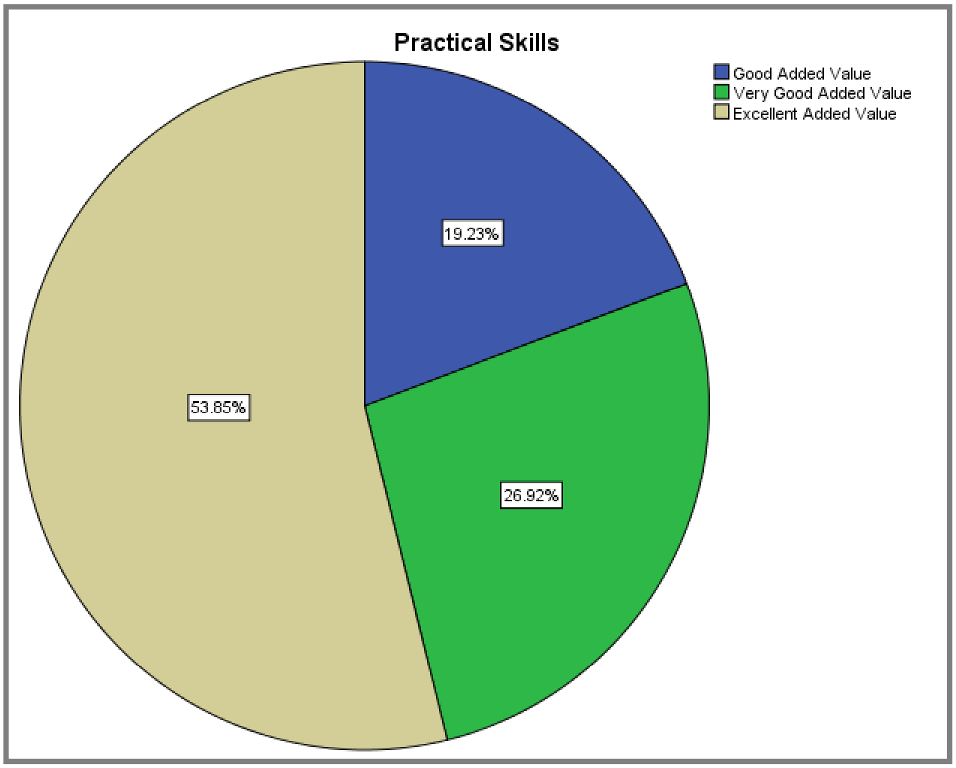


Figure 4- 8: Pie Chart of Practical Skills

Figure 4-8 shows that the interview outcome in practical training topic varied between Excellent added value representing 54%, very good added value representing 27% and good added value representing 19%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in practical skills training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources.

- **LSA and FFA Training**

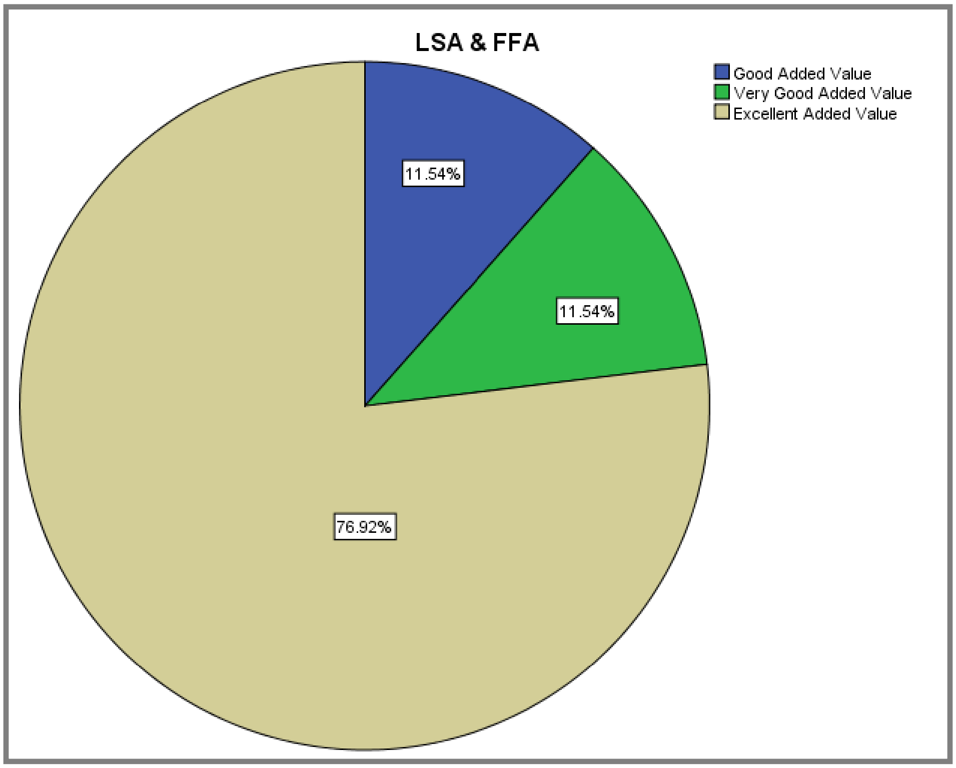


Figure 4- 9: Pie Chart of LSA and FFA Training

Figure 4-9 shows that the interview outcome in Life Saving Appliances (LSA) and Fire Fighting Appliances (FFA) training topic varied between Excellent added value representing 77%, very good added value representing 11.5% and good added value representing 11.5%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in LSA and FFA training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources in LSA and FFA training on-board the training ship.

- **Safety Behaviour Enhancement**

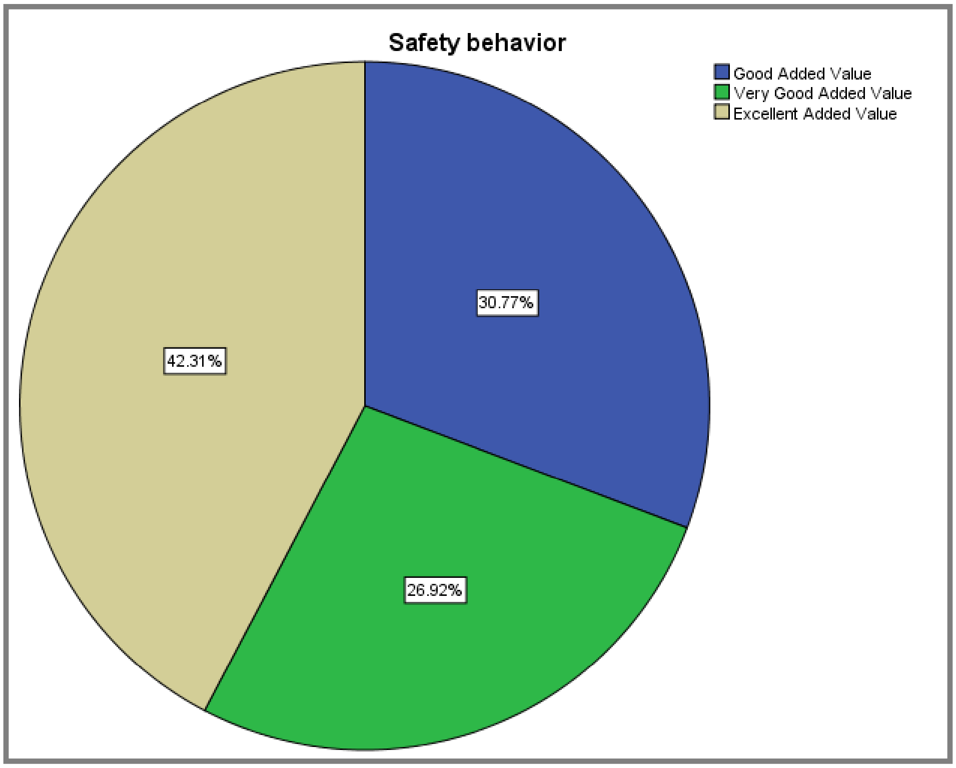


Figure 4- 10: Pie Chart of Safety Behaviour

Figure 4-10 shows that the interview outcome in safety behaviour enhancement topic varied between Excellent added value representing 42.3%, very good added value representing 27% and good added value representing 30%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in safety behaviour enhancement training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources. Where, safety behaviour is a crucial element for workers on-board shipping companies.

- **Theoretical Aspect On-Board**

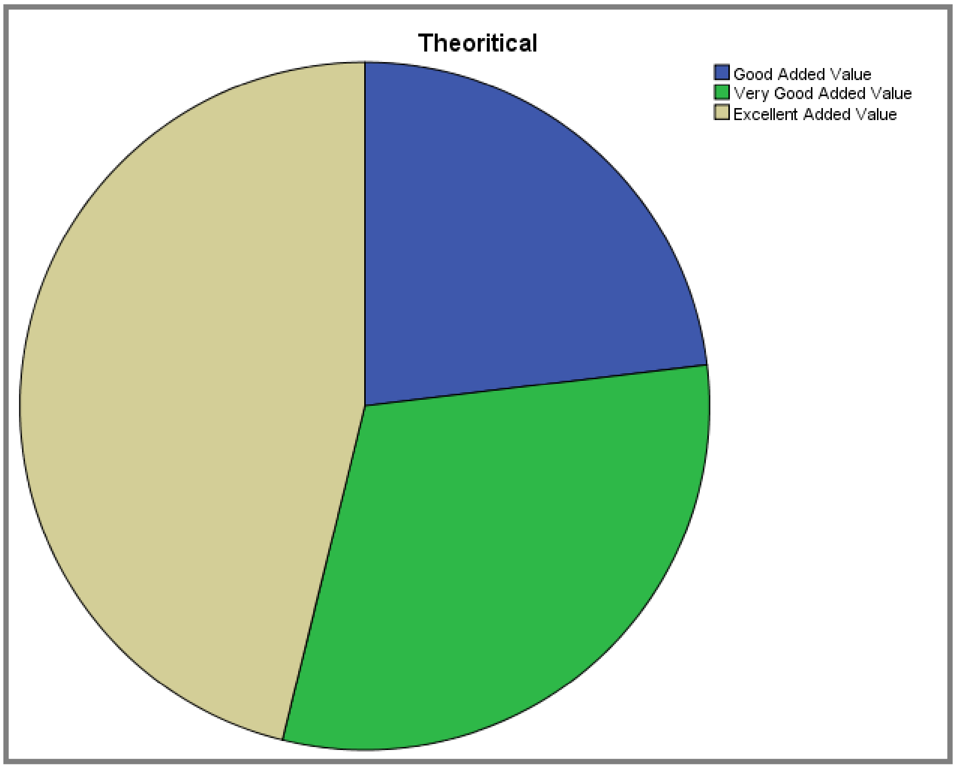


Figure 4- 11: Pie Chart of Theoretical

Figure 4-11 shows that the interview outcome in the theoretical aspect of MET conducted on-board as a base and background for hands on training on-board, interview outcome varied between Excellent added value representing 46%, very good added value representing 31% and good added value representing 23%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in theoretical aspect of MET is a positive feedback, moreover that give a positive perception regarding iMET perceived resources. As iMET had been seen an important assistant for cadets on-board, in order to enhance their gaining theoretical knowledge.

- **Seamanship Training**

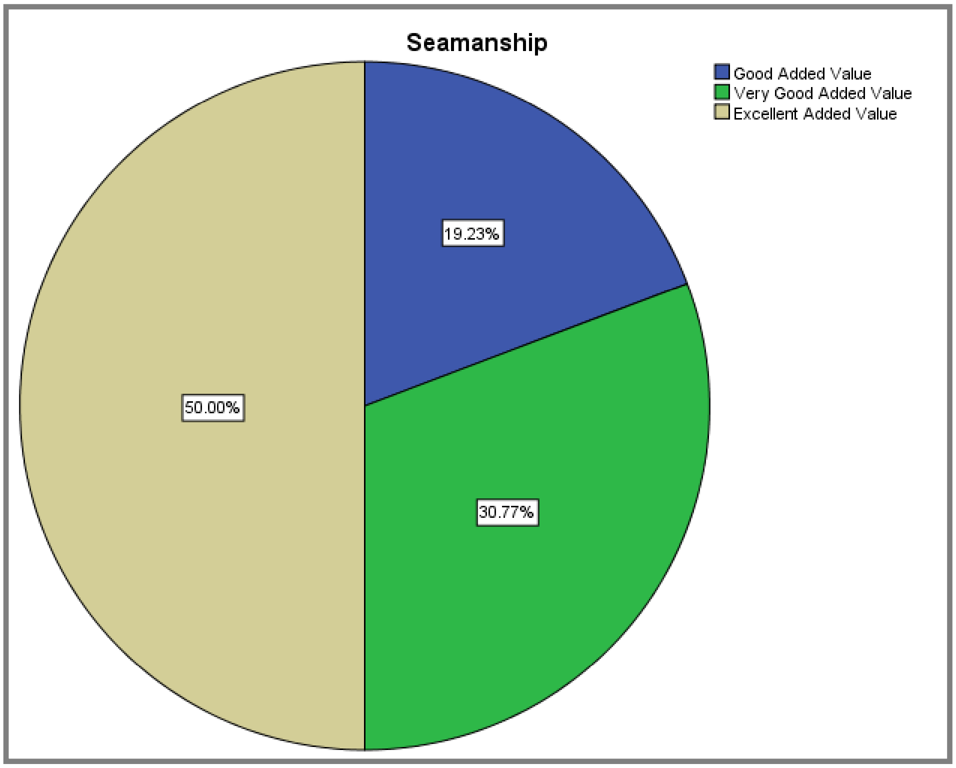


Figure 4- 12: Pie Chart of Seamanship

Figure 4-12 shows that the interview outcome in seamanship training topic varied between Excellent added value representing 50%, very good added value representing 31% and good added value representing 19%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in seamanship training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources. As many seaman ship training details are available on-board the ship, and automating such training in this topic will add value to cadets knowledge and skills.

- **Maritime English**

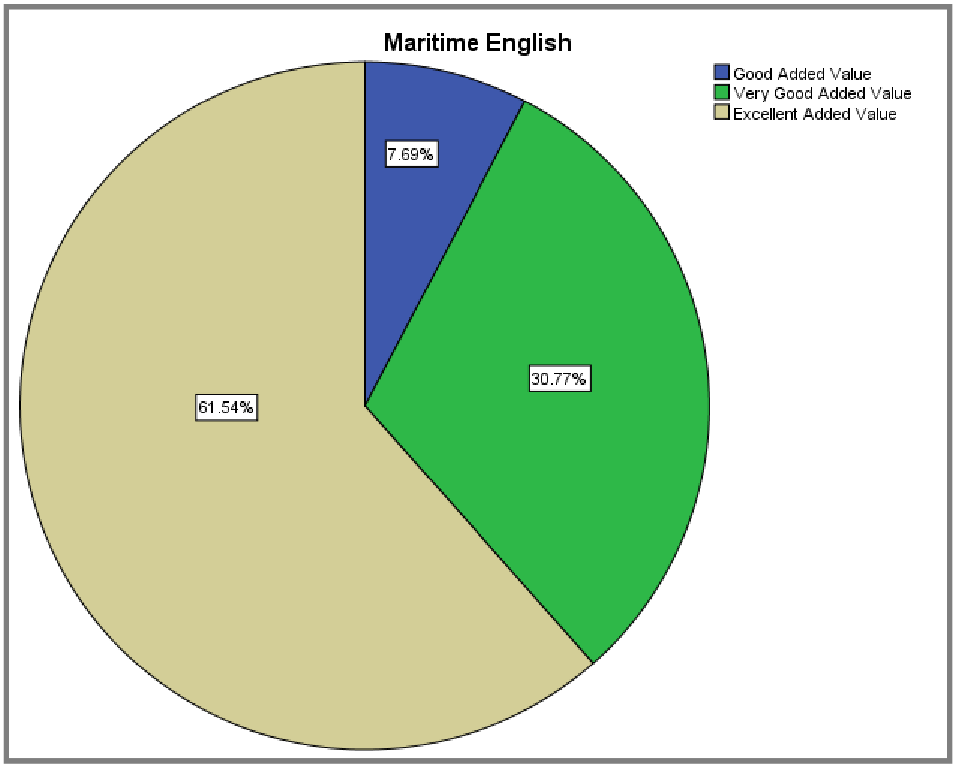


Figure 4- 13: Pie Chart of Maritime English

Figure 4-13 shows that the interview outcome in Maritime English enhancement varied between Excellent added value representing 61.5%, very good added value representing 31% and good added value representing 8%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in Maritime English training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources. As it's a very vital issue in order to maintain safe communication on-board and ashore, moreover Maritime English is the tool through which cadets can be able to acquire more information and knowledge.

- **Engine Room Familiarisation**

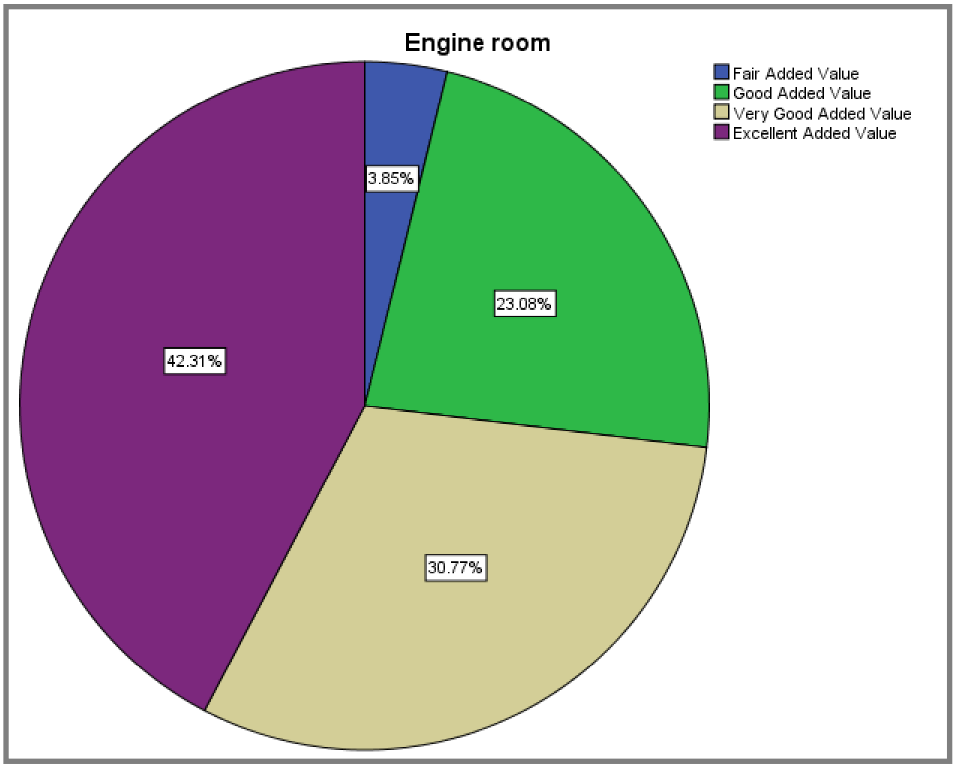


Figure 4- 14: Pie Chart of Engine Room

Figure 4-14 shows that the interview outcome in Engine room familiarisation for the deck cadets varied between Excellent added value representing 42%, very good added value representing 30%, good added value representing 23% and Fair added value representing 4%, while no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in Engine room familiarisation training topic is a positive feedback, moreover that give a positive perception regarding iMET perceived resources. Engine familiarisation was found will be more effective with the aid of iMET, as long as it is applied off the hazardous areas, which will be mainly within the Engine control room.

- **Leadership and Teamwork Development**

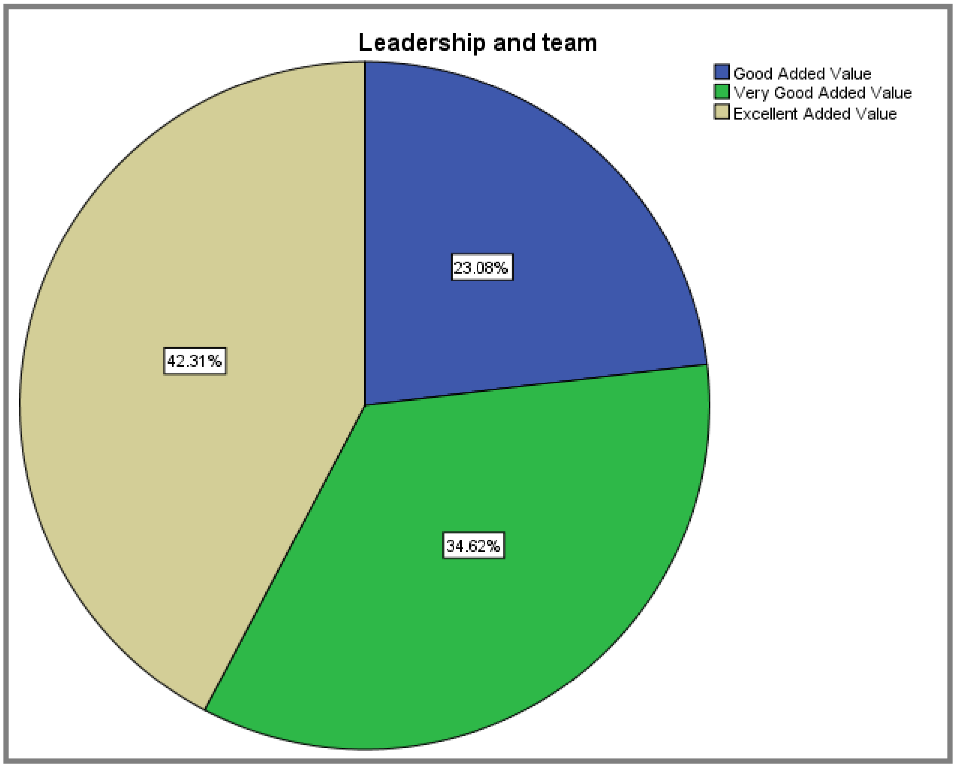


Figure 4- 15: Pie Chart of Leadership and Teamwork

Figure 4-15 shows that the interview outcome in Leadership and teamwork development varied between Excellent added value representing 42%, very good added value representing 35% and good added value representing 23%, while fair added value, no added value and negative added value perceptions were not selected by any of the interviewed personnel.

The interviewed personnel feedback in Leadership and teamwork development is a positive feedback, moreover that give a positive perception regarding iMET perceived resources.

Hence, iMET had been seen as a good tool to enhance cadets' self-reliance, independency, and teamwork.

4.2.5 Technology Acceptance Perception

This section will cover the interviewed personnel perception towards accepting the proposed technological tool from different perspectives as follows:

- Concerning the cadets' acceptance to the technology, the interviewed personnel agreed that the proposed technological tool will be accepted by the cadets concerning its' perceived usefulness and its' perceived ease of use, while 2 out of the 26 interviewed personnel were not sure about the cadets behavioural intention to use technological tool's, furthermore 1 out of the 26 interviewed personnel were not sure about the cadets actual use of the technological tool as main aid of training on-board.
- Concerning replacing the Sea Training book used on-board by the proposed technological tool only 3 out of the 26 interviewed personnel were not sure about the ability of technological tool to clarify all they required training tasks on-board as in the conventional training book, as the training book consists of 2 parts covering both theoretical and practical aspects of the training process on-board.
- Regarding the proposed tool cost effectiveness was fully accepted by the 26 interviewed personnel, while 8 of them highlighted that the cost effectiveness, based on all cadets, will have devices fitted with a built-in NFC reader, so buying a stand-alone NFC readers will not be required.
- As for H.R effectiveness; the 26 interviewed personnel agreed that the proposed technological tool will not replace lecturers and trainers on-board so far.

4.2.6 Main Themes

Themes driven from the interview affiliated with the Maritime training process after applying iMET summed up as follows:

- iMET Will be a good guide and support for lecturers, but will not replace the Guided sea training book, Convenient and available all the time.

- iMET Will improve MET process and will be a second defence line as students oriented to technology, but assessments has to be in the classroom via Computer.
- iMET will save lecturer extra effort and will maintain a good standardised help and assistance for cadet day and night.
- The training processes will be guidance from the lecturer as a facilitator, then iMET will support through the direct interaction with items on-board.
- iMET will assist cadets to get familiar with Manuals on-board, Enhance Maritime English, and very good guide to take the cadet through the sequence of OOW duties and tasks in a personalised method.
- Personalised MET that available all the time is a plus for the MET outcomes, as it mix theory with practice, recommended to work on the common Tablets without the need of a special reader.
- iMET will provide a single point, where theory meets demonstration of the items on-board which will upgrade cadet's knowledge.
- iMET will be a good guide and support for lecturers, but will not replace the Guided sea training book so far, also iMET is convenient and available all the time.
- iMET will save lecturer extra effort and will maintain a good standardised help and assistance for cadet day and night.
- iMET will be able to answer questions at the spot, when need it at any time, education data has to cover also maintenance and how to prevent accidents and rules of inspection, selected data by the cadet can be stored on a cloud or dropbox to be referred to, in case of need.
- iMET is a good idea and information is there for anyone anytime, but I am not sure if iMET will be properly utilised by the Academic staff.

Themes driven from the interview, affiliated with the cadets' behaviour in the training process after applying iMET, are summarised as follows:

- iMET is very good as the cadet has to pass by each item multiple time, the point of concern is cheating by using more than 1 device by 1 cadet.
- iMET usage has to be under supervision, as 1 student can do the task of his friends, cheating is my concern.
- iMET copes with the current generation, as they are technology oriented, recommended as it will work on mobiles/ tablets without the need of a special reader.
- iMET will be more applicable if it will work on the commonly used tablets and handhelds instead of having a special reader for each cadet.
- iMET is a very good tool, as the cadet can explore his own capabilities and will enhance his sense of responsibility, but my concern is cheating in the assessments so it has to be monitored.
- iMET sounds useful, as the problem exist but the system upgrade is required, assessments has to be monitored to prevent cheating.
- iMET is a good idea but will be a need to control the flow of cadets over the items on-board, to manage the number of cadets, over the single item in the same time, iMET will develop self-reliance, hence developing individual reliability.

Themes driven from the interview, affiliated with the cadets' self-development after applying iMET are summed up as follows:

- iMET will enhance cadet self-reliance and self-improvement.
- iMET will stop the teaching based on spoon feeding which will consequently improve cadets self-discipline.
- iMET is easy and flexible time for everyone, but requires preparation for cadet for e-learning, to be research based education, this system will change the mentality, rather than spoon feeding.

Themes driven from the interview, affiliated with the cadets' career after joining the merchant fleet after applying iMET are summarised as follows:

- If implemented on our fleet, iMET will solve many technical issues in the officers as requirements is getting higher but officers level is going down, very good as each individual has to use his mind on his own.
- iMET represents an excellent mechanism, except for hazardous areas on-board, limitations has to be set for risk areas, in non-hazardous environment it's very good.
- iMET answer questions, on the spot at any time, education data has to cover also the routine of the planned maintenance systems, rules of inspection for surveyors and port state control.

4.2.7 Main Interview Results

The 26 interviewed personnel agreed that the proposed technological tool is easy for usage and flexible, moreover they stated that the main advantage that it is a single point where theory meets demonstration in the real workplace and it will stop the spoon feeding teaching.

Mainly highlighted that the application will generally be a guide to the lecturer/ trainer with a detailed personalised follow up process, and for the cadets it will enhance their sense of responsibility, moreover will give them the chance to explore themselves especially that cadets nowadays are more oriented to technology and handheld applications.

On the other hand the interviewed personnel raised some concerns concerning the assessment and examination process, as there is a large roam for cheating by cadets by answering to each other hence the assessment process reliability will be questioned, accordingly they recommended that official assessments should be carried out on computers in a classrooms under supervision of the lecturers and trainers on-board. Also they had concerns if the lecturers/ trainers would be able to utilise the application properly to extract the maximum benefit of it especially that the system will need continuous upgrade and development.

Finally they highlighted that the proposed technological tool might be suitable for hazardous areas such as engine room and open deck of the dangerous cargoes.

Reference to the discussion that was carried out with Mr. Koji Sekimizu , the IMO secretary general, a new point had been raised by him, as he questioned that STCW convention might need to be updated to accommodate such new technological solutions. Other than that, Mr. Sekimizu found iMET as a new innovative approach to on-board training that might fit with the new generations' demands and requirements.

4.2.8 Summary

In this chapter, the researcher has figured out the results and findings, for the stage of the Pre-Intervention part of the technological application introduced in the current study. In order to measure stakeholders represented in cadets, instructors, and shop operators perception towards the proposed technological tool in addition to identifying their requirements and expectations.

This chapter starts by a descriptive analysis of the questionnaire findings that had been conducted to 106 cadets, representing the cadets population on-board the training ship, the descriptive analysis outcomes were encouraging as 77.4% of the responds agreeing about the anticipated perceived usefulness of the proposed iMET technological tool, while 81.1% of the responds agreeing about the anticipated perceived ease of use of the proposed iMET technological tool, as a training tool provided with educational materials 71.4% of the responds agreeing about the anticipated perceived resources of the proposed iMET technological tool.

Concerning predicting cadets' attitude and behaviour towards using iMET, 94.4% of the responds agreeing about the anticipated perceived attitude towards the proposed iMET technological tool, while 92.5% of the responds agreeing about the anticipated behavioural intention towards actual using of the proposed iMET technological tool.

After examining the data's reliability and validity, a Pearson correlation test was analysed to evaluate the relationship between each two variables, resulting a significant positive moderate relationship between behavioural Intention and each of perceived resources, Attitude towards using technology, while a significant positive weak relationship between behavioural intention variable and perceived usefulness variable, while an insignificant relationship between behavioural intention variable and ease of use variable, which can be justified in the pre-intervention phase as cadets did not use the application so they could not estimate accurately its usage and how friendly is the application.

A test of hypothesis with the aid of regression analysis had been conducted to predict the impact of each independent variable (Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude towards using technology) on the dependent variable (Behavioural Intention for Actual System Usage), hypothesis one showed a significant impact of Perceived Usefulness on Behavioural Intention, while hypothesis two showed an insignificant impact of Ease of Use on Behavioural Intention, on the contrary hypothesis three showed a significant impact of Perceived Resources on Behavioural Intention, and hypothesis four showed a significant impact of Perceived Attitude on Behavioural Intention towards actual usage of iMET technological intervention.

The second section of this chapter discussed thoughts and themes driven from the semi-structured interview that had been conducted to 26 maritime experts from maritime academia and industry, the 26 professional had been selected to cover the main two wings of the maritime community, the academic wing and industry.

The 8 industry professionals had worked as officers and engineers on-board, the total years of experience of the 8 industry professionals are 91 years and they are exposed to the ships crewing and on-board personnel training for 1420 different types of cargo ships sailing around the globe, 7 of the 8 interviewed personnel are using technology intensively in their professional and in their personal life, moreover they had a special studies and courses in areas affiliated with training.

The 18 maritime faculty members/ instructors were former captains and engineers on-board different cargo ships with a total 197 years of working as a seagoing personnel, and a total of 134 years involvement in maritime education and training, 17 of the 18 maritime instructors had been through different special studies and training in the areas affiliated with maritime education and training, the training ship master which is mainly responsible for the ship was found with no special studies on education and training, the 18 instructors were found heavy users of technology in many venues in the training process and their personal life.

Reference to the rich experience and knowledge of the 26 interviewed personnel the structured part of the questionnaire was mainly addressed to two goals:

First goal is measuring the perceived resources of iMET technological tool for the on-board training in specific topics and training activities carried on-board the training ship as discussed in details in this chapter, the summary of iMET perceived resources outcome was found promising as 76.5% of the interviewed personnel had a positive perception towards iMET as an added value tool for ship stability and cargo handling training, perceptions varied between excellent added value, very good added value and good added value, moreover 95% was their perception towards deck cadets engine room familiarisation enhancement when using iMET tool, while concerning lifesaving appliances and firefighting appliances training, safety behaviour enhancement, theoretical aspect of training, seamanship training, maritime English enhancement, leadership and teamwork, the 26 interviewed personnel feedback was 100% that iMET tool will be an added value to these training aspects on-board, perceptions varied between excellent added value, very good added value and good added value with no negative perception recorded.

The lowest perception detected as discussed was in the training of ship stability and cargo handling and that can be referred to the unavailability of different cargo handling operations and stability calculations in the training ship as it contains one cargo hold and a crane for training, while dry, gas and liquid cargo spaces are not available accordingly the stability calculations for such types will not be available.

Second goal of the semi-structured interview is to predict the technology acceptance at the ship operator side and cadet side in addition to iMET anticipated benefits, which was covered through the unstructured part of the questionnaire.

The 26 interviewed personnel perception was positive perception; they expected cadets to acceptance iMET tool as a technological tool to assist training on-board, while 2 of the 26 were not sure about cadets' behavioural intention towards using iMET, moreover 1 of the 26 interviewed personnel was not sure if cadets will actually use iMET tool.

Concerning the administrative anticipated outcomes of iMET usage on-board the training ship the interviewed personnel perception that iMET will be a positive assistance for the training process on-board especially that cadets are technology oriented and heavy users of smart mobile devices, while they agreed that iMET at least in its initial implementation phase cannot replace the conventional guided sea training book (training record book), moreover 3 of the 26 interviewed personnel see iMET will not clarify tasks required from cadets as stated in the guided sea training book or as discussed in the classroom. The interviewed personnel agreed in the iMET cost effectiveness as a low cost technological solution comparing to its functionality in addition to its human resources effectiveness.

Regarding the training anticipated outcomes of iMET usage on-board the training ship the interviewed personal are expecting a significant added value in transforming theory in practice in the real workplace in a simplified personalised context, in addition to its positive impact on improving maritime education and training through setting a standards for the practical training on-board that can be extended and applied on different ships.

In addition to enhancing hands on training, cadets engagement in the training process in a self-regulated manner under individually progress tracking by instructors. In addition to getting the cadets acquainted with equipment maintenance within the safety management system on-board and familiarize cadets with required procedures of inspection and periodical surveys.

The interviewed personnel anticipated a high potential for iMET as cadet can use it anywhere and anytime, also iMET will control cadets' flow over different items on-board within a specific training tasks that will be assigned by their instructors, beside the anticipated perceived resources in iMET as a training tool it expected to enhance cadets' self-reliance, individual reliability and self-improvement.

The main concern raised by interviewed personnel is setting rules to prevent cadets from cheating from each other and to count on classroom examinations and one on one oral examinations as the main method of testing cadets knowledge, while they stated that the only area limitations on-board for iMET are the hazardous areas on-board were electronic devices are not allowed to be used.

The next chapter will set the background and framework of the iMET application development as per the readings in the literature and according to expectations and requirements driven from the survey outcomes of the maritime stakeholders during the pre-intervention phase, in addition to developing a prototype iMET application in order to be used by cadets on-board to evaluate and validate their acceptance towards actual usage of iMET application in further chapters.

CHAPTER FIVE

iMET Development and System Framework

5.1 Introduction

This chapter will present the Near Field Communication (NFC) technology, and how it will be implemented in the context of developing the proposed iMET application, for on-board training in the training ship for marine/ deck cadets, the proposed technological intervention in this chapter is to develop iMET application driven according to the concluded concepts from the literature review, in addition to maritime stakeholders perception and expectations that were analysed in chapter 4.

Moreover, this chapter will present the concept of the technological intervention introduced in this research in the form of the iMET developed prototype, as a proof of concept in order to be used for iMET model validation that will be conducted in chapter 6, moreover achieving a TEL self-regulated learn by doing application, which is addressed for cadets training onboard. Furthermore, the last section of this chapter will highlight the framework of the proposed system full implementation including iMET implementation estimated cost.

5.2 Near Field Communication (NFC) Background

Near field communication, which is abbreviated as NFC is a short-range wireless technology; NFC is a form of contactless communication between handheld devices like smartphones or tablets. Contactless communication allows a user to wave the smartphone over an NFC compatible device to exchange information without needing to touch the devices together, or over NFC tags to receive information as in the case of this research. Initially NFC short-range wireless technology was found by the companies Sony and Phillips in 2002, it is driven from Radio-Frequency Identification Technology (RFID), NFC working as RFID for short range data communication.

There is a variety of handheld devices running different operating systems (OS), that includes Android, iOS for Apple, Blackberry, and Windows found using NFC technology in their smart tablets and mobile devices.

Mulevu (2012) classified mobile phones into regular phones and NFC enabled phones, whereby regular phones do not have NFC capacity, but have only cellular communication channels. On the other hand NFC enabled phones have a built in readers, that enables them to capture and retrieve data from or store data into external tags, these phones support regular cellular communication.

The three operating modes of NFC devices shown in figure 5-1, the first is Reader/ Writer, where NFC devices read NFC tag types and this is the type that had been used in the current research in developing iMET technological tool, the second is Peer-to-Peer where two NFC devices able to exchange information, the third is Card Emulation where NFC device appears to an external reader same as a traditional contactless smart card, that allows transfer and data manipulation without changing the existing infrastructure ~~(~~Rahul & Rao, 2015~~)~~

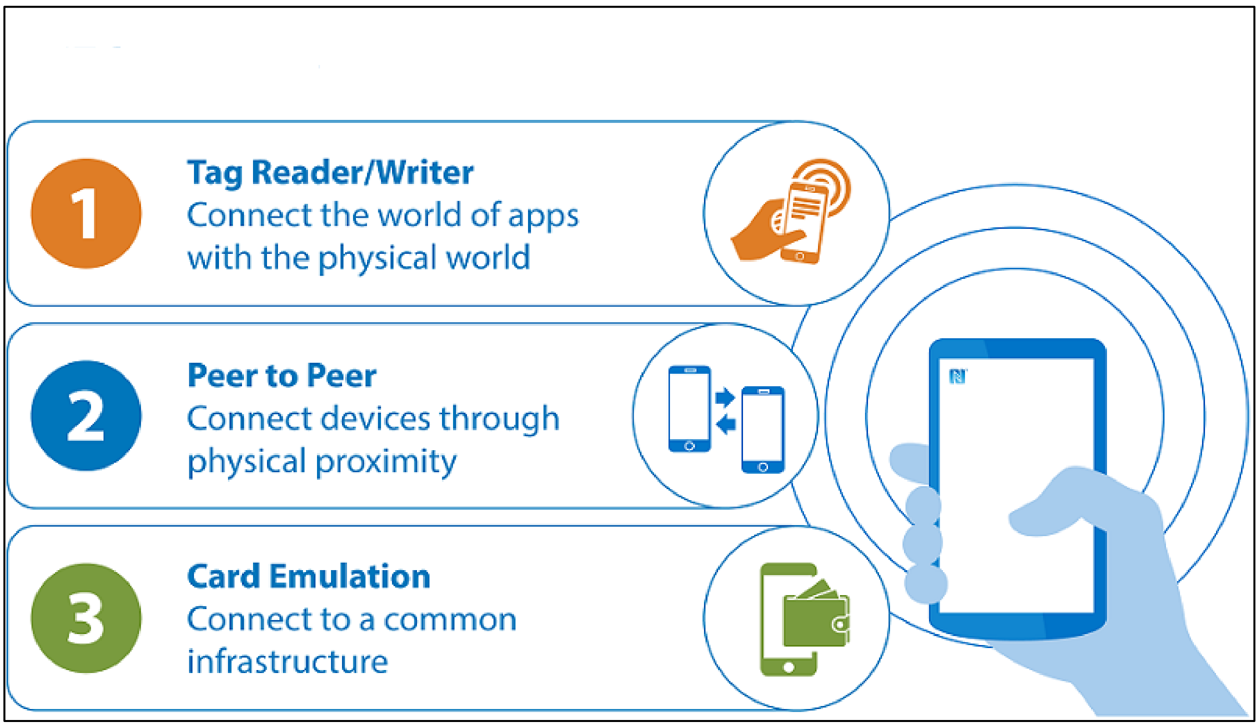


Figure 5- 1: Three operating modes of NFC Devices

The technology behind NFC allows a device, known as a reader, interrogator, or active device, to create a radio frequency current that communicates with another NFC compatible device or a small NFC tag holding through many types as NFC tags are very inconspicuous, and might show up in places you never expected. Whether you have seen NFC tags on a smart poster, or are curious whether that square on the back of your new library book is hiding an NFC tag, the application installed in the NFC device/smart phone will pick up the tag's info and tell you all you need to know about it.

The current major trends in NFC usage are Master Card Pass, as Certain Master Cards offer Pay Pass, a contactless payment service that works with Google Wallet. After applying and being approved for a Pay Pass credit card, the owner can load the credit card information into Google Wallet on his/ her smartphone and pay using NFC at any shop that supports this contactless payment technology.

Another major trend in NFC is Google wallet, though separate from Pay Pass, Google Wallet is currently the only way to use a Pay Pass credit card from a smartphone and only accepts Pay Pass credit cards. In the future as more companies turn to contactless payment methods, other big name brands may add their credit cards to Google Wallet or develop their own apps for storing credit card information and facilitating NFC payments (Ondrus & Pigneur, 2007).

Also Pay Pal utilises NFC technology to let users bump smartphones together to transfer money or make payments. The technology is still limited, though PayPal already offers customers the ability to make mobile payments over a Wi-Fi connection. It is currently looking to expand its NFC technology for more payment options.

Moreover, Visa is currently looking into NFC technology, as are other large brands. As the technology grows in popularity, more companies are offering credit cards and smart phones that work together through near field communication. Before companies can utilise this technology, businesses first need to upgrade to the card readers designed for NFC payments.

NFC enabled smart phones forecast is expected to increase as phones incorporated with NFC will reach 64% of the mobile phones shipped in 2018, rising from 18.2% in 2013, accordingly shipments of NFC-enabled mobile phones will rise four times in 2018 than in 2013, with annual shipments increasing from 275m devices in 2013 to 1.2 billion devices in 2018 (Clark, 2014). Computer magazines such as Computer Sweden, as well as academic authors such as Ondrus and Pigneur (2007) and Remédios, Sousa, Barata, and Osório (2006) predicted that NFC would achieve success and become a renowned technology, widely used and implemented academically.

This did not occur as predicted yet in the Maritime Education and Training sector, which makes this research a novel contribution to the MET practical training aspect. In chapter 6, the researcher will discuss the extent to which NFC enabled application in iMET is accepted by the marine students/ cadets on-board the training ship, aiming to validate the proposed iMET application in this research.

5.3 Implementation of NFC in Training On-board AIDA IV

The iMET proof of concept prototype had been installed in the Academy training ship AIDA IV as shown in figure 5-2, representing Junior officer Marwa Elselehdar, whom is currently present in the local media as the first Egyptian female marine officer, and she allowed using her photos while using iMET application, the cadets on-board installed the iMET application in their android handheld devices in the post intervention phase of the research, through a link had been sent to their smart mobiles to download and install the application.

As discussed in the literature review chapter in the training on-board ship section, that On-the-job training is generally the most effective phase of the maritime training in which cadets develop the required competency needed to act successfully on-board ships.

Training on-board the training ship AIDA IV as a special purpose ship includes a wide variety of training courses, in order to comply with STCW certification requirements for personnel serving aboard merchant ships, and continuing professional development for deck cadets to the highest standards through hands on training. AIDA IV training extends to safety, firefighting, first aid, radio communications, ship handling, navigation techniques, and navigational instruments, cadets training is during the fifth semester, which is 6 months of the cadets' 4 years education scheme.

Moreover, AIDA IV staff is responsible of monitoring and assessment of cadets who join various types of merchant ships after finishing their fifth semester in order to accomplish their second six months sea service time, that enables them to attend the upgrading course for 2nd mate, in order to be qualified to sit for the 2nd mate exam OOW certificate of competency.

Figure 5- 2: iMET Actual Usage On-board AIDA IV

5.3.1 iMET Concept

iMET (Interactive Maritime Education and Training) application is a new approach to implement the interactive personalised e-learning for the marine students/ cadets; this solution had been initiated in the Arab Academy for Science, Technology and Maritime Transport by the researcher based on RFID technology, during his work on-board the training ship as a marine lecturer, the main reason the triggered the proposed idea was to familiarize cadets with all parts of the ship within a standard context, and later the application was developed during this study, where the researcher used NFC technology incorporated with an enhancement to achieve a personalised learning context, that match cadets different learning preferences.

The main technological advance in this proposed solution is providing the proper tools and learning environment for students, in order to maximise the information gain through the self-study process or learn by doing as described in chapter 1. Accordingly; students/cadets will be able to learn by doing their regular training tasks on-board the ship.

The basic concept adopted in this solution is the ability to identify different equipment and devices on-board by attaching them to Radio Frequency Identification (RFID) passive tags, but during the first 2 years in this research the technology had changed and the Near Field Communication (NFC) became very popular in mobiles/tablets as a built-in reader, NFC reader is placed inside the mobiles/tablets, accordingly the researcher changed from RFID into NFC, as such shift will be more practical and cost effective for the proposed system, also such shift will make the iMET system more accessible and usable. NFC is similar to RFID, but with other frequencies.

NFC is a high-frequency, quickly deployed, low bandwidth and a short range wireless communication technology, in addition to that NFC readers are built-in in recent handheld mobile devices; the range is generally less than 10 cm, but it could be up to 20 cm (Ahson & Ilyas, 2011), (Patil et al., 2014).

NFC provides bidirectional communication between electronic devices by only a single touch, touching equipment on-board the training ship will support the learning functionality of the proposed technological intervention in this research. NFC is offering new services to facilitate daily life and can be considered as the best solution for Internet of Things (IoT) proliferation (Yoon, Joshi, & Shim, 2014), (Ahson & Ilyas, 2011), (Patil et al., 2014).

The main concept of iMET is attaching NFC passive tags within different training objects on-board the training ship. Student's learning preferences had been considered in the development of the iMET application. Later on, the students' learning style preferences can be fine-tuned through a case-based reasoning process, which uses students' behaviour and actions as source. The handheld device runs multimedia educational software including different materials (text, images, audio, video, and multiple choice quizzes).

As the student contact/ touch an equipment or a point of interest with a smart mobile to learn/ train about, the integrated NFC reader within the student's mobile/tablet detects the nearby passive tag and is able to identify the object, upon object identification, the installed software on the mobile starts to display information in a rich presentation media about that object.

Further advances had been planned to this solution, to react according to a pre-set training path, planned for the cadets/ students. Educational database is stored in a server on-board and transmitted via Wireless Local Area Network (WLAN) to all users, having a centralized educational database in a server onboard is to simplify the update process to the users. Moreover, instructors will monitor the student's activities and progress through the teacher portal.

The infrastructure is considered the solid ground upon which all other components will operate. It is beyond the scope of this research to go through the technical details of laying down the infrastructure, but it is a must to state the required characteristics as follows:

1. Provide connectivity across different locations on the ship through wireless LAN.
2. The presence of reliable internet connectivity with the Academy main office occasionally.

3. This infrastructure should possess the proper security schemes, for maintaining privacy and security of data exchange between the AASTMT headquarter and the training ship AIDA IV.
4. Availability of mobile devices or tablets having Near Field Communication (NFC) feature.

5.3.2 iMET Theoretical Approach

In this section the researcher develops the technological tool for on-board training in reference to the research literature review outcomes discussed in chapter 2, iMET was inspired by Felder-Silverman learning style model (FSLSM) a learning style model that is often been used in technology enhanced learning and that is designed for traditional learning (Felder & Silverman, 1988).

Felder argued, as presented in chapter 2, that learners with a strong preference for a specific learning style might face some difficulties in the learning/ training process, if their learning style is not supported in the teaching environment (Felder & Silverman, 1988), the proposed solution iMET in this study will adapt the training ship to be a compatible teaching/ training environment, in order to support the learners' different learning styles.

Moreover, Felder advises against the unintentional, permanent mismatch of teaching styles and learning styles, where teachers are unaware of their own learning styles and may, as a result, teach only according to this style, thus favouring certain students and disadvantages others (Felder, 1993).

Accordingly the proposed technological tool is planned to consider presenting the educational and training resources in different learning styles context, with creating a virtual learning environment on-board the training ship, where the handheld devices will take part of the teachers role on-board the training ship.

Therefore, ability of the cadets/students to adapt to different instructional styles within iMET, will prepare them with important life skill, and add value to their career path through out developing their life skills. Such as, providing digital multimedia visual forms of instruction to verbal learners will force them to develop their visual skills. Reference to Grasha (1984) mismatching approach is available in iMET tool in order to make learning interesting and challenging for cadets/ students, moreover in accordance to Kolb argument that the educational objectives for mismatching are personal growth and creativity, as discussed in chapter 2, iMET fits Felder-Silverman learning style model, Kolb and VARK, in addition to major learning models due to learning in the real workplace.

5.3.3 iMET Technical Approach and Sustainability

The purpose of developing the iMET prototype app (application) is as a proof of concept, to provide a convenient testing for the proposed technological tool for deck cadets on-board the training ship Aida IV, iMET prototype app uses the NFC technology to read the passive tags that identifies some devices on-board the training ship Aida IV, the mobile app will provide structured learning material for the students, with the ability to build the contents using a user friendly administration panel.

The mobile prototype app was developed on Android operating system, while the backend was developed using the latest technologies of ASP.NET and implementing MVC (a development framework), which is a software architectural pattern for implementing user interfaces that communicate with back-end server over intranet, based on the following assumptions:

1. The Android app built using native technologies.
2. One language interface (English).
3. Backend is implemented using Microsoft technologies (ASP.NET MVC & SQL Server) and integrated with MS Active Directory.
4. Supported Android versions 4.3 (Jelly bean, which was released in July 9, 2012) and above.

5. The design is compatible with modern browsers that support CSS3 (Firefox, chrome, and IE 11).
6. Mobile app (Android) reads NFC passive tags and displays the required information for each device.
7. Assign passive tags to specific item using an admin privilege on the mobile app.
8. Multiple choices quizzes after each learning/ training objective, as after passing the learning/ training contents, a relevant quiz will be enabled.
9. Dynamic contents for materials (Text, Videos, Images).
10. Integration with the academy exiting systems is out of the prototype scope.
11. Mobile app (IOS) for iPhone users that reads NFC passive tags and displays the required information for each device is out of the prototype scope.

The proposed Sea Training application iMET as shown in the figure 5-3 covers the main aspects of sea training operations, which is running on-board the training ship Aida IV. It consists of different modules, which are integrated into one central database. The central database is to be synchronised periodically whenever the internet is available with the main central database located in the main campus of AASTMT, as separate integration module will be required in further studies to perform this part of the process, in order to shift the proposed system to be an online system. Following is a list of the anticipated modules, in order to provide more details, regarding the data flows within modules, as well as, within each module as illustrated in figure 5-3.

The main modules that will be affiliated with the Education and Training part in the proposed system as follows:

1- Teacher Module
2- Server Admin Module
3- Mobile Application Module
4- Evaluation Module
5- Adaptive Learning System
6- Integration Module

However, proposed iMET application is subject to future development by interested researchers, universities and information technology corporations in the field of Education or Training. The next section will highlight the proposed system structure with the aid of a block diagram showing the different modules making up the whole proposed system.

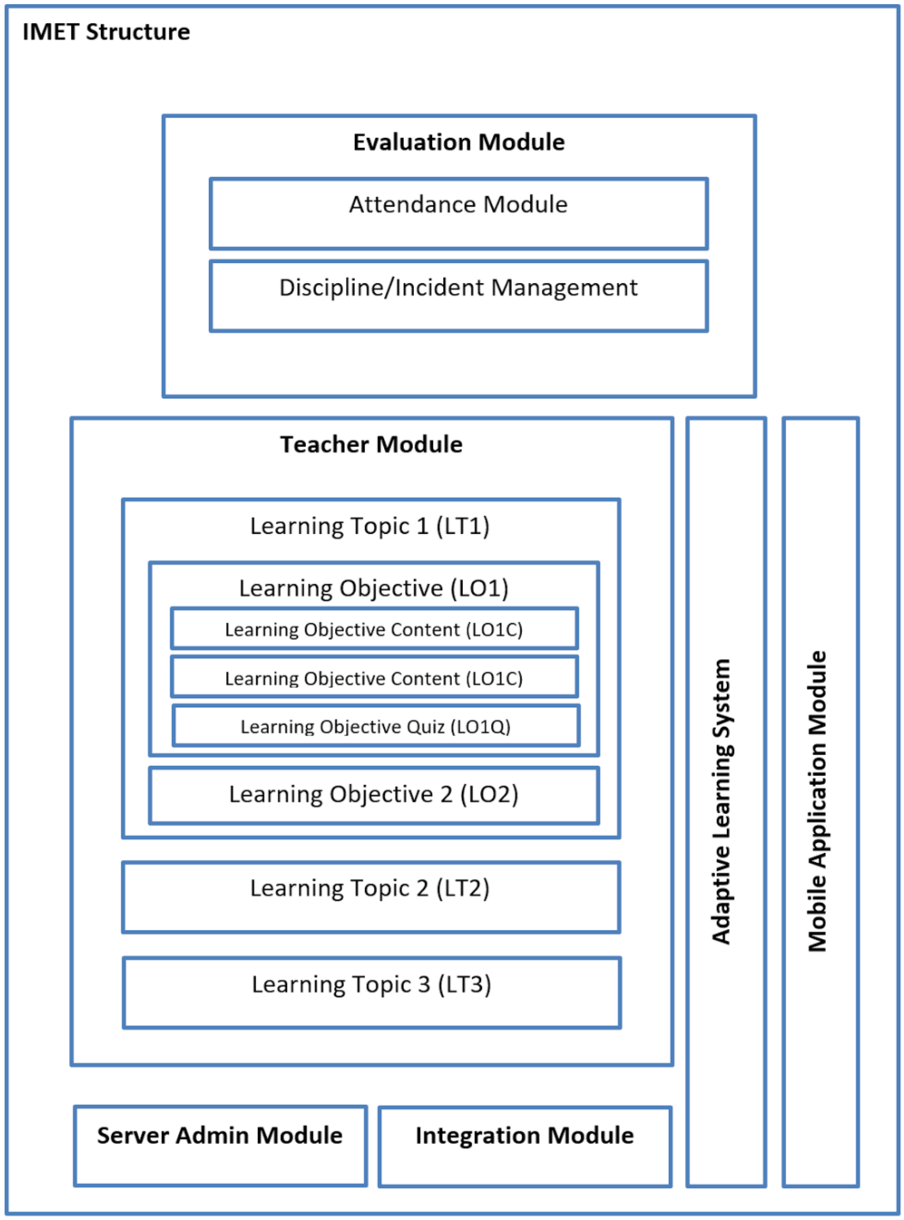


Figure 5- 3: iMET System Layout

5.3.3.1 Teacher Module

The server shall store different learning/ training topics; each training topic is divided into multiple sub-topics. These sub-topics will be represented through web pages, and shall be hosted on a local web server to be accessed from the iMET mobile application. Web pages (Training Sub-topics) shall include texts, images, and videos. Admin and teachers shall be able to define Training topics as well as detailed subtopics through web forms. The sub topics shall be linked to different web pages.

When cadets access the training topic (triggered by NFC tag scan) the system shall track the sub topics accessed by the student on the go. Accordingly, the system shall maintain the percentage completed for each training topic by each student.

The server shall contain a database, which will include different quizzes (multiple choice/complete formats). The quizzes shall be classified into different categories with more than one dimension, for example, a quiz will be related to certain topic category, and also, same quiz might be related to another difficulty category.

The Teacher server components shall be responsible for generating quizzes to students based on runtime attributes, also, the server shall be responsible for tracking students' answers against generated quizzes, as well as required grading and history reporting.

The Teacher server components shall also define/maintain mapping relation between training materials topics (web pages links) and related NFC tags, in addition to mapping relation between training materials topics and related quizzes categories.

5.3.3.2 Server Admin Module

This module acts as the repository for the mutual relationship between the students, lecturers, and courses. This module is used to generate the required schedules, lecturers' utilisation, etc.

Server admin component shall be responsible for maintaining the following:

- Define different system users (students, teachers, etc.)
- Define different users attributes as follows:
  - A student attributes (name, email, face recognition, grade, training log, etc.)
  - A teacher attributes (name, email, face recognition, specialty, related training topics, access privileges, etc.)
  - System Admins (name, email, face recognition, access privileges, etc.)

5.3.3.3 Mobile Application Module

The mobile end user application that will be used by the student is responsible for presenting the different training materials and/or quizzes to the students. The materials presented to the students will be generated from the different server components based on the NFC tag read, as well as the student profile and progress. The mobile application shall include but not limited to the following:

- Availability of different learning preference resources.
- Authenticate user access against server database.
- Enable NFC tags processing, in order to trigger relevant content to be presented to the user.
- Enable students to conduct quizzes on the mobile device and submit answers.
- Students shall monitor their learning progress (percentage) for different training topics.
- Students can view the quiz results instantly.
- Students can view their learning history (topics read/quizzes taken).

5.3.3.4 Evaluation Module

This module will store cadets' marks in their weekly assessments and mean value of the different quizzes he/ she went through. Furthermore, discipline marks deduction, in order to calculate a total evaluation for each cadet.

5.3.3.5 Adaptive Learning System

Personalised learning/ training in an adaptive Educational context was considered during developing the iMET technological tool, in order to enrich the intelligent tutoring system adaptively to fit individuals learning preferences. A rich education and training resources platform with adaptive personalised e-learning for the students can be developed in further studies, with the aid of more sophisticated programming.

The proposed system will provide learning adaptivity, from a holistic perspective, inspired by FSLSM learning theory, moreover fits Kolb and VARK models as discussed in chapter 2, which means that the system is able to present courses according to the knowledge and learning style of the students.

Currently adaptively is based on suggesting sometimes the relevant teaching formats, which is closer to the cadet's learning preference first, while other formats will be available at his disposal as well. Regarding the relevant media format for specific learning styles are presented in slideshows (text and/or multimedia), media clips (graphics, digital movies, and/or audio files), in addition of being physically in the real workplace next to item being learned/ trained on.

5.3.3.6 Integration Module

The integration module is responsible of connecting and synchronising the training ship database with the AASTMT main database, as well as performing the required replication between the two databases without any manual/ user intervention. Also; this module operates independently from the other running modules, so it will not alter their normal operations.

The iMET process framework illustrates a clear flow of the process that will be carried out by the student, as shown in the figure 5-4.

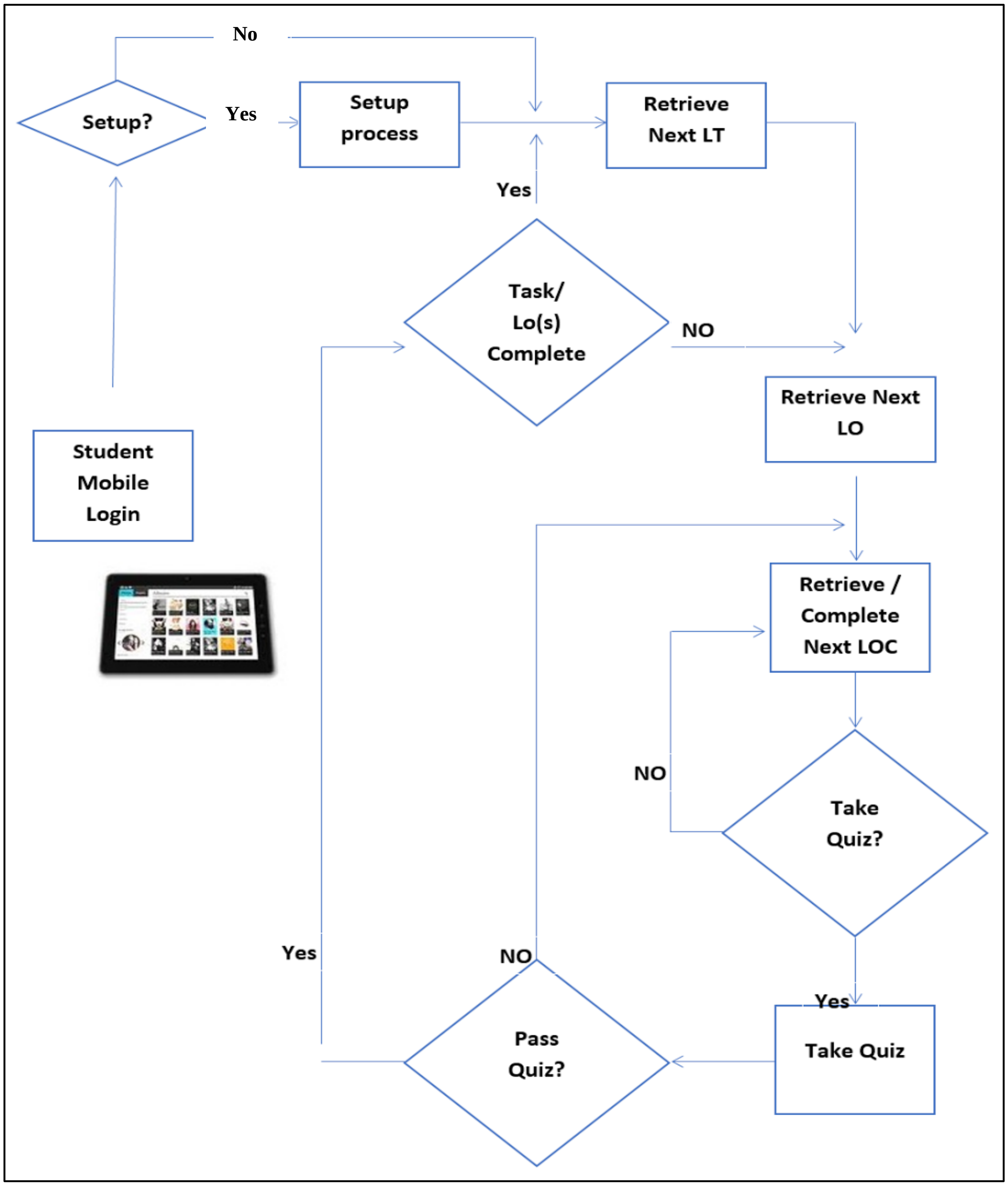


Figure 5- 4: iMET Process Flow Chart

iMET training tasks flow within the learning/training process as shown below in figure 5-5, mainly will be conducted by self-regulated learning/ training tours on-board, which are assigned by the teacher to the students as a training tasks, for example lifesaving training self-regulated tour, will breakdown into life boat learning task, life raft learning task, life buoy learning task, Emergency Position Indicating Radio Beacon (EPIRB) learning task, Search and Rescue Transponder (SART) learning task, etc.

As the training process will be composed of list of training tasks as shown in figure 5-5, where for example training task 1 represents firefighting equipment, while training task 2 represents Satellite communications, where Global Maritime Distress and Safety System (GMDSS) is a training topic. Each training topic is targeting several learning objectives, for example GMDSS training topic consists of EPIRB, SART and Very High Frequency (VHF) learning objectives.

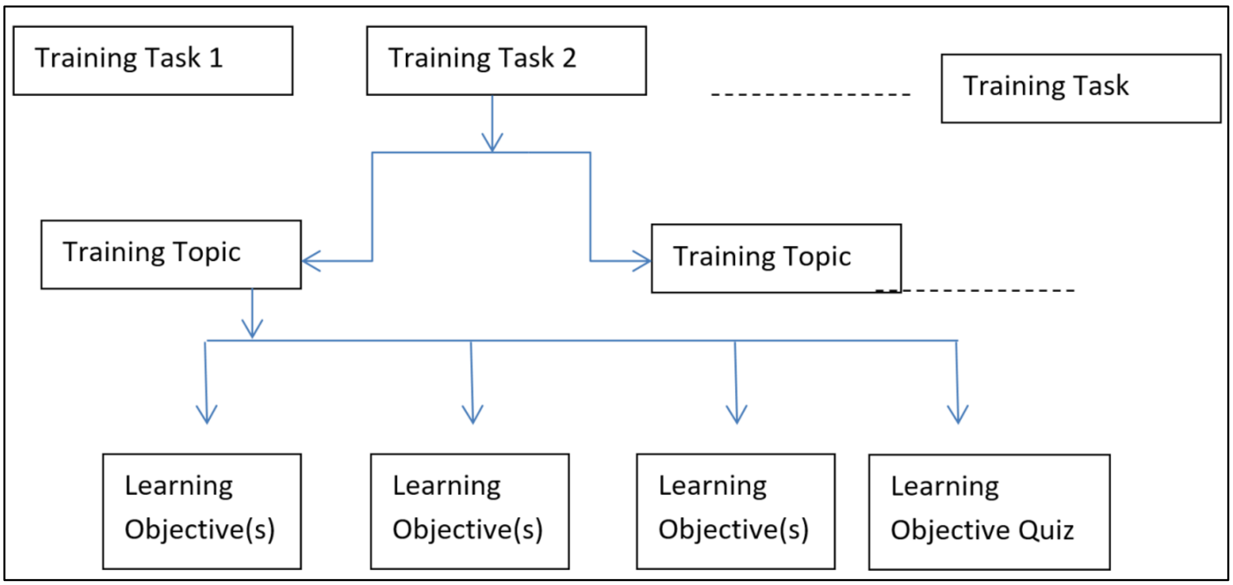


Figure 5- 5: iMET Training Tasks Flow

The student login the system via the hand held mobile/tablet entering a registered data or setting up a new user profile. Student will go along the training track that had been set by the training task, where student has to touch each assigned training point on-board the ship with their own NFC enabled smart mobile/ tablet.

If the student re-login to the iMET, it will automatically retrieve the training topic that was ended in the student's previous session, or he/she may login to the training topic that would be assigned by the teacher as a training task.

The proposed iMET system prototype was developed and described in the following section of this chapter mainly for this research as a proof of the idea; the researcher faced many difficulties in developing this system as follows:

1- Most developers did not have the knowledge or experience in NFC related applications.
2- The cost of developing the application was very expensive due to the rareness of developers in Egypt.
3- Developers were not interested to allocate time for developing this application, as their interests were mainly towards developing commercial applications.
4- No funds or financial support, for neither developers nor the researcher, to develop and improve iMET training application.

Therefore, the researcher moved forward to search online for developers through internet at www.freelancer.com and www.guru.com, and RFQ (Request for Quotation) was sent describing iMET intended layout and its deliverables; unfortunately these correspondences were not fruitful, as overseas developers requested down payments without any guarantees that the produced software will fulfil this research requirement. iMET prototype was finally developed by a local freelancer, who found the application very interesting for him. Furthermore, the researcher maintained a consideration of the three main pillars of sustainability, which are economic impact, environmental impact and social impact.

Accordingly, the researcher conducted a cost analysis for implementing iMET at the end of the current chapter, in order to measure iMET economic impact, especially that it is not a popular technology in MET sector, while regarding environmental impact, the used tool by end users is their own mobile device, so it has no negative environmental impact, except it cannot be used in hazardous areas where liquefied natural gas or fuel is being stored or transferred, also interference with on-board navigation and electronic equipment has not been found, except a temporary significant effect was detected on the magnetic compass, as long as the handheld device within 0.3 meters.

Moreover, concerning the social aspect, humans intending to use iMET will be subject to the same effect of their regular usage of their mobiles/ tablets, while from another perspective, Maritime industry is moving as other societies from an industrialised society towards information or knowledge society.

Cadets/ students need to be familiar with the idea of learning environments and self-learning as they are mainly using traditional teaching as passive recipients. iMET shift towards an active learning/ training process, This development in learning/ training process, requires a professional development and support for teachers, this will be needed to sustain such changes successfully (Barth & Rieckmann, 2012). Researcher according to Chapter 4 outcomes regarding iMET model pre-intervention survey believes that, substantial benefits can be derived in on-board training from the use of iMET, as a facilitator of on-going innovation in MET for achieving its continues development and sustainability.

5.3.4 iMET Prototype

The researcher developed an iMET prototype of the intended application, as a proof of concept, iMET generic prototype covered the educational materials for the EPIRB and SART, in compliance with the curriculum taught on-board the training ship AIDA IV. iMET prototype had been developed for Android smart mobiles as it is more widely used than iPhone ones, as about 89% of the interviewed faculty and staff are using Android smart mobiles, while cadets using iPhone, were found having either an extra Android mobile or tablet.

The developed iMET prototype covered two learning/ training topics (EPIRB and SART) under a training task of getting the cadet acquainted with GMDSS system components on-board the training ship, as each learning topic consists of a number of learning objectives as follows:

- Training Task: GMDSS equipment on-board
- Learning Topic: EPIRB
- Learning Objectives:
  - Learning objective one: Full description of EPIRB that includes; Function; operation, location, fitting method, and types of EPIRB.
  - Learning objective two: Layout of EPIRB that includes; different photos of EPIRB from different angels.

- Learning objective three: How EPIRB works? This objective includes; the operational approach of how the EPIRB operation, testing and inspection.
- Learning objective four: Regulations awareness which includes, the references in the international conventions affiliated with EPIRB.
- Learning objective five: Inspection regulations familiarisation which includes the required information regarding testing and inspecting the EPIRB in order to comply with the different inspections and surveying schemes.

This section will demonstrate the developed prototype main frame, with the aid of screen shots from iMET handheld prototype application, as shown in figure 5-6, the prototype had been developed to validate the concept proposed in this research. iMET consists of 3 main tabs as follows:

NFC Scan tab that triggers the education and training materials affiliated to the touched point.

Learning tab that contains the education and training materials affiliated to touched point, and the points that had already interacted.

My Quizzes tab that stores the history of all quizzes conducted for different points.

iMET prototype user Interface (UI) design as shown in figures 5-6 (a) to (d), focuses on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions. UI brings together MET practical training objectives from interaction design, visual design, and information architecture. Accordingly, iMET interface was designed simple with a consistency within the different pages layouts; in order to achieve the goal of a user-friendly product is to provide a good user experience.

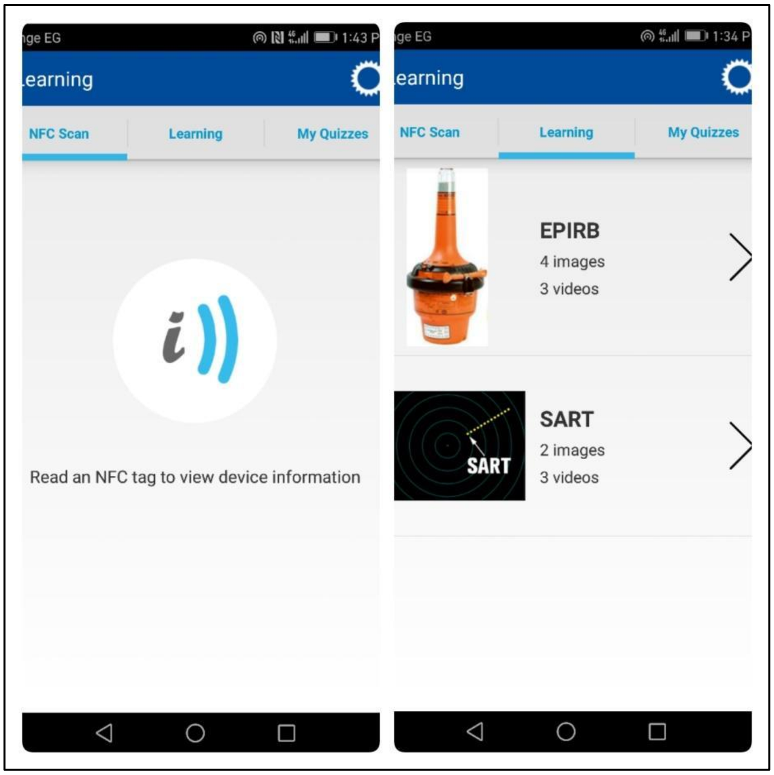


Figure 5- 6 (a): iMET Prototype Screen Shot

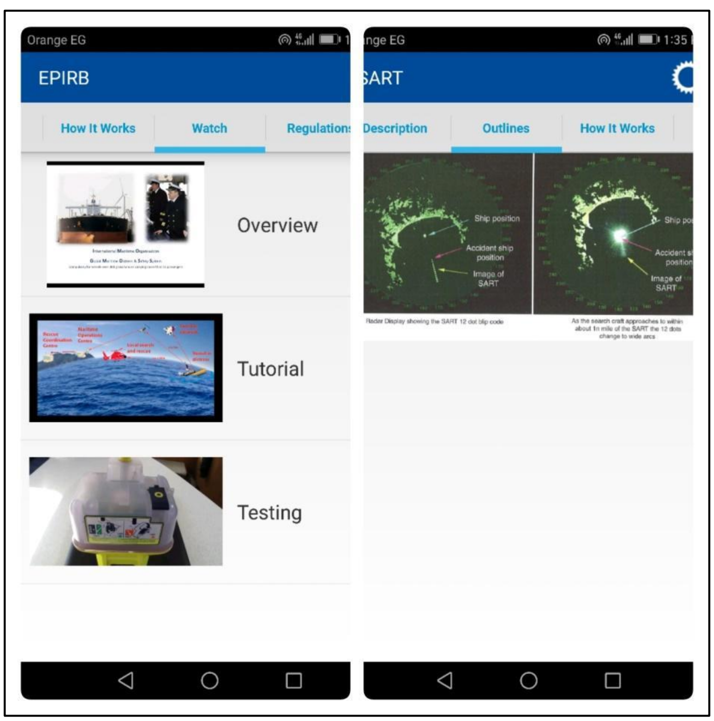


Figure 5-6 (b): iMET Prototype Screen Shot

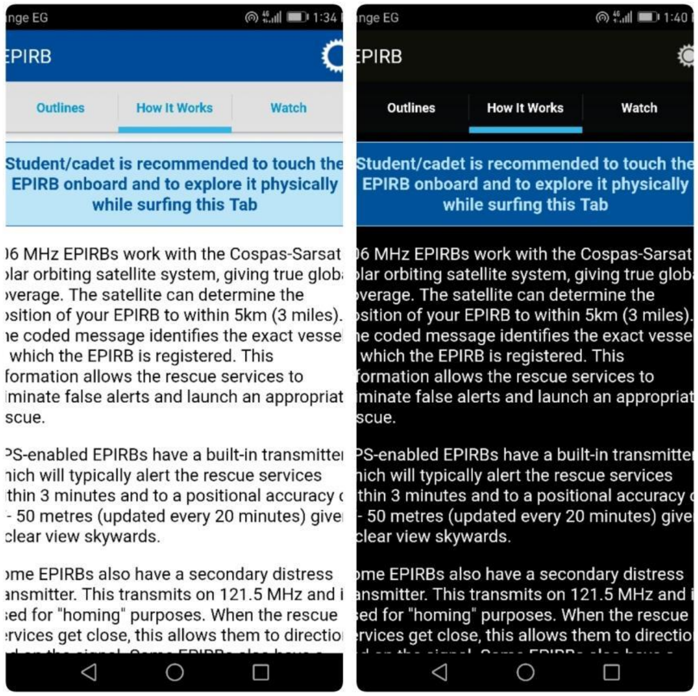


Figure 5-6 (c): iMET Prototype Screen Shot

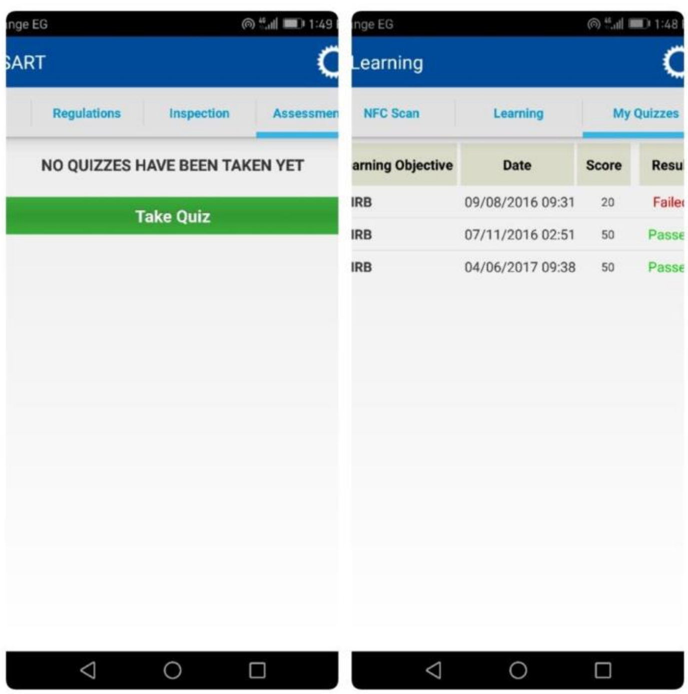


Figure 5-6 (d): iMET Prototype Screen Shot

In figure 5-6(c) represents part of the EPIRB device education and training materials in the 2 formats with different background light, in order to adapt the application usage for the cadets in day time and in night time.

Learning tab consists of seven sub-tabs as follows:

- **Description tab** contains a brief description about the EPIRB/ SART device, function and theory of the device.
- **Outlines tab** contains figures and pictures describing the EPIRB/ SART device function and how it works.
- **How it works tab** contains EPIRB/ SART device operation, deliverables, and testing its efficiency.
- **Watch tab** contains three videos with narration one covering EPIRB/ SART device, and the second covers an overview, while the third is a tutorial and the device testing procedures.
- **Regulations tab** contains the EPIRB/ SART device references and background in the international conventions.
- **Inspection tab** contains items that should be covered for the EPIRB/ SART device for inspection and survey.
- **Assessment tab** contains ten multiple choice questions covering the EPIRB/ SART learning topic main points.

To be able to design a scalable full system we have to consider the following:

- **Functionalities:** in terms of functionalities, further future studies has to inform the developer about the possible and expected scenarios of changes, in requirement, to be considered in the system architecture and recorded in the analysis document. In addition to client's/ end users' experience with the prototype and method of enhancing the process.
- **System Architecture**: based on the possible scenarios, the iMET software architecture will be built to enable changes in future.

- **Technology**: using a scalable technology like ASP.NET/SQL Server is very suitable for this project size.
- **Scalability Testing**: to ensure proper performance of the system, with large number of users and requests, scalability test to be applied to recognise the maximum number of users' requests on the system, to estimate the maximum number of users that can work on the system concurrently.
- **Minimum server Configurations:** minimum server configuration is Intel Core i5, 2.5 MHz, above 8 GB Ram, 1TB Hard Disk and External Hard Disk for backups, concerning intranet/ local network availability, wireless network coverage should be available on all the places that include any training devices / points assigned to passive NFC tags.

5.4 Project Cost Estimation

Regarding the iMET economical aspect, which is very crucial element for the management decision for iMET implementation, an estimated cost in Egyptian pounds (EGP) of iMET application development as described in this chapter, table 5-1 will break down the main projects' two phases (back-end and front-end), where maximum 5 reports will be generated to 5 working groups on-board the training ship, to cover all the training sections on-board with consideration of the number of full time lecturers/ Instructors on-board.

Where generated reports are for the following training sections: Life Saving Appliances; Fire Fighting Appliances, Navigation Bridge, Main Deck and Mooring Equipment. Below table 5-1 was estimated according to a quotation received from software Development Company in Alexandria, Egypt, based on the developers' rates in 2017, cost of server and 250 passive tags that will be attached to the points of interest of the training process on-board.

Table 5-1: iMET Development Cost

Description of Work	Developing Days	Cost (EGP.)
Back-end Development		
NFC Tags Management	6	11,000
Devices contents (text - images - videos)	8	19,000
Questions and answers	8	17,000
Reports (Maximum 5 reports)	17	4,000
Android App		
NFC Tag Reading	3	8,000
Display device contents	10	19,000
Quiz	7	14,000
Listing and Search	6	12,000
Total	**63** Working days	**104,000 EGP** = 5000 GBP (£)

Table 5-1 estimated the cost of developing and installing iMET technological intervention on-board the training ship is one hundred and four thousands Egyptian pounds (104,000 EGP.), that is equivalent to five thousand Great Britain Pounds (5000 GBP.) according to the exchange rates in January 2017, where the iMET application development is in 63 working days, including back-end development and Android hand held operating system development for the user end. Moreover the cost of buying 250 NFC tags is 50 GBP, and server cost is 650 GBP, Accordingly the total cost will be 5700 £ (GBP.).

5.5 Summary

This chapter presented the concept of iMET and a prototype had been developed as a proof of concept, also this chapter highlighted the proposed application layout, modules and process framework, the final part of this chapter stated the overview of the full system development framework and used programming languages in addition to an estimated cost of the system's full implementation on-board the training ship as a main tool of training.

The first section of this chapter represented NFC technology as a part of RFID technology and stating the three operating modes of NFC, and then a brief description of the practical training process carried out on-board the training ship as it represents the installation and application of iMET provided with explanation of function and how iMET will be used on-board.

iMET concept had been introduced in this chapter through two approaches; first approach was a theoretical one based on reviewing literature in order to develop a personalised training tool designed in reference to Felder-Silverman learning style model (FSLSM) and fits Kolbs and VARK as explained in chapter 2, in addition to critique that had been discussed in the literature review towards learning styles had been considered in order to overcome it during designing iMET technological tool.

Moreover, requirements and expectations of maritime stakeholders through the survey conducted in this research had been considered in iMET technological tool design, accordingly a further explanation had been added to the learning/ training topics of the iMET prototype which are references of the international conventions related to learning/ training topics to get the cadets acquainted with periodical surveying process references, in addition to methods of testing and inspecting equipment related to learning/ training topics.

Furthermore a display setting at night time to adapt iMET usage at the navigation bridge at night, while a different one at day time to make it easier for user to go through the application in sunny days.

iMET concept second approach was introduced from a technical aspect stating required infrastructure, programming language, iMET technical characteristics and modules contained in the proposed technological intervention, in addition to a flow chart of the training process which consists of learning/ training topic which consists of number of learning/ training objectives where a quiz is provided by the end of each learning/ training objective, the training flow chart discussed in this chapter aims to assure delivering the training objectives to cadets with repeatability in sometimes according to cadets progress.

Many challenges faced the researcher in developing iMET prototype application due to lack of developers in this field or due to high cost of developing the application, in addition to absence of such applications in the maritime and education field.

The researcher developed an iMET application as a proof of concept; iMET state of art prototype covered the educational materials for the EPIRB and SART in compliance with the curriculum taught on-board the training ship AIDA IV and stakeholders survey feedback. The developed iMET prototype covered two learning topics under a training task of getting the cadet acquainted with GMDSS system components on-board the training ship as each learning topic consists of a number of learning objectives that had been presented in this chapter including the prototype contents structure and contents.

Regarding the estimated cost in Egyptian pounds (EGP) of iMET application development as described in this chapter it shows a cost effective solution for multiple users on-board the ship, as the cost is almost equivalent to the cost of buying 2 advanced professional laptops, such as the latest version of Apple MacBook Pro Laptop with Touch Bar.

The next chapter will discuss and analyse the feedback received from the questionnaire survey, which had been conducted to the cadets on-board in the post-intervention phase of iMET tool in order to identify their behavioural intention towards actual usage of iMET technology tool, for iMET model validation.

CHAPTER SIX

Post-Intervention Empirical Study for iMET Model Validation

6.1 Introduction

This chapter is built up after the iMET intervention in presented the previous chapter. To assess the intervention statistically, data analysis will be presented in this chapter as a complementary analysis for what had been performed for the pre-intervention analysis in chapter 4. Therefore, the statistical analysis and techniques used to obtain results out of the data under study will be displayed in this chapter after developing iMET prototype application and being actually used by marine cadets on-board the training ship. It aims to figure out whether to accept or reject the research hypotheses, through applying the statistical techniques selected for the post intervention study.

To achieve this aim, the current chapter starts by presenting descriptive analysis for the research variables, including mean, minimum, maximum, variance, and standard deviation, as well as the frequency tables. Also, it presents the correlation and regression analysis between the research variables to find the corresponding relationships and effects for the Post intervention study.

In the current research, the statistical package "Statistical Program in the Social Science", SPSS – Version 22, will be used in the above mentioned analysis techniques, as it is the most widely used and comprehensive package in statistics. Data was collected through a questionnaire designed for 106 observations, representing the population under study of the same group of students to the pre-intervention part.

In addition, a comparative analysis will be conducted between the pre-intervention and post intervention stages. The comparison had been carried out using multiple regression analysis for both stages of the study. Also, a pair wise sample t-test for pre and post interventions had been constructed by comparing means of both groups of pre and post interventions.

6.2 Post-Intervention Results and Findings

In this section, the researcher will figure out the results and findings for the stage of the Post-Intervention part of the iMET technological application introduced in the current study.

6.2.1 Descriptive Analysis for the Post-Intervention

The descriptive analysis gives a brief summary about the research variables. The researcher in this part will introduce a descriptive analysis for the data obtained from the questionnaire.

Table 6-1 shows that more than 90% of the questionnaire respondents agree on perceived usefulness. Also, half the sample under study strongly agrees on perceived ease of use. In addition, around 51% agree on having perceived resources. Besides, more than half of the questionnaire respondents strongly agree on having perceived attitude. Finally, around 85% of the respondents have strong behavioural intention.

It could be observed that the cadets are satisfied by the iMET intervention application as their responses are almost in the agreement zone. This means that the zone of disagreement that was appearing in the pre-intervention stage had been vanished in the post intervention stage. In other words, there might be an improvement in the cadets' perception due to their actual usage of the iMET prototype.

Table 6- 1: Frequency Tables of Research Variables for Questionnaire Respondents of Post Intervention

Variable	Items	Frequency	Percent
Perceived Usefulness (U)	**Uncertain**	7	6.6
	Agree	67	63.2
	Strongly Agree	32	30.2
	Total	106	100.0
Perceived Ease of Use (E)	**Uncertain**	6	5.7
	Agree	47	44.3
	Strongly Agree	53	50.0
	Total	106	100.0

Variable	Items	Frequency	Percent
Perceived Resources (R)	**Uncertain**	15	14.2
	Agree	54	50.9
	Strongly Agree	37	34.9
	Total	106	100.0
Perceived Attitude (A)	**Uncertain**	3	2.8
	Agree	46	43.4
	Strongly Agree	57	53.8
	Total	106	100.0
Behavioural Intention (B)	**Uncertain**	1	0.9
	Agree	15	14.2
	Strongly Agree	90	84.9
	Total	106	100.0

The following graphs show the same results obtained from table 6-1, where it could be shown that the largest areas are given for agree and strongly agree items.

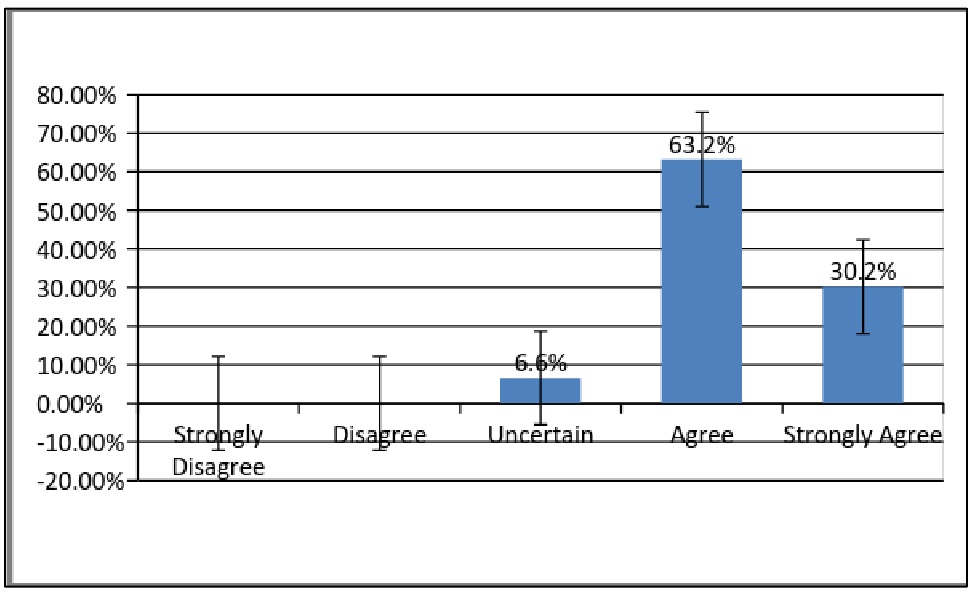


Figure 6- 1: Bar Chart of Perceived Usefulness for Questionnaire Respondents of Post Intervention

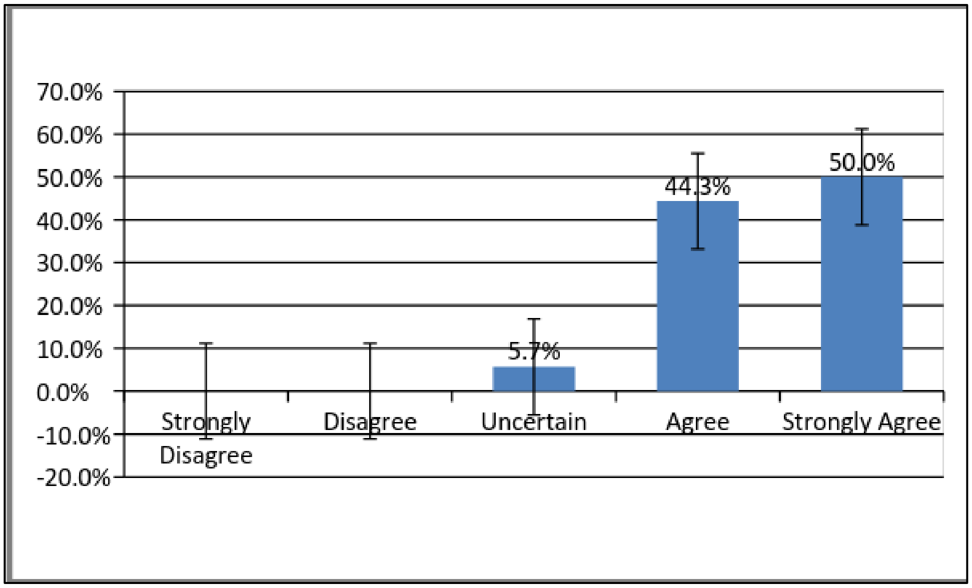


Figure 6- 2: Bar Chart of Perceived Ease of Use for Questionnaire Respondents of Post Intervention

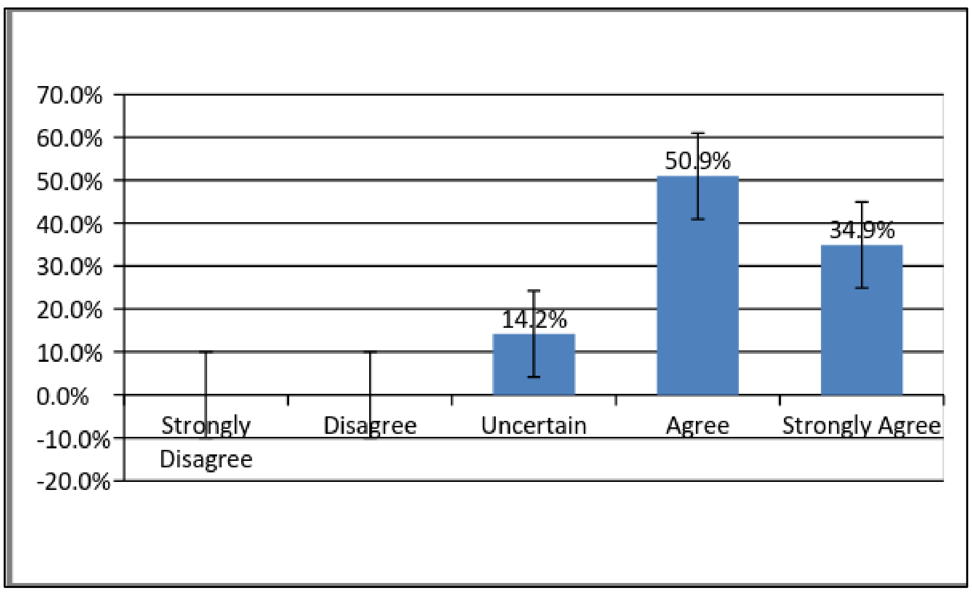


Figure 6- 3: Bar Chart of Perceived Resources for Questionnaire Respondents of Post Intervention

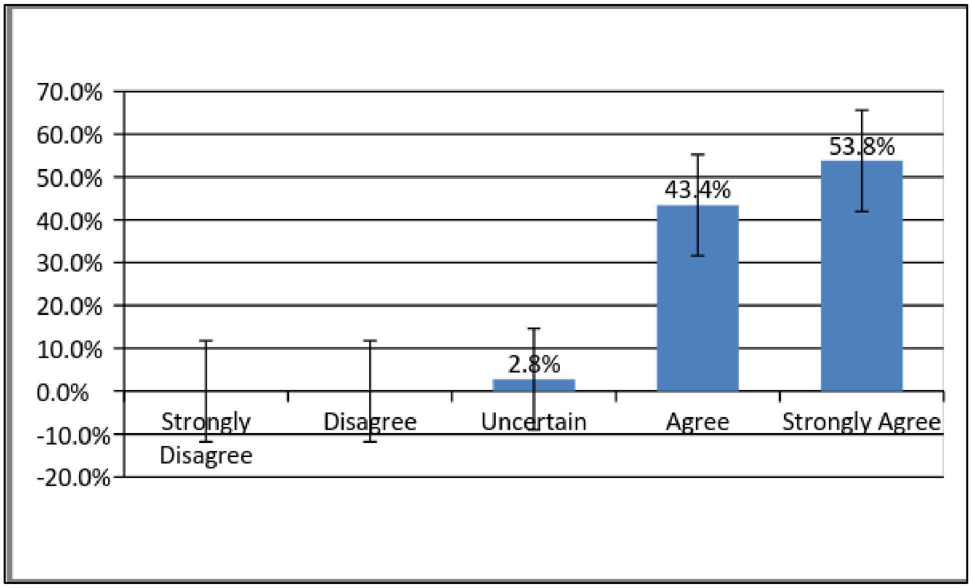


Figure 6- 4: Bar Chart of Perceived Attitude for Questionnaire Respondents of Post Intervention

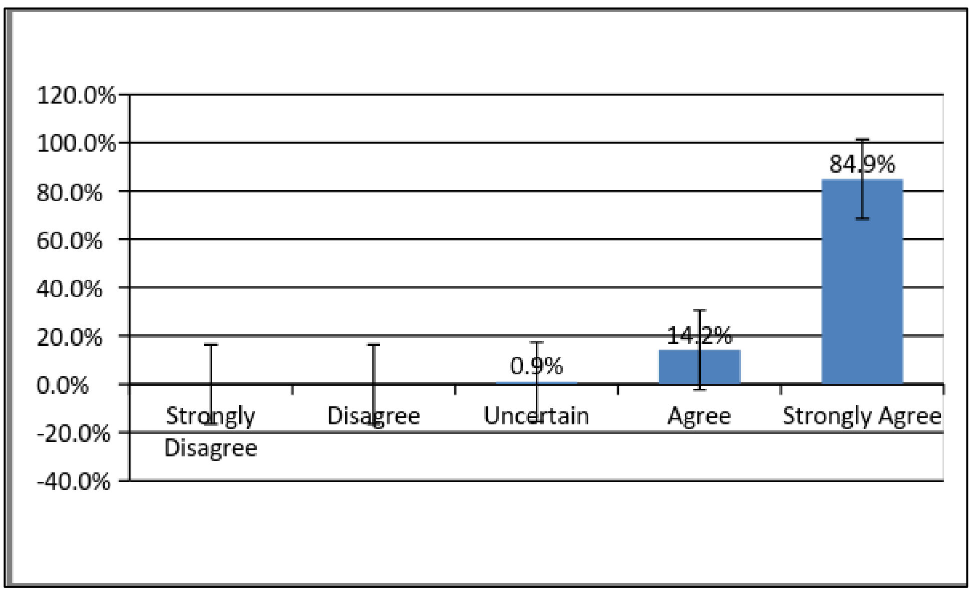


Figure 6- 5: Bar Chart of Perceived Usefulness for Questionnaire Respondents of Post Intervention

Also, the researcher will present in Appendix C, Table (2) all the descriptive analysis of the breakdown of the research variables mentioned above.

6.2.2 Hypotheses Testing of Post Intervention

This section will illustrate the findings of the hypotheses testing for the post intervention stage. It will present the main findings of the data testing, including its validity and reliability analysis. Also, the correlation and regression analysis will be applied to test the impact of the independent variables on the dependent variable in the post intervention stage.

6.2.2.1 Data Testing using Validity and Reliability of Post Intervention

Data testing will be applied using the validity and reliability analysis as a preliminary step for the hypotheses testing, in order to assess the data to be able to rely on its results in testing the research hypotheses.

6.2.2.1.1 Validity Testing of Post Intervention

The results of the factor analysis conducted on the current research constructs are shown in table 6-3. It could be observed that AVE values for all scales under study were found to be greater than 0.5 or 50%, after deleting some items in each variable of the ones under study. Also, table 6-3 represents the remaining items considered with acceptable AVE and factor loading after deleting some items as shown in table 6-2. This means that all dimensions under study have now convergent validity.

Table 6-3 represents the items considered in computing the research variables and their corresponding factor loading, where it could be observed that the items shown have high factor loading, or in other words, acceptable contribution in their corresponding constructs (greater than 0.4). For example, U1, U2 and U4, which are items of the variable Perceived Usefulness, have a factor loading of 0.632, 0.507 and 0.519 respectively after ignoring the items U3 and U5. This means that the items U3 and U5 have weak contribution to the variable Perceived Usefulness and they should be deleted from the items considered in calculating the variable.

In the same way, the items E1 and E5 have weak contribution in calculating the variable Perceived Ease of Use and they have to be ignored from the list of items used in calculating the variables Perceived Ease of Use, where the considered items are E2, E3 and E4, with an acceptable factor loading of 0.594, 0.506 and 0.742 respectively. The following table 6-2 shows the items loading of the weak factors before deleting them, where the items deleted are as follows:

U3) iMET will enhance gaining required practical skills on-board
U5) iMET will support putting theoretical knowledge into practical one
E1) Do you think that technology is essential for you
E5) Do you play video games frequently
R2) iMET will improve your seaman ship training
R6) iMET will improve your Maritime English
R7) iMET will improve your self-reliance, rationality and sense of responsibility
A1) I would be able to use Technology Enhanced Learning on-board AIDA IV
B2) Do you intent to use iMET as training tool on-board AIDA IV

Table 6- 2: Factor Loadings of Deleted Items for Post-intervention

Variables Under Study	Factor Loading of Items
Perceived Usefulness	
U3	**0.388**
U5	**0.344**
Behavioural Intention	
B2	**0.376**
Perceived Resources	
R2	**0.286**
R6	**0.385**
R7	**0.276**
Attitude	
A1	**0.107**
Perceived Ease of Use	
E1	**0.009**
E5	**0.005**

Table 6-3 shows the item loadings after ignoring those with weak loadings and considering the remaining factors as follows:

U1) Do you think the implementation of iMET tool would be beneficial for training on-board
U2) iMET will be an added value for OOW duties training
U4) iMET will help understanding theoretical aspect of MET

E2) Are you a frequent user of mobile applications
E3) Are you a frequent user of Marine mobile applications
E4) Are you a frequent user of Microsoft office
R1) iMET will improve your Lifesaving and Firefighting equipment training
R3) iMET will improve your Engine room familiarisation training
R4) iMET will improve your Stability and Cargo calculations training
R5) iMET will improve your Safety behaviour on-board
A2) Are you willing to use iMET for you as a main training guide
A3) Are you willing to increase your usage of Marine educational software's
B1) Do you personally intent to use your handheld device for self-tutoring
B3) Cadets ***(your colleagues)*** *will use the handheld device for self-tutoring on-board AIDA IV*

Table 6- 3: Average Variance Extracted and Factor Loadings of items for Post Intervention

Variables Under Study	AVE in %	Factor Loading of Items
Perceived Usefulness		
U1	55.254%	0.632
U2		0.507
U4		0.519
Perceived Ease of Use		
E2	61.372%	0.594
E3		0.506
E4		0.742
Perceived Resources		
R1	51.7972%	0.582
R3		0.494
R4		0.594
R5		0.403
Attitude towards using Technology		
A2	62.470	0.625
A3		0.625
Behavioural Intention		
B1	63.804	0.638
B3		0.638

Regarding the discriminant validity as shown in table 6-4, it had been computed for the post intervention stage, as had been done for the pre intervention one. It is shown in the following table, where all constructs are shown to have discriminant validity as all square roots of AVEs are greater than the correlation of the corresponding variables with other ones.

Table 6- 4: Discriminant Validity between Variables

Post Intervention		Usefulness	Ease	Resources	Attitude	Intention
SQRT-AVE		**80.97%**	**80.82%**	**75.33%**	**71.08%**	**71.89%**
Usefulness	Pearson Correlation	1				
	P-value					
Ease	Pearson Correlation	.279**	1			
	P-value	.004				
Resources	Pearson Correlation	.374**	.194*	1		
	P-value	.000	.047			
Attitude	Pearson Correlation	.465**	.030	.198*	1	
	P-value	.000	.760	.041		
Intention	Pearson Correlation	.345**	.142	.127	.116	1
	P-value	.000	.147	.195	.238	

* Correlation is significant when P-value < 0.05

** Correlation is significant when P-value < 0.01

6.2.2.1.2 Reliability Testing of Post Intervention

Table 6-5 below revealed the reliability and the internal consistency between the selected items of the studied variables. It can be shown that the values of Cronbach's alpha for the variables under study are 0.6 and more, which is an acceptable level for the reliability of the variables in social science (Ghazali, 2008). This means that the cadets' perception had been reflected on the calculated Cronbach's alpha in the post intervention stage rather than the values shown in the pre intervention stage shown in chapter 4, which means that the post intervention stage shows better internal consistency between items of the research variables, which might be referred to the usage of cadets for the prototype.

Table 6- 5: Reliability Test for Research Variables for Post Intervention

Variables	Number of items	Cronbach's Alpha
Perceived Usefulness	3	0.6
Perceived Ease of Use	3	0.7
Perceived Resources	4	0.7
Attitude towards using Technology	2	0.7
Behavioural Intention	2	0.7

6.2.2.2 Hypotheses Testing using Correlation and Regression Analysis for Post Intervention

In this section, the researcher will reach the anticipated deliverables, after testing hypotheses using the correlation and regression analysis.

To make it easier, the researcher will start with presenting a brief discussion of the results and findings of both, the correlation and regression analysis.

6.2.2.2.1 Post-Intervention Analysis

The Pearson's Correlation Coefficient is used to evaluate the relationship between two variables. It is represented with the symbol "r". The value for a Pearson's correlation can fall between 0.00 (no correlation) and 1.00 (perfect correlation). If the correlation (r) is significant, then the P-value will be shown to be less than 0.05, where P-value is the significance level, and vice-versa (Foster et al., 2001).

Table 6-6 presents the correlation and p-values found between Behavioural Intention and each of the research variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude towards using technology for the post-intervention stage.

Table 6-6 shows that there is a significant positive moderate relationship between behavioural Intention and each of perceived usefulness (r= 0.465, P-value = 0.000), perceived ease of use (r= 0.375, P-value = 0.007), perceived resources (r= 0.471, P-value = 0.000), Attitude towards using technology (r= 0.436, P-value = 0.000), as all p-values are less than 0.05.

Table 6- 6: Correlation Matrix between the Research variables and Behavioural Intention for the Post Intervention

		Perceived Usefulness	Perceived Ease of Use	Perceived Resources	Attitude towards using Technology
Behavioural Intention	Pearson Correlation	.465**	.375**	.471**	.436**
	P-value	.000	.007	.000	.000
	N	106	106	106	106

** Correlation is significant when P-value < 0.01

Regarding linear regression analysis, it is a statistical procedure that is widely used to predict the value of one dependent variable based on the value of one or more independent variables. It is also used to understand which variable among the independent variables is related to the dependent variable and to explore the forms of these relationships.

The regression coefficient (β) represents the amount of change that happens in the dependent variable due to a change in the independent variable by one unit. If the regression coefficient shows a significant impact of the independent variable on the dependent variable, then P-value should be shown to be less than the significance level (0.05 or 0.01).

A t-test is applied using regression analysis to find out the regression coefficient and p-values for the impact of each independent variable (Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude towards using technology) on the dependent variable (Behavioural Intention)

Table 6-7 shows a summary of the simple linear regression analysis results, where it was found that that there is a significant positive impact of perceived usefulness (β=0.336, P-value = 0.000), perceived ease of use (β=0.258, P-value = 0.007), perceived resources (β=0.312, P-value = 0.000), Attitude towards using technology (β=0.301, P-value = 0.000) on Behavioural Intention, as all p-values are less than 0.05.

Table 6- 7: Summary of Simple Regression Analysis Results of Research variables on Behavioural Intention for the Post Intervention

	B (Regression Coefficient)	P-value
Perceived Usefulness	.336**	.000
Perceived Ease of Use	.258**	.007
Perceived Resources	.312**	.000
Attitude towards using technology	.301**	.000

** Regression is significant when P-value < 0.01

The above results could be summarised to figure out a response of the research hypotheses in the post intervention stage as shown in table 6-8. It could be observed that the all the research hypotheses are accepted for the post intervention stage.

Table 6- 8: Summary of Research Hypotheses Response for the Post Intervention

Research Hypothesis	**Details**	**Results**	**Response**
Hypothesis One	Impact of Perceived Usefulness on Behavioural Intention	r=0.465, β =0.336 P-value = 0.000	Accept Hypothesis One: There is a significant impact of Perceived Usefulness on Behavioural Intention
Hypothesis Two	Impact of Perceived Ease of Use on Behavioural Intention	r=0.375, β=0.258 P-value = 0.007	Accept Hypothesis Two: There is a significant impact of Perceived Ease of Use on Behavioural Intention
Hypothesis Three	Impact of Perceived Resources on Behavioural Intention	r=0.471, β= 0.312 P-value = 0.000	Accept Hypothesis Three: There is a significant impact of Perceived Resources on Behavioural Intention
Hypothesis Four	Impact of Attitude towards using technology on Behavioural Intention	r=0.436, β=0.301 P-value = 0.000	Accept Hypothesis Four: There is a significant impact of Attitude towards using technology on Behavioural Intention

As per the above brief discussion, the following sections will present how such results are obtained in details. Each section will represent the findings of the correlation and regression analysis between each independent variable and the dependent variable for the post intervention stage.

6.2.2.2.2 Testing the First Hypothesis: The Relationship Between Perceived Usefulness and Behavioural Intention for Post Intervention

Table 6-9 shows the correlation analysis between Perceived Usefulness and Behavioural Intention. It could be observed that there is a significant positive moderate relationship between perceived usefulness and behavioural intention (r=0.465, P-value = 0.000 < 0.05).

Table 6- 9: Correlation for Perceived Usefulness and Behavioural Intention for Post Intervention

		Perceived Usefulness	Behavioural Intention
Perceived Usefulness	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.465**	1
	P-value	.000	
	N	106	106

** Correlation is significant when P-value < 0.01

Table 6-10 shows the regression analysis and the model fitted between Perceived usefulness as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 21.6%, which means that the model explains 21.6% of the variance in Behavioural Intention. The model as a whole is significant (P-value = 0.000 < 0.05). In addition, there is a significant effect of Perceived Usefulness (P-value = 0.000 < 0.05).

Table 6- 10: Regression Analysis for impact of Perceived Usefulness on Behavioural Intention for Post Intervention

Model		Unstandardised Coefficients		Standardised Coefficients	t	P-value	R – Squared
		B	Std. Error	Beta			
1	(Constant)	3.387	.274		12.383	.000	0.216
	Usefulness	.336	.063	.465	5.352	.000	

** Regression is significant when P-value < 0.01

6.2.2.2.3 Testing the Second Hypothesis: The Relationship Between Perceived Ease of Use and Behavioural Intention

Table 6-11 shows the correlation analysis between Perceived Ease of Use and Behavioural Intention. It could be observed that there is a significant positive moderate relationship between perceived ease of use and behavioural intention (r = 0.375, P-value < 0.05).

Table 6- 11: Correlation for Perceived Ease of Use and Behavioural Intention for Post Intervention

		Perceived Ease of Use	Behavioural Intention
Perceived Ease of Use	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.375**	1
	P-value	.007	
	N	106	106

** Correlation is significant when P-value < 0.01

Table 6-12 shows the regression analysis and the model fitted between Perceived Ease of Use as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 14.0%, which means that the model explains 14.0% of the variance in Behavioural Intention. The model as a whole is insignificant (P-value = 0.000 <0.05). In addition, there is an insignificant effect of Perceived Ease of Use.

Table 6- 12: Regression Analysis for Impact of Perceived Ease of Use on Behavioural Intention for Post Intervention

Model		Unstandardised Coefficients		Standardised Coefficients			
		B	Std. Error	Beta	T	P-value	R – Squared
1	(Constant)	3.689	.282		13.104	.000	0.140
	Ease of Use	.258	.063	.375	4.121	.000	

** Regression is significant when P-value < 0.01

6.2.2.2.4 Testing the Third Hypothesis: The Relationship Between Perceived Resources and Behavioural Intention

Table 6-13 shows the correlation analysis between Perceived Resources and Behavioural Intention. It could be observed that there is a significant positive moderate relationship between perceived resources and behavioural intention (r=0.471, P-value = 0.000 < 0.05).

Table 6- 13: Correlation for Perceived Resources and Behavioural Intention for Post Intervention

		Perceived Resources	Behavioural Intention
Perceived Resources	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.471**	1
	P-value	.000	
	N	106	106

** Correlation is significant when P-value < 0.01

Table 6-14 shows the regression analysis and the model fitted between Perceived Resources as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 22.2%, which means that the model explains 22.2% of the variance in Behavioural Intention. The model as a whole is significant (P-value = 0.000 < 0.05). In addition, there is a significant effect of Perceived Resources (P-value = 0.000 < 0.05).

Table 6- 14: Regression Analysis for Impact of Perceived Resources on Behavioural Intention for Post Intervention

Model		Unstandardised Coefficients β	Unstandardised Coefficients Std. Error	Standardised Coefficients Beta	t	P-value	R – Squared
1	(Constant)	3.472	.253		13.699	.000	0.222
	Resources	.312	.057	.471	5.443	.000	

** Regression is significant when P-value < 0.01

6.2.2.2.5 Testing the Fourth Hypothesis: The Relationship Between Attitude Towards Using Technology and Behavioural Intention

Table 6-15 shows the correlation analysis between Perceived Attitude and Behavioural Intention. It could be observed that there is a significant positive moderate relationship between perceived Attitude and behavioural intention (r=0.436, P-value = 0.000 < 0.05).

Table 6- 15: Correlation for Perceived Attitude and Behavioural Intention for Post Intervention

		Perceived Attitude	Behavioural Intention
Perceived Attitude	Pearson Correlation	1	
	P-value		
	N	106	
Behavioural Intention	Pearson Correlation	.436**	1
	P-value	.000	
	N	106	106

** Correlation is significant when P-value < 0.01

Table 6-16 shows the regression analysis and the model fitted between Perceived Attitude as the independent variable and Behavioural Intention as the dependent variable. The model coefficient of determination (R Square) equals 19.0%, which means that the model explains 19.0% of the variance in Behavioural Intention. The model as a whole is significant (P-value = 0.000 < 0.05). In addition, there is a significant effect of Perceived Attitude (P-value = 0.000 < 0.05).

Table 6- 16: Regression Analysis for Impact of Perceived Attitude on Behavioural Intention for Post Intervention

		Unstandardised Coefficients		Standardised Coefficients			
Model		B	Std. Error	Beta	t	P-value	R – Squared
1	(Constant)	3.472	.279		12.461	.000	0.190
	Attitude	.301	.061	.436	4.944	.000	

** Regression is significant when P-value < 0.01

6.3 Comparison between Pre and Post Intervention

This section presents a comparative study between the Pre-Intervention and the Post Intervention of the application under study. It aims to figure out whether there is a significant difference between the pre-intervention and the post intervention of the data under study.

6.3.1 Comparison Using Multiple Regression Analysis for Pre and Post Intervention Models

In this section, a comparison between the two models will be constructed by using the multiple regression analysis of both; pre and post intervention models. The multiple regression will present the impact of all the dimensions under study; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude on the dependent variable; Behaviour Intention in the presence of each other's.

Multiple regression analysis is different from simple regression, as the former tests the overall impact of the independent variables (Predictors) rather than testing the single impact of each independent variable.

6.3.1.1 Testing the Pre-Intervention Model Using Regression Analysis

Table 6-17 shows the multiple regression analysis of the Pre-Intervention model. Checking the overall significance of the model, it was found that the overall P-value = 0.000, which means that the overall model is significant. Also, it could be observed that there is a significant impact of Perceived Resources and Attitude on Behaviour Intention, as P-value are 0.048 and 0.000 respectively (P-value < 0.05). On the other hand, there is an insignificant impact of Perceived Usefulness and Perceived Ease of Use on behaviour intention, as P-value are 0.171 and 0.818 respectively (P-value > 0.05).

It could be observed as well from table 6-17 that R-squared equals 28.9%, which means that the model -including the predictors; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude - explains around 29% only of the variation in Behaviour Intention.

In addition, the Pre-Intervention model could be stated as follows using the unstandardised coefficients shown in table 6-17:

Behaviour Intention = 1.991 – 0.131*Usefulness +0.017*Perceived Ease of Use

+0.161*Perceived Resources + 0.560*Perceived Attitude

Finally, the standardised coefficients of Beta are useful to describe the relative importance of the independent variables with respect to the dependent variable. Thus, the most important variable was shown to be Perceived Attitude, as the corresponding standardised coefficient is 0.500. The second in rank is the Perceived Resources, as the corresponding standardised coefficient is 0.216. The third in rank is the Perceived Usefulness with a corresponding standardised coefficient is -0.165, while the least in rank is the Perceived Ease of Use with standardised coefficient of 0.021.

Table 6- 17: Multiple Regression Analysis of the Pre-Intervention Model

Model		Unstandardised Coefficients	Standardised Coefficients				
		B	Beta	T	P-value	Overall P-value	R^2
1	(Constant)	1.991		4.424	.000		
	Usefulness	-.131	-.165	-1.379	.171		
	Ease	.017	.021	.231	.818	0.000	0.289
	Resources	.161	.216	2.000	.048		
	Attitude	.560	.500	4.530	.000		

** Regression is significant when P-value < 0.01

6.3.1.2 Testing the Post Intervention Model Using Regression Analysis

Table 6-18 shows the multiple regression analysis of the post intervention model. The overall significance of the model, it was found that the overall P-value = 0.000, which means that the overall model is significant. It could be observed that there is a significant impact of all the variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude on Behaviour Intention, as P-values are 0.016, 0.038, 0.001 and 0.006 respectively (P-value < 0.05).

Also, R-squared equals 41%, which means that the model explains 41% of the variation in behaviour intention. This also means that the second model was able to explain higher variation in Behaviour Intention, proving better results for the intervention of the application under study.

In addition, the Post Intervention model could be stated as follows using the unstandardised coefficients shown in table 6-18:

Finally, the standardised coefficients of Beta are useful to describe the relative importance of the independent variables with respect to the dependent variable. Thus, the most important variable was shown to be Perceived Resources, as the corresponding standardised coefficient is 0.295. The second in rank is the Perceived Attitude, as the corresponding standardised coefficient is 0.240. The third in rank is the Perceived Usefulness with a corresponding standardised coefficient is 0.218, while the least in rank is the Perceived Ease of Use with standardised coefficient of 0.173.

Behaviour Intention = 2.020+ 0.157*Usefulness +0.119*Perceived Ease of Use

+0.195*Perceived Resources + 0.165*Perceived Attitude

Table 6- 18: Regression Analysis of the Post Intervention Model

Model		Unstandardised Coefficients	Standardised Coefficients	T	P-value	Overall P-value	R^2
		B	Beta				
1	(Constant)	2.020		5.891	.000		
	Usefulness	.157	.218	2.458	.016		
	Ease	.119	.173	2.098	.038	0.000	0.410
	Resources	.195	.295	3.561	.001		
	Attitude	.165	.240	2.831	.006		

** Regression is significant when P-value < 0.01

The above results lead the researcher to several conclusions, which are: First, the overall Post Intervention Model succeeded in expressing and explaining a greater percentage in Behaviour Intention than the Pre-Intervention model, as R-squared in the former was around 29%, while that of the latter was shown to be 41%. This means a better result and contribution of the application in the Behaviour intention.

Also, the number of variables which contribute in the explanation of Behaviour Intention was found to be only two variables; which are Perceived Attitude and Perceived Resources in the Pre-Intervention model. On the other hand, all the four variables under study; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude contribute in explaining the variation in Behaviour Intention for the Post Intervention model.

The overall results show that the Post Intervention model shows better findings than the Pre-Intervention model and higher contribution in Behaviour Intention and referred to the intervention of the application.

6.3.1.3 Testing Regression Assumptions

The regression analysis is trying to truly find the exact estimate of the model coefficients using the ordinary least square method. This method assumes that the data under study should be verifying some assumptions, like Normality, Linearity, no multicollinearity, and no autocorrelation.

In this section, some tests will be verified in order to make sure that regression analysis could be applied. Those assumptions could be stated as; data should follow the normal distribution. Also, relationships should be linear, no autocorrelation, and no multicollinearity problems. As there are two models under study; the Pre-Intervention and the Post Intervention models, then the researcher will test the assumptions stated for the two models.

6.3.1.3.1 Normality Testing

This test assumes that data is normally distributed to be able to apply Regression Analysis. It is a necessary test for the ordinary least squares method of estimating regression coefficients. A normal distribution means that there is neither skewness nor kurtosis. Table 6-19 shows the skewness and kurtosis values for the research variables, where it is found that the skewness and kurtosis of the data under study are within the range of -3 to 3 (Farrell & Rogers-Stewart, 2006). This means that the data under study is approximately normally distributed.

Table 6- 19: Skewness and Kurtosis of the Data Under Study

Model	Variables	Skewness	Kurtosis
Pre-Intervention Model	Usefulness	-.502	-.129
	Ease	-.441	-1.112
	Resources	-.429	-.402
	Attitude	-.046	-.495
	Intention	-1.173	.285
Post Intervention Model	Usefulness	.035	-.680
	Ease	-.472	-.736
	Resources	-.380	-.668
	Attitude	-.813	-.331
	Intention	-1.344	1.875

6.3.1.3.2 Autocorrelation Testing

Autocorrelation is the dependence of error terms resulting from the estimated model. Errors are supposed to be independent to avoid biasness in the model. Autocorrelation is tested using Durbin Watson Test. Table 6-20 below shows the Durbin Watson test values obtained by testing the two models; Pre-Intervention and Post Intervention. It could be observed that the Durbin Watson test values are greater than 2, implying that a problem of autocorrelation does not exist (Hair, Black, Babin, & Anderson, 2003).

Table 6- 20: Durbin Watson Test for Pre and Post Intervention Models

Model	D-W Values
Pre-Intervention Model	2.972
Post Intervention Model	2.071

6.3.1.3.3 Multicollinearity Testing

The multicollinearity problem arises when there is a high correlation between the independent variables in one of the models under study. It results in having insignificant impacts while they were supposed to be significant, which is referred to as type I error. Multicollinearity is tested using the Variance Inflation Factor (VIF), where high VIF (VIF > 5) implies that a problem of multicollinearity exists (Sekaran & Bougie, 2010).

Table 6-21 shows the VIF values for all the research variables included in both models under study; the Pre-Intervention and the Post Intervention models. The VIF values are shown below to be all less than 5, implying that the problem of Multicollinearity does not exist.

Table 6- 21: VIF for Pre and Post Intervention Models

Model	Variables	VIF values
Pre-Intervention Model	Perceived Usefulness	1.340
	Perceived Ease of Use	1.162
	Perceived Resources	1.175
	Attitude	1.228
Post Intervention Model	Perceived Usefulness	2.024
	Perceived Ease of Use	1.129
	Perceived Resources	1.651
	Attitude	1.730

6.3.2 Comparison using Means of the Pre and Post Intervention Models

A comparison is constructed between the research variables in the pre and post intervention models. The comparison is constructed using the pair wise t-test for comparing means of two variables which are considered the result of an experiment done on the same observations.

Thus, the cadets under study are considered the observations under study, the intervention is the experiment and the data collected from the cadets before and after the intervention is considered as the data collected as a result from the experiment. The t-test for pre and post intervention variables is constructed to show if there is a significant difference in the research variables between the pre and post intervention and to show if there is any improvement due to the application intervention (Dimitrov & Rumrill, 2003).

Table 6-22 shows the t-test for the research variables in the Pre and Post intervention cases. If P-value is less than 0.05, then this means that a significant difference is found between the two groups under study, which means that there is a difference between the data of pre and post interventions. On the other hand, if P-value is greater than 0.05, then this means that an insignificant difference is found between the two groups under study, which means that there is no difference between the data of pre and post interventions and the intervention does not cause any difference in the data, whether positive or negative difference.

From table 6-22, it could be noticed that the p-values are all less than 0.05, as p-values corresponding to the research variables; Perceived usefulness, Perceived Ease of Use, Perceived Resources, Perceived Attitude, and Behaviour Intention are 0.001, 0.019, 0.000, 0.001 and 0.000 respectively. This means that there is a significant difference in all research variables under study from pre-intervention to post intervention, as all p-values are less than 0.05.

Also, by observing the mean values shown in table 6-22, it could be noticed that the mean values of all research variables for the post intervention variables are greater than that of the pre intervention. As an example for this scenario is that the mean perceived usefulness for the pre-intervention is 4.0189, while the mean perceived usefulness for the post intervention increases to be equal to 4.3208.

In addition, the mean perceived Ease of Use for the pre-intervention is 4.2453, while the mean perceived Ease of Use for the post intervention increases to be equal to 4.4623. Besides, the mean perceived Resources for the pre-intervention is 3.9245, while the mean perceived resources for the post intervention increases to be equal to 4.3868. Thus, it could be claimed that the variables under study show greater range of agreement and better results after applying the application under study.

Table 6- 22: Comparing Means for Pre and Post Intervention Models

	Pre-Post	**N**	**Mean**	**P-value**
Perceived Usefulness	Pre	106	4.0189	0.001
	Post	106	4.3208	
Perceived Ease of Use	Pre	106	4.2453	0.019
	Post	106	4.4623	
Perceived Resources	Pre	106	3.9245	0.000
	Post	106	4.3868	
Perceived Attitude	Pre	106	4.2830	0.001
	Post	106	4.5472	
Behaviour Intention	Pre	106	4.5660	0.000
	Post	106	4.8396	

6.3.3 Comparison Using Mean Scores of Quiz for Pre and Post Intervention Model

As a supporting tool for the result shown in the previous section, the researcher constructed a quiz to be applied before and after the intervention of the application. To do so, the researcher introduced the quiz for two training subjects, which are; EPIRB and SART. Therefore; 2 groups, each consisting of 20 students, are randomly selected to do the quiz for each subject. Each group did the test two times; the pre-intervention and the post intervention time. In other words, both groups are subjected to the same quiz twice. The first time of quiz was before the intervention and the other time was after introducing the research iMET prototype application. The groups mentioned represent the experimental group, where the scores are calculated for each subject in the pre and post intervention states and the mean scores are calculated (Dimitrov & Rumrill, 2003).

To control the results obtained and make sure it is due to the intervention applied in the current study, a control group is introduced as well. Therefore, another group of 20 students were selected in each subject of EPIRB and SART to represent a control group. This group was not exposed to the intervention, which means that the group was introduced for the same exam twice without being exposed to the proposed iMET prototype application. The scores are calculated for each subject in the pre and post states and the mean scores are calculated just as what happens with the experimental group (Dimitrov & Rumrill, 2003).

The difference between the mean scores of both groups; before and after the experiment was tested using pair wise and independent samples t-tests applied on SPSS version 22. The independent samples t-test is used to test the difference between the two groups; experimental and control (Dimitrov & Rumrill, 2003). So, it will be used twice, one time to test the difference between the experimental and the control groups in the pre intervention state, and another time to test the difference between the experimental and the control groups in the post intervention state.

In addition, the pair wise t-test is used as it tests the scores of the same group before and after the experiment of the application intervention, which means that this test will be used to test if there is a significant difference between the same group before and after the intervention. Thus, it will be applied twice, one time for the group which will be exposed to the intervention, named as "Experimental Group", and another time for the group which won't be exposed to the intervention, named "Control Group".

The researcher will start displaying the results obtained from the independent samples t-test in tables 6-23 and 6-24 and then display the results obtained from the pair wise t-test in tables 6-25 and 6-26. The tables 6-23 and 6-24 of the independent samples t-test will show if there is a difference between the experimental and control groups in each state of the pre and post interventions. If the P-value is less than 0.05, then there is a significant difference between the two groups and vice versa.

Table 6-23 shows the results obtained from the independent samples t-test of the difference between the experimental and the control groups in the pre intervention state. It could be observed that the p-value is 0.636, which is greater than 0.05. This means that there is insignificant difference between the two groups; experimental and control groups in the pre intervention state, or, in other words, the results showed that the two groups are equivalent in their levels of perception before applying any intervention in the application (Dimitrov & Rumrill, 2003).

Table 6- 23: Independent Samples T-test for the Experimental and Control Group in the Pre-Intervention State

	Mean	Mean Difference	T	P-value
Experimental	65.875	1.00000	0.477	.636
Control	66.875			

Table 6-24 shows the results obtained from the independent samples t-test of the difference between the experimental and the control groups in the post intervention state. It could be observed that the p-value is 0.000, which is less than 0.05.

Thus, it could be claimed that there is a significant difference between the two groups; experimental and control groups in the post intervention state, which means that the two groups differ from each other in scores after applying the intervention presented in the current research.

Also, observing the mean scores of the two groups; experimental and control group, it could be noticed that the mean score of the experimental group is equal to 83.625, while the mean score of the control group is equal to 68.625. This leads to the result that the mean score of the experimental group is significantly higher than the mean score of the control group. Thus, the researcher could conclude that the mean scores had been improved and increased due to the intervention of the application of the current study.

Table 6- 24: Independent Samples T-test for the Experimental and Control Group in the Post-Intervention State

	Mean	Mean Difference	T	P-value
Experimental	83.625	15.0000	6.687	.000
Control	68.625			

After that, the researcher would like to examine the difference between pre and post states in each group using the pair-wise t-test. Table 6-25 shows the results obtained from the pair wise t-test of the difference between the pre and post intervention states of the experimental group. It was found that the corresponding p-value is equal to 0.000, which is less than 0.05.

This means that there is a significant difference in the experimental group results of the quiz before and after the intervention (P-value = 0.000 < 0.05). Thus, it was clear that there is a significant impact that happens due to the intervention of the application introduced in the current research.

In addition, it could be observed from table 6-25 that the mean score of the experimental group was 65.875 in the pre intervention state, while the mean score of the experimental group was 83.625 in the post intervention state. This result leads to the claim that the mean score of the experimental group is significantly higher in case of the post intervention state than the pre intervention state. These values show an increase in the overall scores of the quiz after the intervention of the application, showing an improvement that is referred to the application.

Table 6- 25: Pair wise T-test for the Pre and Post Intervention of Experimental Group

	Mean	Mean Difference	T	P-value
Pre	65.875	17.75000	5.451	.000
Post	83.625			

Table 6-26 shows the results obtained from the pair wise t-test of the difference between the pre and post intervention states of the control group. It was found that the corresponding p-value is equal to 0.439, which is greater than 0.05. This means that there is an insignificant difference in the control group results of the quiz before and after the intervention (P-value = 0. 439 > 0.05). Therefore, despite the fact that the control group was exposed to the same exam twice but their results do not really significantly differ between the two times.

Table 6- 26: Pairwise T-test for the Pre and Post Intervention of Control Group

	Mean	Mean Difference	T	P-value
Pre	66.875	1.75000	0.778	.439
Post	68.625			

Thus, the result supports the significant impact of the intervention introduced in the current research, as the control group showed an insignificant difference by time, while the experimental group showed a significant difference due to the intervention presented.

Finally, a graph will be presented showing the scores obtained by the experimental group in the pre and post interventions states. The following figure 6-6 represents the scores achieved by each person in the experimental group, where the first upper line shows the scores in the post intervention state, while the second lower line shows the scores in the pre-intervention state. It could be easily noticed that the overall scores were higher after the intervention of the application, while all the scores were lower in the pre-intervention state. Thus, this graph display the same results obtained above and prove the claim that that the intervention of the application shows better overall results in all the scores of the observations under study.

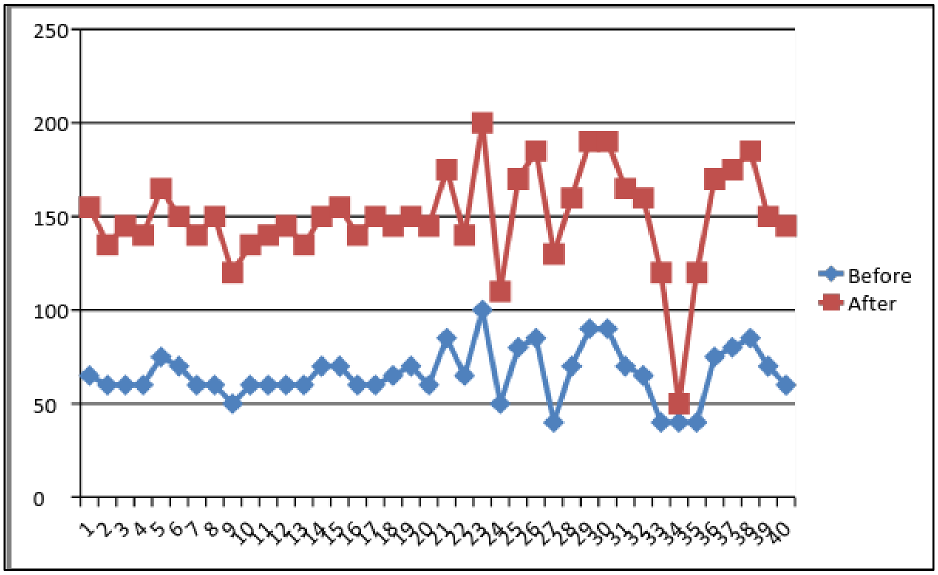


Figure 6- 6: Overall Scores for the Pre and Post Interventions

6.4 Summary

In this chapter, the researcher has two main goals; the first one is discussing and analysing results and findings for the stage of the Post-Intervention part of the technological application introduced in the current study after the prototype being used by the cadets on-board. In order to measure cadets' perception towards the technological tool acceptance in addition to its fulfilment to their training tasks, while the second goal of this chapter is measuring the improvement between pre-intervention analysis outcomes and the post-intervention ones through comparisons, in order to measure the improvement that will be referred to iMET prototype usage.

The first goal of this chapter will be achieved by a descriptive analysis of the questionnaire findings that had been conducted after developing iMET prototype to 106 cadets, representing the cadets population on-board the training ship, the descriptive analysis outcomes were encouraging as 93.4% of the responds agreeing about the anticipated perceived usefulness of the proposed iMET technological tool, while 94.3% of the responds agreeing about the anticipated perceived ease of use of the proposed iMET technological tool, as a training tool provided with educational materials 85.8% of the responds agreeing about the anticipated perceived resources of the proposed iMET technological tool.

Concerning predicting cadets' attitude and behaviour towards using iMET, 97.2% of the responds agreeing about the anticipated perceived attitude towards the proposed iMET technological tool, while 99.1% of the responds agreeing about the anticipated behavioural intention towards actual using of the proposed iMET technological tool. Previous figures showed a rise in cadets' perception percentage towards iMET after being introduced to iMET application prototype and using it.

After examining the data's reliability and validity a Pearson correlation test was analysed to evaluate the relationship between two variables, there is a significant positive moderate relationship between behavioural Intention and each of perceived usefulness, perceived ease of use, perceived resources, and Attitude towards using technology.

The rise measured in Pearson correlation outcomes in this chapter comparing to chapter 5 outcomes can be justified as in the pre-intervention phase cadets did not use the application so they could not estimate accurately its usage and how friendly is the application, while in chapter 6 outcomes were based on cadets' feedback after actual usage of iMET application prototype.

A test of hypothesis with the aid of regression analysis had been conducted to predict the impact of each independent variable, Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude towards using technology showed a significant impact for each of these independent variables on the dependent variable Behavioural Intention for Actual System Usage.

The second goal of this chapter introduced a multiple regression analysis for pre and post in order to predict the overall impact of independent variables instead of testing the single impact of each independent variable on the dependent one.

In the pre-intervention phase the overall model was found significant, were a significant impact was found in perceived resources variable and attitude towards using iMET, while an insignificant impact was detected in perceived usefulness variable and ease of use variable. According to 28.9% R-Squared calculations, means that predictors who are iMET perceived usefulness, iMET perceived ease of use, iMET perceived resources, and attitude towards using iMET explains about 29% of behavioural intention towards actual usage of iMET, where sorting factors according to its importance with respect to dependent variable as follows: attitude towards using iMET variable will be the most important variable followed by perceived resources variable, then perceived usefulness variable and least one is perceived ease of use variable.

In the post-intervention phase the overall model was found significant, were a significant impact was found in perceived resources variable, attitude towards using iMET variable, perceived usefulness variable and ease of use variable.

According to 41% R-Squared calculations, means that predictors who are iMET perceived usefulness, iMET perceived ease of use, iMET perceived resources, and attitude towards using iMET explains about 29% of behavioural intention towards actual usage of iMET, where sorting factors according to its importance with respect to dependent variable as follows: perceived resources variable will be the most important variable followed by attitude towards using iMET variable, then perceived usefulness variable and least one is perceived ease of use variable.

Overall results show that post Intervention model showed better findings than Pre-Intervention model and higher contribution in Behaviour Intention towards actual usage of iMET and that is referred to the intervention of the application prototype and cadets' feedback were based on their actual usage of the iMET prototype.

This chapter presented testing regression assumptions in the used two models (pre and post intervention models) to verify that the regression analysis can be applied in the two models as data normally distributed, relationships are linear, no autocorrelation to avoid biasness in the model and no multicollinearity.

In order to detect if any improvement took place due to cadets' direct usage to the iMET application a means comparison between pre and post interventions models using t-test was conducted as its results proved a significant improvement in all research variables from pre-intervention model to post-intervention model values outcomes, as mean value of all research variables in the post-intervention model are greater than the corresponding ones in the pre-intervention model.

A quiz had been applied before and after the intervention of the application in two training topics, which are; EPIRB and SART, the quiz was conducted to randomly selected 2 groups each consists of 20 cadets for two times, once before using iMET and another time after using iMET during a training trip through which cadets are using iMET in the bridge during their watch.

The difference of time between the two quizzes was 2 sailing days, after analysing the difference between the two quizzes scores with the aid of pair wise t-test, a significant improvement was resulted as pre iMET usage mean score was 65.875 while the post iMET usage mean score was 83.625 and that improvement was referred to iMET application prototype.

The next chapter will discuss the research outcomes, recommendations, and limitations, in addition to the proposals for further work.

CHAPTER SEVEN

Results and Discussion

7.1 Introduction

This chapter presents a detailed discussion of the results and finding obtained from the empirical study of the current research after conducting the required surveys using a mixed research based approach of quantitative and qualitative tools. Quantitative approach was applied using a questionnaire design, while the qualitative tool was applied using a semi-structured interview. Surveys were directed to a number of 106 maritime stakeholders represented in marine cadets, ship owners/operators and Maritime instructors/ faculty members, while semi structured interview that had been conducted to a total of 26 maritime professional, consists of 18 maritime educations and training professional and 8 experts from the maritime industry in addition to the power point presentation and discussion with the IMO secretary general.

Therefore, this chapter will provide an explanation of research outputs achieved through both mentioned tools towards the application of the iMET tool in enhancing the training process on-board. A model validation will be introduced for the model used to prove the importance of the iMET tool taking in consideration that the model used for measuring the maritime stakeholder's acceptance towards technology had been adapted from Motivation and Acceptance Model (MAM) and Perceived Resources and Technology Acceptance Model (PRATAM).

Also, an evaluation had been presented for the extent to which the iMET tool has a direct positive impact on the on-board maritime and training process, through measuring the maritime stakeholders' perception and expectations. Afterwards, a discussion will be introduced for validating the iMET prototype application by comparing the results obtained of the pre and post intervention studies done through surveys to the cadets on-board the training ship to measure their Technology Acceptance and their Intention towards actual usage of iMET application as a training tool.

In addition, a conclusion will be observed out of the discussion to support or contradict with previous studies done in the same field. This will help the researcher to suggest recommendations regarding the current research as well as recommendations for future work or further studies. Finally, the research limitations will presented at the end of the chapter.

7.2 Discussion

This research idea was initiated by the researcher during his work as a lecturer on-board the training ship, where the researcher observed at that time that some cadets did not acquire the targeted knowledge, nor skills due to their different methods of acquiring and processing information, also due to the rough weather that causes motion sickness to some cadets, which is reflected negatively on their ability to learn and practice, especially that these cadets had never been on-board a ship, so it is a new environment for them, so cadets efforts to adapt with this new environment sometimes distract them from gaining all the knowledge and skills

The researcher at that time started to develop an application based on RFID, through which the cadet can do a self-study tour on-board the ship, during that time it had been observed by the researcher that the training on-board is not as quality controlled in details in comparison with college classrooms education, so the concept of Maritime Education and Training (MET) has to maintain the balance between Education and Training, in order to fill the gap between academic education and practical training, as Maritime Education in the College was fully details oriented, monitored and controlled, while the Maritime Training is mainly conducted on-board ships was not details oriented, quality controlled and monitored as much as the Maritime Education.

Due to the development in technology, the researcher started to develop the new application iMET, which is based on NFC connectivity rather than RFID, as NFC readers are available in most handheld devices and is getting more popular recently, where through iMET it is intended to achieve a quality controlled, details oriented and monitored system for on-board training, in order to balance the Maritime Training wing and the Maritime Education wing, to derive a balanced Maritime Education and Training scheme. Finally an iMET prototype application had been developed in order to be used by cadets and lecturers on-board the training ship in their handheld devices, where iMET will provide cadets with a self-regulated on-board training, which fits their different learning styles as described in chapter 4.

The main aim of the current research is to explore and identify the degree of iMET tool impact on the maritime education and training process on-board training ship. This aim had been developed as it had been clear that implementing a new technology is an important and crucial phase when introducing a generic technology application.

Therefore, proper identification of the end users' expectations and implications during the implementation process from different aspects could have a major impact on achievement of the new technology tool objectives. Moreover, it had been observed that professional acceptance to use technology is an important issue, as many commonly used theories and models predicting the end users' perception and behaviour towards actually using a new technology.

Accordingly, iMET application had been developed by the researcher as a generic technological intervention tool to assist the cadets' on-board training, where a prototype had been adopted to assess the application of the iMET technology acceptance, and expectations of marine cadets' on-board training ship and stakeholders, whom are interested in developing quality seagoing personnel through conducting a survey prior to developing the iMET tool.

To achieve the research main aim and provide an evidence of the positive strong impact of the iMET tool application on the maritime education and training process, the researcher passed through several stages as a proof of the concept.

First of all, the theoretical approaches of technology acceptance models had been examined and traced through the literature review. Second, a model had been identified with the research variables under study and tested using several statistical tools in the pre and post phases of the iMET application intervention installation.

Regarding the statistical tools used the researcher first tests for the validity and the reliability of the items identified for each research variable. Then, a descriptive analysis using frequency tables and correlation analysis had been introduced. Moreover, a regression model had been fitted to evaluate the significance of the research variables impact as criteria for measuring the significance of the iMET application pre and post the intervention. Finally, a comparison had been conducted between the pre and post phases to measure the difference between the two phases using a t-test. The following sections will provide a detailed discussion of the results found in each of the mentioned stages.

7.2.1 Model Validation and Data Testing

For the model validation, TAM models had been reviewed, the researcher had selected Siegel (2008) Motivation and Acceptance Model (MAM), in addition to Mathieson, Peacock, & Chin, (2001) Perceived Resources And Technology Acceptance Model (PRATAM), in order to adapted research model from MAM and PRATAM models. Accordingly, the researcher was able to define the research variables, through which the evaluation of the iMET tool technology acceptance could be examined, which are; Perceived Usefulness, Perceived Ease of Use, Perceived Resources, Perceived Attitudes and Behavioural Intention towards iMET actual usage. The first four variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources, and Perceived Attitudes were considered as the independent variables, while the latter one is a dependent variable; adapted models included those mentioned variables in their models.

After determining the research variables under study, the semi structured interview and questionnaire statements were designed, and a pilot phase was done where 5 maritime experts reviewed them, accordingly the statements were modified as per their amendments and comments. Regarding the questionnaire, the validity and reliability tests had been conducted to validate the statements used for the assigned research variables.

The validation was done for both phases of pre and post iMET intervention, where it was found that some statements should be deleted due to their weak loadings, which might negatively affect the research outputs.

For example, regarding the pre intervention phase, the third and fifth items of Perceived Usefulness (U3 and U5) were excluded due to their loadings of 0.212 and 0.145 respectively. Also, the first and fifth items of Perceived Ease of Use (E1 and E5) were excluded due to their loadings of 0.324 and 0.261 respectively. In addition, the second and third items of Perceived Resources (R2 and R3) were excluded due to their loadings of 0.115 and 0.217 respectively. In the same way, the third and fifth items of Perceived Usefulness (U3 and U5), first and fifth items of Perceived Ease of Use (E1 and E5), and second and third items of Perceived Resources were excluded due to their weak loadings for the post intervention phase.

After the validity analysis of the research variables, the Cronbach's alpha was computed for the remaining items after those excluded due to weak loadings, for the purpose of reliability testing. The values computed for Cronbach's alpha were shown to exceed 0.5, which means an acceptable level of data reliability, without the need of excluding other items for any of the variables under study.

According to the above mentioned stages, the research model was validated theoretically and practically. The model was validated theoretically as the researcher used the research variables claimed in previous studies, while it was validated practically as the data collected from the questionnaire was tested for its validity and reliability.

7.2.2 Descriptive Analysis Results

The descriptive analysis includes the frequency tables as well as the correlation analysis. For the frequency tables, it had been presented for both the semi structured interview and the questionnaire, while the correlation analysis had been performed for the questionnaire only.

Regarding the semi structured interview frequencies; it had been observed that the 26 interviewed personnel agreed that the proposed technological tool is easy for usage and flexible. Moreover, they stated that the main advantage that it is a single point where theory meets demonstration in the real workplace and it will stop the spoon feeding teaching.

Mainly highlighted that the application will generally be a guide to the lecturer/ trainer with a detailed personalised follow up process and for the cadets it will enhance their sense of responsibility, moreover will give them the chance to explore themselves especially that cadets nowadays are more oriented to technology and handheld applications.

On the other hand the interviewed personnel raised some concerns concerning the assessment and examination process as there is room for cheating by cadets by answering to each other hence the assessment process reliability will be questioned, accordingly they recommended that official assessments should be carried out on computers in a classrooms under supervision of the lecturers and trainers on-board. Also they had concerns if the lecturers/ trainers would be able to utilise the application properly to extract the maximum benefit of it especially that the system will need continuous upgrade and development. Finally, they highlighted that the proposed technological tool might be suitable for hazardous areas such as engine room and open deck of dangerous cargoes ships.

As for the questionnaire and after excluding the items with weak loadings of each variable under study; the assigned variables were computed according to the acceptable levels of data testing for reliability and validity analysis. The research variables were computed after excluding the items with weak loadings. As a first step of the analysis, a descriptive analysis had been introduced to present the frequency tables of the assigned variables for the pre and post phases. It was found that relatively larger percentages had been shown in the agreement zones than those percentages shown in the disagreement zones.

For example, for the pre intervention phase, a percentage of around 28% of the cadets under study strongly agree regarding the iMET Perceived Usefulness in the maritime education and training process and approximately 49% of the cadets agree regarding the iMET Perceived Usefulness, while only 3.8% of the cadets strongly disagree and around 19% were uncertain regarding the Perceived Usefulness. Considering iMET Perceived Ease of Use, a percentage of around 43% of the cadets under study strongly agree and a percentage of around 38% agree, while only around 19% of the cadets under study were uncertain regarding the Perceived Ease of Use currently present in the maritime education and training process. In the same way, around 70% were in the agreement zone while only 5.7% were in the disagreement zone and the remaining percentages were uncertain. Moreover, around 92% were in the agreement zone while others were uncertain regarding the Perceived Attitude and Behavioural Intention to use iMET in the maritime education and training process.

Considering the post intervention phase, where questionnaire had been conducted after iMET prototype had been installed and used by cadets, it was found that relatively larger percentages had been shown in the agreement zones than those percentages shown in the disagreement zones. For example, for the post iMET intervention phase, a percentage of around 30% of the cadets under study strongly agree regarding the iMET Perceived Usefulness in the maritime education and training process after introducing the iMET application, and approximately 63% of the cadets agree regarding the Perceived Usefulness present after the iMET application intervention, while only 6.6% of the cadets were uncertain regarding the Perceived Usefulness.

Considering Perceived Ease of Use, a percentage of around 50% of the cadets under study strongly agree and a percentage of around 44% agree, while only 5.7% of the cadets under study were uncertain regarding the Perceived Ease of Use present in the maritime education and training process after the iMET application intervention. In the same way, around 85% were in the agreement zone while only 14% were uncertain. Moreover, around 97% and 99% were in the agreement zone while other were uncertain regarding the Perceived Attitude and Behavioural Intention of iMET usage in the maritime education and training process.

Moreover, it was found that the percentages of cadets in the agreement zone of the post iMET intervention phase are greater than those of the pre intervention phase of the current research. This is clear when observing the fact that the disagreement zone had been disappeared in the post intervention phase, as well as comparing the percentages of the agreement zones of each variable in the pre intervention versus the post intervention phases.

As an example, the percentage of the cadets in the agreement zone of the pre intervention phase were 77% for the Perceived Usefulness, while the percentage of the cadets in the agreement zone of the post intervention phase were 93%.

Also, percentage of cadets in the agreement zone of the pre intervention phase were 81% for the Perceived Ease of Use, while the percentage of the cadets in the agreement zone of the post intervention phase were 94%. In the same way, the percentage of cadets in the agreement zone of the pre intervention phase were 70% for the Perceived Resources, while the percentage of cadets in the agreement zone of the post intervention phase were 85%. Moreover, the percentage of cadets in the agreement zone of the pre intervention phase were 92% for Perceived Attitude, while the percentage of cadets in the agreement zone of the post intervention phase were 97%. Finally, the percentage of cadets in the agreement zone of the pre intervention phase were 92% for Behavioural Intention, while the percentage of cadets in the agreement zone of the post intervention phase were 99%.

Regarding the correlation analysis that was carried out for the pre and post intervention phases of the iMET application, it is considered by some studies as a descriptive analysis, while other studies consider it as an analysis used for the purpose of hypotheses testing. In all cases, the correlation analysis was conducted here to figure out the relationship between research variables in the pre and post intervention phases. Thus, considering the pre intervention phase of the iMET application, it was found that there is a positive significant moderate relationship between Perceived Resources and Behavioural Intention, with a coefficient of 0.365 (Correlation Coefficient > 0.3, P-value < 0.05). Also, there is a significant moderate relationship between Perceived Attitude and Behavioural Intention, with correlation coefficient of 0.507 (Correlation Coefficient > 0.3, P-value < 0.05).

On the other hand, it was observed that there is a positive significant but weak relationship between Perceived Usefulness and Behavioural Intention, with a correlation coefficient of 0.282 (Correlation Coefficient < 0.3, P-value < 0.05). Finally, it was noticed that there is an insignificant relationship between Perceived Ease of Use and Behavioural Intention, with a correlation coefficient of 0.185 (P-value > 0.05).

Considering the post intervention phase of the iMET application, it was found that there is a positive significant moderate relationship between Behavioural Intention and all other research variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude with correlation coefficients of 0.465, 0.375, 0.471 and 0.436 respectively. Therefore, it could be claimed that the relationships between Behavioural Intention and the research variables are shown to be significantly stronger in case of the Post Intervention phase of the iMET application than the Pre Intervention phase.

7.2.3 Hypotheses Testing Results for the Pre Intervention Phase

Testing the hypotheses under study, the simple regression analysis had been used to fit a model for the pre intervention phase of the iMET application. Considering the Behavioural Intention as the dependent variable and the research variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude as the independent variables, it had been found that there is a positive significant impact of Perceived Usefulness, Perceived Resources and Perceived Attitude on Behavioural Intention, with regression coefficients of 0.225, 0.272, and 0.568 respectively.

Also, comparing the R-squared value, the relative importance of the dependent variables could be ranked as follows; Perceived Attitudes is the most important variable to Behavioural Intention with an R-squared of 0.257, Perceived Resources is the second in importance with an R-squared of 0.133, Perceived Usefulness is the third in importance with an R-squared of 0.080, while Perceived Ease of Use is the least important variable in importance with an R-squared of 0.034.

7.2.4 Hypotheses Testing Results for the Post Intervention Phase

For the purpose of testing the hypotheses under study for the post intervention phase, the simple regression analysis had been used to fit a model for the post intervention phase of the iMET application. Considering the Behavioural Intention as the dependent variable and the research variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude as the independent variables, it had been found that there is a positive significant impact of all the research variables under study, which are: Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude on Behavioural Intention, with regression coefficients of 0.000, 0.007, 0.000 and 0.000 respectively.

Also, comparing the R-squared value, the relative importance of the dependent variables could be ranked as follows; Perceived Resources is the most important variable to Behavioural Intention with an R-squared of 0.222, Perceived Usefulness is the second in importance with an R-squared of 0.216, Perceived Attitude is the third in importance with an R-squared of 0.190, while Perceived Ease of Use is the least important variable in importance with an R-squared of 0.140. Observing the values of R-squared in the post intervention phase of the iMET application compared to the pre intervention phase, it could be noticed that the overall importance of the research variables had been improved with some extent after the intervention of the iMET application.

7.2.5 Hypotheses Testing Results for Comparing the Pre and Post Intervention Phases

Comparing the pre and post intervention of the iMET application had been performed on several stages. First of all, a multiple regression analysis had been conducted for the pre and post phases so that two models had been fitted; one for each phase.

For the pre intervention phase, it was found that there is a significant positive impact of Perceived Resources and Perceived Attitude on Behaviour Intention, as P-value are 0.048 and 0.000 respectively (P-value < 0.05).

On the other hand, there is an insignificant impact of Perceived Usefulness and Perceived Ease of Use on behaviour intention, as P-value are 0.171 and 0.818 respectively (P-value > 0.05). Moreover, the overall R-squared value was found to be 28.9%. Therefore, the Pre-Intervention model could be stated as follows:

*Behaviour Intention = 1.991 – 0.131*Usefulness +0.017*Perceived Ease of Use*

*+0.161*Perceived Resources + 0.560*Perceived Attitude*

For the post intervention phase, it was found that there is a significant positive impact of all the research variables; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Attitude on Behaviour Intention, as P-values are 0.016, 0.038, 0.001 and 0.006 respectively (P-value < 0.05). Moreover, the overall R-squared value was found to be 41%, which means that the importance of the post intervention model of the iMET application is better than that of the pre intervention with a difference of 11.1%. Thus, the overall Post Intervention Model succeeded in expressing and explaining a greater percentage in Behaviour Intention than the Pre-Intervention model, which means a better result and contribution of the iMET application intervention in the Behaviour intention. Therefore, the Pre-Intervention model could be stated as follows:

*Behaviour Intention = 2.020+ 0.157*Usefulness +0.119*Perceived Ease of Use*

*+0.195*Perceived Resources + 0.165*Perceived Attitude*

So, the number of variables which contribute in the explanation of Behaviour Intention was found to be only two variables; which are Perceived Attitude and Perceived Resources in the Pre-Intervention model. On the other hand, all the four variables under study; Perceived Usefulness, Perceived Ease of Use, Perceived Resources and Perceived Attitude contribute in explaining the variation in Behaviour Intention for the Post Intervention model. The overall results show that the Post Intervention model shows better findings than the Pre-Intervention model and higher contribution in Behaviour Intention and referred to the intervention of the application.

After applying the multiple regression analysis, the researcher went for further analysis using the pair wise t-test to compare the research variables outcomes in the pre intervention phase with those in the post intervention phase of the iMET application. It had been shown that there is a significant difference between the two phases in all the research variables considered under study. This was due to the fact that the P-value in comparing the Perceived usefulness of pre and post intervention phases was 0.001. P-value in comparing the Perceived Ease of Use of pre and post intervention phases was 0.019. P-value in comparing the Perceived Resources of pre and post intervention phases was 0.000. P-value in comparing the Perceived Attitude of pre and post intervention phases was 0.001, and finally, the P-value in comparing the Behavioural Intention of pre and post intervention phases was 0.000.

It was also found that the mean scores of the research variables were higher in case of the post intervention phase than those of the pre intervention phase. For example, mean perceived usefulness for the pre-intervention is 4.0189, while the mean perceived usefulness for the post intervention increases to be equal to 4.3208. In addition, the mean perceived Ease of Use for the pre-intervention is 4.2453, while the mean perceived Ease of Use for the post intervention increases to be equal to 4.4623. Besides, the mean perceived Resources for the pre-intervention is 3.9245, while the mean perceived resources for the post intervention increases to be equal to 4.3868.

A third and final tool of comparing the pre and post intervention phases of the iMET application was comparing the mean scores of a quiz conducted for 40 cadets, divided into two equal groups; first group used the iMET application, while the second group did not use the application at all. The comparison was handled using a pair wise t-test for the pre and post intervention tests as well as the independent samples t-test for comparing the two groups in both phases.

The output showed that there is a significant difference between the experimental group before and after the intervention of the iMET application. Also, it had been shown that there is a significant difference between the experimental and the control group after the intervention of the iMET application despite the fact that there was insignificant difference between the two groups before the iMET application intervention.

This means that the result supports the significant impact of the intervention introduced in the current research, as the control group showed an insignificant difference by time, while the experimental group showed a significant difference due to the intervention presented.

Main themes driven from the semi structure interview, which had been conducted to marine lecturers, ship operators and ship owners, the 26 interviewed personnel agreed on iMET proposed technological tool is easy for usage, and they accepted iMET technology as an assistant tool for on-board training, that will enhance and improve MET on-board training, in a way that will cope with the current generations in a flexible way, moreover, they found iMET will save lecturers and instructors extra effort and will maintain a good standard.

Furthermore, they found iMET personalised context that will be used on cadets' personal mobiles and tablets will be more likely to be used as a training tool, hence will upgrade cadets knowledge and will help cadets to mix theory with practice, in addition to getting the cadets familiar with manuals on-board, enhance maritime English and good guide for cadets to go through OOW duties on-board, as answers for questions will be at the spot at any time, also they found iMET very good as cadets can pass by each item multiple times.

Ship operators and owners stated that iMET is a useful tool on board merchant fleet as it can solve technical issues concerning maintain a continues upgrade for officers, iMET was seen as an excellent mechanism also for covering rules and procedures of inspection and surveying training except for hazardous areas.

Therefore, Maritime Education and Training (MET) on-board training methodologies have been impacted by iMET and becoming more adaptive to cope with current rapid technological advances. New technologies became essential tools for human skills development by using informatics MET systems.

Reference to the IMO STCW convention requirements, MET are subject to important updates regarding the development in computer technology. New concepts in maritime training have been shifted from knowledge-based to competency-based orientation in the development of shipboard personnel. The STCW Code requires that all seafarers should be properly qualified for the position that they hold on board.

Ship managers have to adopt industry standards in respect of the recruitment and training of seafarers; and to ensure that they receive the training necessary for operation and/or maintenance of technically complex and multidiscipline systems on-board ships.

Also, instructors, supervisors and assessors are required to be 'appropriately qualified.' Of equal importance, is the need for maritime college lecturers to be properly qualified to teach those competencies for which they are employed to teach, and to have an up to date appreciation of modern day ship operations and of the new technology on-board ships. On-the-job training is the most effective part of the training system for developing the competency needed on-board ships.

The main problem in the on-board training was the lack of supervision and cooperation with the students'/cadets' learning on-board ships by the ships' officers, shipping companies, and training institutes. Alternative and supported IT based methods are highly required to improve and ease the processes of MET on-the-job training. The iMET system proposed in this study achieved the users' positive attitude and behavioural intention towards using it, and is designed to improve and ease the MET on-board training

The requirements for achieving a quality seafarers, is by keep him/ her with updated knowledge and skills, because of the advancement of navigational technology, development of maritime administration systems and higher standards in maritime safety, security and marine environment protection.

Quality seafarers refer to those with good experiences on-board, excellence in seamanship, computer operations, English language, ship management, interpersonal communication, professional virtues and commitment, etc.

7.3 Results

This study has established a novel technology enhanced method to conduct the on-board training for maritime cadets, during their training on-board a training ship. Hence, cadets will be able to learn while they are doing their training tasks, through developing a generic iMET application for mobile devices.

Hence, added to the literature regarding Maritime Education and Training on-board training, also to students/ cadets' perception towards using their handheld smart devices in the on-board training. Moreover, this research is introducing a new concept to the MET on-board training.

After reviewing the literature, this research had proposed a technological intervention with a holistic learning style, that was inspired by FSLSM and cope with VARK and Kolb's experiential theory, due to iMET's resources richness in different types and formats in order to match student/ cadet learning preference, it is claimed that iMET might be able to cope with the majority of learning modes, due to its presence in the real workplace, in a direct interaction between students/ cadets and the items being trained on, after retrieving the item's educational resources automatically, once a specific item is touched by the handheld device.

This research had proven its main hypothesis, that iMET tool has a direct positive impact on the Maritime Education and Training on-board the training ship, the current research had reviewed the literature from different aspects which is MET, learning theories, learning models, personalised learning, online learning and mobile learning.

Moreover, this research had considered demands and expectations of cadets, marine lecturers, ship operators and ship owners, in order to derive a meaningful iMET personalised technological training tool for on-board training.

Impact of iMET had been assessed and validated, as cadets and other maritime stakeholders such as ship operators, ship owners and IMO secretary general, were found accepting iMET as a technological tool that will assist on-board training process.

Moreover, cadets and rest of maritime stakeholders found iMET has a positive perceived usefulness, ease of use, and educational resources richness, in regard of cadets' attitude towards using iMET and their behavioural intention towards using it, it was found positive.

Concerning research hypothesis, the following results were driven from chapter 6, which implies the acceptance of the five research hypotheses:

H_1: There is a positive relationship between iMET perceived usefulness and the behavioural intention towards iMET actual usage by cadets

H_2: There is a positive relationship between iMET perceived ease of use and the behavioural intention towards iMET actual usage by cadets

H_3: There is a positive relationship between iMET perceived resources and the behavioural intention towards iMET actual usage by cadets

H_4: There is a positive relationship between iMET perceived attitude towards using it and the behavioural intention towards iMET actual usage by cadets

H_5: There is a significant change in research dimensions (perceived usefulness, perceived ease of use, perceived resources, attitude towards using iMET and behavioural intention towards iMET actual usage) between the pre iMET implementation as discussed in chapter 4 and the post iMET implementation as discussed in chapter 6, as well as per the discussion presented in the previous sections of the current chapter.

This research had found that MET learning and training experience on-board the training ship can be enhanced by the proposed technological intervention in this study, in spite of the increasing number of students/ cadets being trained on-board, as iMET is introducing the training process within a personalised manner.

Moreover, extra method had been conducted to assess and validate iMET positive impact, by examining cadets using iMET versus cadets using conventional training method; it was found that cadets using iMET had obtained slightly better marks in their quiz, than cadets using the conventional method of training.

iMET had maintained the three main pillars of sustainability which are social impact, environmental impact and economic impact, which means that implementing iMET will be a sustainable process. Accordingly, iMET is able to be a facilitator of on-going innovation in MET for achieving its continues development and sustainability

Finally, as the data collection for this research was conducted mainly on-board the Arab Academy training ship, while the semi-structured interview had been conducted to all the faculty staff on-board the training ship and is extended to a sample of faculty staff of the Arab Academy headquarter, a decision had been made and a budget had been approved by the Arab Academy management in order to implement iMET application on-board the training ship AIDA IV, as iMET was recognised by the Arab Academy management as a new idea that will add value to the training process on-board.

CHAPTER EIGHT

Conclusion and Recommendations

8.1 Conclusion

Literature relevant to enhancing maritime education and training (MET), personalised learning and e-learning was the main themes have impact on the research objectives. Maritime education and training literature review extended to cover Standardisation systems in MET, European Union (EU) Harmonisation of MET schemes, MET new concepts and on-board training.

Personalised learning literature review extended to cover main learning theories and styles, in order to give more understanding to the proper methods of delivering a personalised learning that adapt each student/cadet learning preferences.

While online learning literature review extended to cover concepts of self-regulated learning and Adaptive Education Hypermedia Systems (AEHS), to be able to deliver a personalised learning/training in a technological context. Moreover, discussions concerning the Technology Enhanced Learning (TEL) via Mobile have been highlighted.

Maritime Education and Training (MET) literatures combined theory and practice, educating knowledge and training skills to produce a competent quality seafarer. The research emphasise on the need of a quality seafarer in the context of globalisation in shipping industry.

MET is standardised globally through the STCW IMO International Convention 1978 (as amended). STCW convention was subject to several amendments, were in 2010 was the last comprehensive review and amendment.

Unfortunately, STCW 2010 did not include requirements for online learning or technology enhanced learning method, except simulator as tool for training areas limited to navigation, communications and cargo handling.

The outcome of this research has proven that the proposed iMET technological intervention in this study is going to add value to training on-board the training ship, and will integrate with the present MET process as an enhancement for STCW convention efficiency, iMET as an additional learning tool will be able to value learning opportunity as much as learning experience, hence on-board training recession will be strengthened by iMET on-board ships in any area of navigation worldwide.

Literature concerning the technology development on-board and its compact on teaching methods conclude that the Use of simulator is high cost training solution and does not cover all required training aspects in a shipboard reality, practical aspects (as seaman ship training, deck work, shipboard maintenance, safety systems management, inspection routine training) and equipment familiarisation training. Moreover, skills like enhancing maritime English language and enhancing management proficiency are not available in simulators training.

Personalised learning/training as it is found through reviewing literature, it is an important and effective method to adapt educational materials for individual needs including mentoring programs in a self-regulated manner. Confusion in the literature about elements to include in personalised learning is detected. Literatures of detailed different learning styles are reviewed to identify required elements for personalised learning and to achieve an individually adapted learning.

Learning styles and methods of measuring individual learning style definitions, arguments and critique are addressed. Despite clear implications of learning styles in education and its absence in the field of MET on-board training, but it had been found through reviewing literature that adopting learning styles will reflect in a positive way to make learning easier, hence will increase learning efficiency.

Reviewing the literature shows the lack of any previous studies about applying learning styles in the MET practical training process in the Maritime academies and universities. This research is an intervention that tackles part of the challenges and introduces new interactive TEL approach which contributes to develop the seagoing calibre.

Reference to the literature findings, a holistic model had been developed in the developed iMET application prototype, inspired by Felder-Silverman learning style model (FSLSM) and is coping with Kolb’s and VARK. Relevant aspects of learning styles are integrated in the proposed technological tool and prototype had been developed as described in chapter 5.

In order to avoid the different concepts of many researches that discussed the learning styles’ multifaceted subjects, there are important questions still unanswered and related issues are under debate. Arguments in literature reviewed concerning learning style stability and the importance of measuring individual learning style accuracy and reliability are respected.

The proposed iMET technological tool, due to its rich educational resources that fits different learning styles, is able to match with the majority of learning styles and models, such as Felder-Silverman learning style model (FSLSM), Kolb’s experiential theory and VARK, whom are very popular learning models and widely common used, as discussed in chapter 2, as iMET’s competitive edge of being used in the real workplace.

Reviewed literatures of online learning indicate that there are many terminologies and definitions were found for online learning that reflects diversity of practice and technologies associated with online learning.

Online learning definition in this research is “an approach to personalised adaptive handheld TEL solution in a self-regulated method within a virtual learning environment on-board a training ship”, with the intention to get it online in further studies.

The perspective of reviewing online learning literatures is to develop a learner centred e-learning program for maritime education and training in a technology based environment.

Literature reviewed concerning online learning definition found supporting technology enhanced self-regulated learning, as an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate and control their cognition, motivation and behaviour, guided and constrained by their goals and the contextual features in their environments.

Moreover, concerning adaptivity, literature review shows that researchers concerning developing online learning relation to Adaptive Education Hypermedia System (AEHS) are centred on learning styles based personalisation. Moreover, after reviewing types of Technology Enhanced Learning (TEL) which is available in different learning situations, the proposed technological intervention in this research will provide an Asynchronous learning and in other situations a synchronous learning, but it gives the student additional time for reflection, collaboration and interaction with instructors.

As this research proposes a new generic intervention to enhance on-board maritime education and training by using iMET application through handheld devices, which is smart mobiles or tablets, mobile learning literatures are also reviewed.

Mobile learning found in literatures as an accepted tool in education in a flexible way as it can be used anytime and anywhere. Also, the increased availability of mobiles makes the students more comfortable and confident when using their own mobiles in the education, rather than using a borrowed or the institution ones, which is the same method that had been adopted by this research.

In addition to using iMET on personally owned mobile devices will support students to adapt the education materials into their learning style and pace. Findings of literature reviewed reflect that technology is deeply rooted in the environment and this research aligns with institutional trends of utilising technology and supporting its usage.

The iMET technology tool designed to support cadets combine theory with practice on-board through introducing knowledge and training skills related to his future job on-board which is the most important part of MET.

Therefore, the results and findings of the current research proved several points towards the positive impact of the iMET application intervention. First of all, it had been shown that the iMET application intervention is a cause of driving and facilitating more meaningful MET technology, based personalised learning.

Also, the intervention of the iMET application provided by tools based on triangulation, for measuring the cadets' requirements and perception of the proposed iMET tool as a training tool for deck cadets during the on-board training. Moreover, measuring the Maritime faculty members/ instructors, and ship owners/ operators requirements and perception of the proposed iMET tool as a training tool for deck cadets during the on board training, in addition to the secretary general of the IMO.

Assessing and validating of the impact of iMET tool on the on-board training for marine cadets was carried out by measuring their perception towards iMET technology acceptance in order to estimate their behavioural intention towards the iMET application actual use. Moreover, developing and justifying a generic automated one on one Maritime Education and Training (MET) to enhance the quality of the training process all over the different aspects on board the training ship

Accordingly, the researcher was able to answer the research questions to find a significant difference in the training process in favour of introducing the iMET application, which means greater ability of meeting the key stakeholders' requirements and expectations using the iMET application.

Also, the significant difference found in the perceived resources between the pre and post intervention phases of the iMET application, which means that the portable iMET tool educational resources are fulfilling students/ cadets different training topics. Besides, the perceived usefulness, perceived ease of use, perceived resources, resources richness and attitude towards using of the iMET tool stakeholders have positive effect on the actual usage of the system, represented in the behavioural intention. Thus, in general, the iMET tool had a positive impact on enhancing students/ cadets' knowledge after using it.

Overall results show that post intervention model showed better findings than pre-intervention model, and higher contribution in behavioural intention towards actual usage of iMET, and that is referred to the intervention of the application prototype and based on cadets' actual usage of the developed iMET prototype.

8.2 Significant Findings of the Study

The researcher developed a technological intervention, a generic prototype of iMET application as a proof of concept, that had been applied to Emergency Position Indicating Radio Beacon (EPIRB) and Search and Rescue Transponder (SART) training topics, where the training content as per the training ship of the Arab Academy had been included in the developed iMET prototype, in addition to further additions based on the conducted surveys feedback, which is received from the maritime stakeholders.

This research is considered the first that is aiming to develop and enhance MET on-board training, in a TEL personalised manner, through students/ cadets smart mobiles/ tablets, with respect to users' different learning preferences. In order to, enhance students learning while they are doing their training tasks on-board the ship in an active learning/ training process.

Which had been carried out by the adoption of mixing the quantitative analysis supplemented with a qualitative one through triangulation, by measuring the perception of the main three stakeholders of the maritime industry affiliated with seagoing careers represented in cadets as the iMET users, ship operators/ owners as the cadets' employer after graduation in addition to maritime education and training professionals as the cadets' instructors.

Moreover, assessing cadets score before and after using iMET. Furthermore, initial cost analysis for developing full version of iMET application and installing it on-board the training ship had been conducted in order to prove iMET cost effectiveness and sustainability.

This study discovered a positive potential of utilising handheld devices provided with iMET application in on-board maritime training. The findings in this study provide confidence for both academic staff and industry professionals, to utilise handheld devices in training on-board the training ship in a personalised context in addition to cadets' acceptance to actually use it as a training tool. This study also shows that handheld devices provided with iMET application have the potential to promote the deck cadets knowledge gain.

This research finds that there is a positive effect of using handheld smart mobiles on cadets/ students' learning of Maritime English, and on their general acquisition of knowledge. Understanding maritime stakeholders' perception concerning on-board training conditions, experiences, expectations and requirements has had a broad impact on the research in order to develop iMET application prototype accordingly.

Both pre and post iMET surveys analysis outcomes in this study illustrated that cadets achieved better score results in the two tested training topics as discussed in chapters 5 and 6. Generally, maritime stakeholders' perception reflections on using iMET application for training activities on-board were positive.

Prospects of iMET Intervention, in on-board training can be summarised particularly, in the context of maritime education and training sector, as a ground that can bring several attractive benefits for maritime training as with the continual advances in TEL, from a perspective of a software-based maritime training and education (referred to as iMET in this research), is offering a cost-effective and flexible alternative to traditional face-to-face learning, with the aid of a rich multimedia format within an interactive personalised learning experience, using a variety of learning styles preferences, iMET offers a range of benefits as there are the immediate cost-effective gains of applying iMET in terms of cost-effective savings, in terms of course materials, training booklets, handouts, and stationary, in addition to its low initial cost as explained in chapter 5.

In addition to an increased training effectiveness as discussed in chapter 6 and reducing cost by blending the traditional training with iMET. Therefore, iMET is clearly the better alternative for on-board training. Once developed the iMET application, it can be used many times with minimal delivery costs especially that iMET application does not require being connected to internet. In addition to, its inexpensive opportunities, as students will use their own mobiles or tablets.

iMET will enable cadets/ students to learn at their own pace, repeating parts of the training as necessary, to ensure effective learning and training can be undertaken during or outside normal working hours with consistent training ensured. Moreover, different training pathways to the same content can deliver the flexibility to cover in-depth personalised training.

Training content can be updated frequently with minimal effort, in order to apply the new knowledge or processes to maintain an updated on the job training, also this research had proven slightly improved scores on tests after using iMET application prototype during the practical on-board training.

Competence assessments can readily be built into check learning progress, whether voluntary or mandatory in nature, which can be used to unlock subsequent content to follow up each cadet's progress. In addition to competence record keeping can be automated. Finally implementing iMET application may gradually eliminate the need for paper, thus saving trees.

8.3 Recommendations for Further Studies

After completing this quantitative analysis supplemented with qualitative analysis study on maritime stakeholders acceptance of iMET application, as a tool for on-board maritime training, this research has identified areas of potential improvement and future research.

First, it was clear that in the quantitative section of the study, marine/ deck cadets were most likely to use iMET application in their training activities on-board the training ship. When asked to respond to the iMET questionnaire, maritime professionals in the semi structured interview part of the study gave an overwhelming response about their usage of technology on the personal level and in their training classes.

To understand better perception of iMET application, a future study should focus on other various iMET applications in different fields of Maritime Education and Training, than training deck cadet on-board a training ship, also should focus in the area affiliated to e-learning adaptivity enhancements, in order to fit different learning preferences.

Additionally, expanding the pool of qualitative participants would have allowed for more insight into the iMET application, along with additional reasons for maritime stakeholders acceptance.

Further research will be needed to cover the raised concerns by the interviewed professionals in this research, one of their main concerns was controlling the cheating that might take place during the training process by iMET, and during assessment, as cadets may solve each other's assessments, accordingly adopting a face recognition feature can be studied in further researches as solution or any other tool that can be able to control users.

Moreover, enhancing iMET application to familiarize cadets with users manuals may be incorporated with iMET solution in a standalone sector, while linking it to the relevant training topics. Moreover, further study will be needed to structure the flow of cadets on-board over the training items, in order to be able to manage the number of cadets over a single training item at the same time.

Although, the proposed iMET application had considered the interviewed professionals feedback, regarding adding tabs, that contains inspection and surveying information, further study will be needed to set a comprehensive detailed educational materials, for rules of inspection, port state control surveys and safety management applications.

Furthermore, as per industry interviewed professionals, that iMET is an added value for familiarisation and continues training on-board the merchant fleet, in addition to, planned maintenance system routine that is carried out on-board different types of ships, so further studies regarding adding a specialised tabs to the application, for specialised cargo ships, such as oil tankers, gas carriers, car carriers,…etc.

Finally, in order to maintain a quality technology guided operations on-board, as driven from the quantitative analysis feedback from the interviewed professionals in chapter 5, further studies are needed to enhance the proposed iMET for developing cadets' soft skills.

This research is the first mixed-method study implemented using mobile based TEL in the proposed iMET interactive application for on-board training. To construct the study, the researcher adapted iMET TAM, driven from PRATAM and MAM models to investigate iMET application technology acceptance.

Although PRATAM and MAM models did provide a solid theoretical base for concluding the individuals’ technology acceptance, additional elements, such as an investigation into the personality traits of teachers who use iMET application may add breadth to technology acceptance research, that is not currently present in this research. Moreover, Future research could look at assessing iMET application acceptance using a different variant of the TAM to compare with the results of this study.

This study also uncovered a potential that may exist between maritime faculty members’ perceptions of cadets’ ability to use educational iMET application. Results from this study suggest that when teachers believe students’ ability is limited, they are more likely to use technology. Maritime faculty member’s perception of students’ ability might be driven from several factors including first-hand experience with cadets, teacher self-efficacy or other factors not investigated in this study. Future studies focused on these previously uncovered elements would provide more information on the possible role it plays in acceptance.

This study did not recognize the expectancy of iMET application to become less important over time. As facilitating conditions might, also, become less important to acceptance as it becomes more available. A study on the effect of facilitating conditions causing potential diminishing effect on iMET application acceptance, will be needed, however, future studies focused on this aspect would provide more information on iMET application stability.

Future studies should focus on the role of social influence may provide insights on the social influence element that might affect cadets’ acceptance of iMET application. Accordingly, an updated version of iMET can be developed with more social activities, in order to enhance interaction between cadets.

From a technical perspective, future improvements will be needed to the application features, in order to support face recognition, to identify the user to make sure that the device owner is the one who is using the application, in order to prevent cheating by users, iMET application further development for integration with the academy exiting systems, in order to make the system online through synchronizing periodically with the main central database located overseas in the main campus of AASTMT, whenever the internet is available, as this out of the developed prototype scope, also developing iMET application to be able to run over (IOS) for NFC enabled iPhone users, as the developed prototype in this research as a proof of concept had been developed for Android smart mobiles only.

Moreover, a special safety case for the handheld device might be needed, in order to be able to use it in hazardous areas on-board the ship. Furthermore, due to the new concepts and updates of technology, further studies needed to incorporate mixed reality smart glasses and augmented reality with iMET application, in order to achieve a better tool for education and training. Regarding the adaptivity with student/ cadet learning preferences, it is needed in further studies to be implemented via advanced machine learning, as an application of the artificial intelligence, which provides systems the ability to automatically learn from experience, without being programmed.

iMET as an existing validated system, can be enhanced in further versions, to be able to replace the guided sea training book that is used on-board the training ship in Egypt, and can replace Merchant Navy Training Board (MNTB), which is responsible for setting and approving the training frameworks for new entrants into the merchant navy. It will be required to approve iMET by IMO, and in reference to the discussion with the IMO secretary general concerning the proposed iMET application, it is recommended to amend STCW convention, to be able to accommodate the proposed application and/or any similar ones in the MET process globally.

Moreover, further studies are needed to adapt iMET application in the engine room and machinery space, furthermore in different training fields other than the training ship on-board training, where iMET can be implemented in merchant ships, offshore units, marine engine workshops, meteorology labs, and seamanship labs. As implementing it on-board merchant fleets in order to assist seafarers familiarisation with the ship, also can support continues training on-board. In addition to linking iMET with internet, in order to be a fully online system for facilitating the system’s updating’s and to enhance its interactivity and discussions among students/ seafarers.

8.4 Research Limitations

There are several limitations that represent some challenges to the current research despite the fact that the current study provided significant implications to the literature. One of these limitations is the sample size of the cadets under study for both, the qualitative and quantitative tools used for the purpose of data collection.

The available number of participants, on-board the training ship, who took part in this study's quantitative analysis was n = 106, and for the supplementary qualitative part, only 26 maritime professionals took part, in addition to the IMO secretary general. Therefore, making generalisations based on this sample is limited and the researcher tried to overcome this issue by validating data normality.

Another limitation for the current study is that the overall R-squared for the post intervention model is only 41%, which means that the total explained variance in behavioural intention of the cadets by the research variables considered in the current study is only 41%. This means that there are other variables that might be included in the study to show better explanation of the variation in Behavioural Intention.

In addition, a limitation that needs to be discussed for future studies to overcome is that the current study depends in its sample on students from the Arab Academy for Science, Technology and Maritime Transport during their on-board training semester which had an environment of extensive experience in practical training applications. The nature of the experiences by the cadets in this situation may have an impact on the results of the study. The study encompassed cadets in the fifth semester on-board the training ship. The area of research is on-board a special ship that had been constructed for training marine cadets only, so this special environment may have an influence on the results of the study.

Moreover, the experience of the teachers working with student technology in their classrooms is a limitation for the current study. The maritime faculty members and ship operators engaging in the semi structured interview in this particular setting have had a considerable amount of training experience working with students and integrating technology into their lesson plans and daily training use in a computer based training setting. The nature of technological training experience by the maritime faculty members may have had an impact on the results of the study due to the ways in which the technology was utilised via a personalised handheld training.

To address the trust issue, participants were guaranteed anonymity and confidentiality throughout the questionnaire and interview process. Ethical assurances were implemented to protect participants' rights, the researcher, and the university. Ethical consideration during this study included obtaining the required approval from Liverpool John Moores University, obtaining participants' informed consent, and maintaining honesty throughout the research process.

As this research involved a quantitative analysis supplemented by a qualitative one, the qualitative supplementary in this study involving survey results of the semi structured interview data is fraught with limitations. Additionally, narrative data and reliable participation was addressed. Survey data driven from the semi structured interview cannot measure a specific population absolutely, but does provide an approximation of the targeted group.

Researcher bias is always a consideration and limitation in research. To reduce researcher bias, a semi interview script (see Appendix B) was used throughout the semi-structured interview process. Each semi-structured interview carried out was signed by the interviewed person.

The relationship bias was a limitation during the semi-structured interview process. Given the researcher's role as a maritime faculty member in the Arab Academy for Science, Technology and Maritime Transport, relationship bias was a limitation. To address this, a research assistant was employed to interview the maritime faculty participants as there was a significant working relationship between the researcher and interview participant.

REFERENCES

Ahson, S. A. & Ilyas, M. eds., 2011. *Near field communications handbook.* 1st ed. New York: Taylor & Francis.

Aiken, L. S. & West, S. G., 1991. *Multiple Regression: Testing and interpreting interactions.* California: Sage Publications.

Ajzen, I., 1991. The theory of planned behaviour. *Organisational Behaviour and Human Decision Processes,* 50(2), pp. 179-211.

Ajzen, I., Heilbroner, R. L., Fishbein, M. & Thurow, L. C., 1980. *Understanding Attitudes and Predicting Social Behaviour.* s.l.:Prentice Hall PTR.

Akkoyunlu, B. & Soylu, M. Y., 2008. A Study of Student ' s Perceptions in a Blended Learning Environment Based on Different Learning Styles. *Educational Technology & Society,* 11(1), p. 183–193.

Alcalay, R. & Bell, R., 2000. *Promoting nutrition and physical activity through social marketing: current practices and recommendations.* Davis: Center for Advanced Studies in Nutrition and Social Marketing, University of California.

Allinson, C. W. & Hayes, J., 1996. The Cognitive Style Index: A Measure of Intuition-Analysis For Organisational Research. *Journal of Management studies,* 33(1), pp. 119-135.

Ally, M., 2004. Foundations of educational theory for online learning. *Theory and practice of online learning,* pp. 3-32.

Alop, A., 2004. *Education and Training or Training contra Education?.* St. Petersburg, Admiral Makarov State Maritime Academy, pp. 5-12.

Baker, C. C. & Seah, A. K., 2004. Maritime Accidents and Human Performance. *MARTECH 2004.*

Bandura, A., 1977. Self efficacy: towards a unifying theory of behavioural change. *Psychological Review,* 84(2), pp. 191-215.

Bandura, A., 2001. Social cognitive theory: An agentic perspective. *Annual Review of Psychology,* 52(1), pp. 1-26.

Baran, E., Correia, . A.-P. & Thompson, A., 2011. Transforming online teaching practice: Critical analysis of the literature on the roles and competencies of online teachers.. *Distance Education,* 32(3), pp. 421-439.

Barsan, E., Hanzu-Pazara, R. & Arsenie, P., 2007. New Navigation Competencies Required For an Updated STCW Convention. *Journal of Maritime Studies,* 21(2), pp. 151-161.

Barth, M. & Rieckmann, M., 2012. Academic staff development as a catalyst for curriculum change towards education for sustainable development: an output perspective. *Journal of Cleaner Production,* Volume 26, pp. 28-36.

Basham, J. D. & Marino, M. T., 2013. Understanding STEM education and supporting students through universal design for learning. *Teaching Exceptional Children,* 45(4), pp. 8-15.

Beer, J. & Meethan, K., 2007. 'Marine and maritime sector skills shortages in the South West of England: developing regional training provision, Journal of Vocational Education & Training. *Journal of Vocational Education & Traning,* 59(4), pp. 467-484.

Biggs, J., 1979. Individual Differences in Study Processes and the Quality of Learning Outcomes. *Higher Education,* 8(4), pp. 381-394.

BIMCO/ISF, 2010. *Manpower 2010 Update: The Worldwide Demand for and Supply of Seafarers.* [Online]
Available at:
http://www.dieselduck.info/library/10%20hr/2012%20BIMCO%20ISF%20Manpower%20Study.pdf [Accessed December 2015].

Box, G. E., Jenkins, G. M., Reinsel, G. C. & Ljung, G. M., 2015. *Time series analysis: forecasting and control. John Wiley & Sons, 2015..* 5th ed. s.l.:John Wiley & Sons.

Bray, B. & McClaskey, K., 2013. A step-by-step guide to personalize learning. Learning & Leading with Technology. *Learning & Leading with Technology,* 40(7), pp. 12-19.

Brown, E., Stewart, C. & Brailsford, T., 2006. *Adapting for visual and verbal learning styles in AEH.* Kerkrade, IEEE.

Brusilovsky, P., 1996. Methods and Techniques of Adaptive Hypermedia. *User Modeling and User Adapted Interaction,* 6(2-3), pp. 87-129..

Brusilovsky, P., 2003. Developing adaptive educational hypermedia systems: From design models to authoring tools. *Authoring Tools for Advanced Technology Learning Environments,* pp. 377-409.

Bryant, D., 2014. Expectations of student learning quality: An introductory study. *Australian Universities' Review,* 56(1), pp. 32-38.

Canada, T., 2008. *Simulated Electronic Navigation Courses.* [Online]
Available at: https://www.tc.gc.ca/media/documents/marinesafety/tp4958e.pdf
[Accessed August 2013].

Carson, L., 2012. *An Exploration of Metacognition and its Interplay with other forms of Conscious through Processing in Independent Learning at Tertiary Level. Ph.D.,* s.l.: Dublin City University.

Carver, C. A., Howard, R. A. & Lane, W. D., 1999. Enhancing student learning through hypermedia courseware and incorporation of student learning styles. *IEEE Transactions on Education,* pp. 33-38.

Cheney, P. H. & Dickson, G. W., 1982. Organisational characteristics and information systems: An exploratory investigation. *Academy of Management,* 25(1), pp. 170-184.

Childress, S. & Benson, S., 2014. Personalised Learning for Every Student Every Day. *Phi Delta Kappan,* pp. 33-38.

Chismar, W. G. & Wiley-Patton, S., 2002. *University of Central Florida.* s.l., National Center for Biotechnology Information, pp. 155-159.

Clark , S., 2014. *Two in three phones to come with NFC in 2018.* [Online]
Available at: https://www.nfcworld.com/2014/02/12/327790/two-three-phones-come-nfc-2018/

Coffield, F., Moseley, D., Hall, E. & Ecclestone, K., 2004a. *Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review.* UK: Learning and Skills Research Centre.

Coffield, F., Moseley, D., Hall, E. & Ecclestone, K., 2004b. *Should We Be Using Learning Styles? What Research Has to Say to Practice.* UK: Learning and Skills Research Centre.

Cole, C. & Trenkner, P., 2010. *Tightening the communicative provision within MET Institutions.* s.l., Shanghai Maritime University, pp. 120-131.

Collis, J. & Hussey, R., 2014. *'Business Research: A Practical Guide for Undergraduates and Postgraduates Students.* 4th ed. s.l.:Palgrave.

Creswell, J. W., 1994. *Research design: qualitative & quantitative approaches.* London: Sage Publications.

Creswell, J. W., 2014. *Research design: Qualitative and Quantitative approach.* 4th ed. California: Sage.

Creswell, J. W. & Plano Clark, V. L., 2011. *Designing and Conducting Mixed Methods Research.* London: SAGE Publications.

Cristol, D. & Gimbert, B., 2013. *Academic Achievement in BYOD Classrooms.* Qatar, College of the North Atlantic.

Croxton, R. A., 2014. The role of interactivity in student satisfaction and persistence in online learning. *Journal Of Online Learning & Teaching,* 10(2), pp. 314-324.

Curry, L., 1983. *An Organisation of Learning Style Theory and Constructs.,* s.l.: American Educational Research Association.

Dabbagh, N., 2007. The online learner: Characteristics and pedagogical implications. *Contemporary Issues in Technology and Teacher Education*, 7(3), pp. 217-226.

Dağa, F. & Geçerb, A., 2009. . Relations between online learning and learning styles. *Procedia - Social and Behavioural Sciences,* 1(1), p. 862–871.

Dahlstrom, E. & Jacqueline, B., 2014. *ECAR Study of Undergraduate Students and Information Technology, 2014,* Louisville: EDUCAUSE Center for Analysis and Research.

Davis, F. D., 1986. *A technology acceptance model for empirically testing new end-user information systems: theory and results,* Boston, MA.: Massachusetts Institute of Technology.

Davis, F. D., 1993. User acceptance of information technology: system characteristics, user perceptions and behavioural impacts. *International Journal of Man-Machine Studies,* 38(3), pp. 475-487.

Davis, F. D., Bagozzi, R. P. & Warshaw, P. R., 1989. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Managment Science,* pp. 982-1003.

Davis, I. K., 1977. *The Management of Learning.* Maidenhood, Berkshire: Mc Grow – Hill, Book Company Limited..

De Waard, I. I., 2014. Using BYOD, apps, sensors, mobile social media for meaningful mLearning. In: M. Ally & A. Tsinakos, eds. *Mobile learning development for flexible learning.* Vancouver: Commonwealth of Learning and Athabasca University, pp. 113-124.

Dewey, J., 1938. *Experience and education.* s.l.:Simon & Schuster.

Dimitrov, D. M. & Rumrill, J. P. D., 2003. *Pretest-posttest designs and measurement of change.* [Online] Available at: https://www.ncbi.nlm.nih.gov/pubmed/12671209 [Accessed December 2015].

Dochy, F., Segers , M., den Bossche, P. V. & Gijbels, D., 2003. Effects of problem-based learning: a metaanalysis. *Learning and Instruction,* 13(5), p. 533–568.

Doğru, M. & Kalender, S., 2007. Applying the Subject "Cell" Through Constructivist Approach during Science Lessons and the Teacher's View. *International Journal of Environmental and Science Education,* 2(1), pp. 3-13.

Doyle, W. & Rutherford, B., 1984. Classroom Research on Matching Learning and Teaching Styles. *Theory into Practice,* 23(1), pp. 20-25.

Draper, S., 1996. Observing, Measuring, or Evaluating Courseware: A Conceptual Introduction. In: *Implementing Learning Technology, Learning Technology Dissemination Initiative.* s.l.:s.n., pp. 58-65.

Dunn, R. & Dunn, K., 1974. Learning Style as a Criterion for Placement in Alternative Programs. *Phi Delta Kappan,* 56(4), pp. 275-278.

Dunn, R. & Griggs, S., 2003. *Synthesis of the Dunn and Dunn learning styles model research: who, what, when, where and so what–the Dunn and Dunn learning styles model and its theoretical cornerstone.* New York: St. John's University.

Eisenberg, N., Fabes, RA., Schaller, M., Miller, P., Carlo, G., Poulin, R., Shea, C.,& Shell R., 1991. Personality and socialization correlates of vicarious emotional responding. *Journal of Personality and Social Psychology,* 61(3), pp. 459-470.

Ellis, S. & Arieli, S., 1999. Predicting Intentions to Report Administrative and Disciplinary Infractions: Applying the Reasoned Action Model. *SAGE Publications,* 52(7), pp. 947-967.

Emad, G. & Oxford, I., 2008. *Schema Theory and Situatedness of Simulator Training.* St. John's, NL, University of Victoria.

Emad, G. R., 2011. *Rethinking adult and vocational education: hauling in from maritime domain,* s.l.: University of Victoria.

EMSA, 2017. *Evaluation on the Implementation of the Regulation (EC) No 1406/2002 Establishing EMSA: Final Report,* s.l.: Ramboll.

Entwistle, N., Hanley, M. & Hounsell, D., 1979. Identifying Distinctive Approaches to Studying. *Higher Education,* 8(4), pp. 365-380.

Entwistle, N. J., 1998. Improving Teaching through Research on Student Learning.. In: J. J. F. Forrest, ed. *University Teaching: International Perspectives.* New York and London: Routledge studies in Higher Education, pp. 73-112.

Entwistle, N. J., 1981. *Styles of Learning and Teaching: Integrated Outline of Educational Psychology for Students, Teachers and Lecturers.* New York: John Wiley & Sons.

Entwistle, N., McCune, V. & Walker, P., 2001. Conceptions, styles and approaches within higher education: Analytical abstractions and everyday experience. In: S. R. J & Z. L-F, eds. *Perspectives on thinking, learning, and cognitive styles.* Mahwah, New Jersey: Lawrence Erlbaum Associates, pp. 103-136.

Farrell, P. & Rogers-stewart, K., 2006. Comprehensive study of tests for normality and symmetry: Extending the Spiegelhalter test. *Journal of Statistical Computation and Simulation,* Volume 76, pp. 803-816.

Felder , R. M., 1996. Matters of Style. *ASEE Prism, 6 (4), 18-23.,* 6(4), pp. 18-23.

Felder, R. M., 1993. Reaching the Second Tier: Learning and Teaching Styles in College Science Education. *Journal of College Science Teaching,* 23(5), pp. 286-290.

Felder, R. M. & Silverman, L. K., 1988. Learning and Teaching Styles in Engineering Education. *Engineering Education,* 78(7), pp. 674-681.

Fishbein, M. A. & Ajzen, I., 1975. *Belief, attitude, intention and behaviour: An introduction to theory and research.* s.l.:Addison-Wesley Pub. Co.

Fleming, N. D. & Mills, C., 1992. Not Another Inventory, Rather a Catalyst for reflection. *To Improve the Academy,* Volume 11.

Ford, N., 1985. Learning Styles and Strategies of Postgraduate Students. *British Journal of Educational Technology,* 16(1), p. 65–77.

Foster, D. H., Nascimento, S. M. C., Amano, K., Arend, L., Linnell, K. J., Nieves, J. L., & Foster, J. S., 2001. Parallel Detection of Violations of Color Constancy. *National Academy of Sciences,* 98(14), pp. 8151-8156.

Foti, M. K. & Mendez, J., 2014. Mobile Learning: How Students Use Mobile Devices to Support Learning. *Journal of Literacy and Technology,* 15(3), pp. 58-78.

Franetovic, M., 2012. *A Higher Education Case: Millennial Experience Towards Learning in a Virtual World Designed as an Authentic Learning Environment,* s.l.: Wayne State University.

Fried, C. B., 2008. In-class laptop use and its effects on student learning. *Computers & Education,* 50(3), p. 906–914.

Gable, G. G., 1991. 'Consultant engagement for computer system selection: A pro-active client role in small businesses. *Information & Management,* 20(2), pp. 83-93.

Garrett, R. & Steinberg, M. P., 2015. Examining teacher effectiveness using classroom observation scores: Evidence from the randomization of teachers to students. *Educational Evaluation And Policy Analysis,* 37(2), pp. 224-242.

Garson, D. G., 2015. *Structural Equation Modeling.* 5th ed. Asheboro: Statistical Associates Publishing.

Gekara, V., 2009. Understanding attrition in UK maritime education and training. *Globalisation, Societies and Education,* 7(2), pp. 217-232.

Georgiou, I., Zahn, C. & Meira, B. J., 2008. A systemic framework for case-based classroom experiential learning. *Systems Research and Behavioural Science,* 25(6), p. 807–819.

Ghazali, D., 2008. Kesahan dan Kebolehpercayaan Dalam Kajian Kuantitatif dan Kualitatif. *Jurnal Institut Perguruan Islam.*

Giroux, H. A., 1981. *Ideology, Culture and The Process of Schooling.* London: Falmer Press.

Graf, S., 2007. *Adaptivity in Learning Management Systems Focussing on Learning Styles,* s.l.: Vienna University of Technology.

Graf, S. & Kinshuk, 2007. *Providing Adaptive Courses in Learning Management Systems with Respect to Learning Styles,* s.l.: Athabasca University.

Graf, S., Kinshuk & Liu, T.-C., 2009. Supporting Teachers in Identifying Students' Learning Styles in Learning Management Systems : An Automatic Student Modelling Approach. *Educational Technology & Society,* 12(4), p. 3–14.

Graf, S., Lin, T. & Kinshuk, 2008. The relationship between learning styles and cognitive traits: Getting additional information for improving student modelling. *Computers in Human Behaviour*, March, 24(2), pp. 122-137.

Graf, S., Viola, S. R., Kinshuk & Leo, T., 2006. *Representative Characteristics of Felder Silverman Learning Styles: An Empirical Model,* s.l.: Austrian Federal Ministry for Education.

Graf, S., Viola, S. R., Leo, T. & Kinshuk, 2007. In-Depth Analysis of the Felder-Silverman Learning Style Dimensions. *Journal of Research on Technology in Education,* 40(1), pp. 79-93.

Grasha, A. F., 1984. Learning Styles: The Journey from Greenwich Observatory (1796) to the College Classroom (1984). *Improving College and University Teaching*, 32(1), pp. 46-53.

Grasha, A. F., 1996. *Teaching with style: A practical guide to enhancing learning by understanding teaching and learning styles.* Pittsburgh, PA: Alliance Publishers.

Gregorc, A. F., 1982a. *An Adult's Guide to Style.* Maynard, MA: Gabriel Systems Inc..

Gregorc, A. F., 1982b. *Gregorc style delineator : development, technical, and administration manual.* Maynard, MA: Gabriel Systems, Inc..

Gregorc, A. F., 1985. *Style Delineator: A Self-Assessment Instrument for Adults.* Columbia: Gregorc Associates Inc..

Gregorc, A. F., 2002. *Frequently Asked Questions on Style.* [Online]
Available at: http://gregorc.com/faq.html [Accessed July 2013].

Haghshenas, M. & Jeddi, K. Y., 2013. Using Mobile Devices to Improve Learning Technologies. *International Journal oF Innovative Technology and Research (IJITR)* , 1(6), pp. 519-523.

Hair, J. F., Black, W. C., Babin, B. J. & Anderson, R. E., 2003. *Multivariate Data Analysis.* NJ, USA: Upper Saddle River.

Hart, C., 2012. Factors associated with student persistence in an online program of study: A review of the literature. *Journal Of Interactive Online Learning,* 11(1), pp. 19-42.

Herrmann, N., 1989. *The Creative Brain.* Lake Lure, North Carolina: The Ned Herrmann Group.

Honey, P. & Mumford, A., 1982. *The Manual of Learning Styles.* Maidenhead: Peter Honey.

Honey, P. & Mumford, A., 1992. *The Manual of Learning Styles.* 3rd ed. Maidenhead: Peter Honey.

Honey, P. & Mumford, A., 2000. *The Learning Styles Helper's Guide.* Maidenhead: Peter Honey.

Honey, P. & Mumford, A., 2006. *The Learning Styles Helper's Guide.* Rev. ed. Maidenhead: Peter Honey.

Hudson, L., 1966. *Contrary Imaginations.* London: Penguin Books.

Igbaria, M. & Livari, J., 1995. The Effects of Self-Efficacy on Computer Usage. *Omega,* 23(6), pp. 587-605.

ILO, 1998. *Shipping Act 1998: Samoa.* [Online] Available at:
http://www.ilo.org/dyn/natlex/docs/ELECTRONIC/102759/124336/F-1435564732/WSM102759.pdf [Accessed August 2017].

IMO, 1948. *Convention on the International Maritime Organisation.* [Online]
Available at:

http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/Convention-on-the-International-Maritime-Organisation.aspx [Accessed August 2013].

IMO, 2010. *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).* [Online]
Available at:
http://www.imo.org/en/About/conventions/listofconventions/pages/international-convention-on-standards-of-training,-certification-and-watchkeeping-for-seafarers-(stcw).aspx [Accessed October 2012].

Iordănoaia, F., 2009. How could an addicted video-game student turn into a marine officer. *Revista Academiei Fortelor Terestre,* 14(1), pp. 27-38.

Ipbuker, C., 2009. *Learning Styles and Teaching Models in Engineering Education.* Istanbul , Proceedings of the 6th WSEAS International Conference on Enineering Education.

Islam, E., 1995. *Technology in Maritime Education & Certification,* s.l.: Maritime Faculty.

ITF, 2017. *STCW: a Guide for Seafarers.* [Online] Available at:
http://www.itfglobal.org/media/1391/stcw_revised_rk-bb_small.pdf [Accessed August 2017].

James, W. B. & Gardner, D. L., 1995. Learning Styles: Implications for Distance Learning. *New Directions for Adult and Continuing Education,* Volume 67, pp. 19-31.

Jonassen, D. H. & Grabowski, B. L., 1993. *Handbook of Individual Differences, Learning, and Instruction.* Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Jones, C., Reichard, C. & Mokhtari, K., 2003. Are students' learning styles discipline specific?. *Community College Journal of Research and Practice*, 27(5), pp. 363-375.

Joughin, G., 1992. Cognitive Style and Adult Learning Principles. *International Journal of Lifelong Education,* 11(1), pp. 3-14.

Jung, C. G., 1964. *Psychological Types, or The Psychology of Individuation.* London: Pantheon Books.

Kanninen, E., 2009. *Learning Styles and E-Learning: Master of Science Thesis,* s.l.: Tempere University of Technology.

Kemp , J. E., Morrison, G. & Ross, S. M., 1998. *Designing Effective Instruction.* 2nd ed. Upper Saddle River, NJ: Prentice Hall.

Khan, S., 2012. *The one world schoolhouse: Education reimagined.* London: Hodder & Stoughton.

Kirschner, P., Sweller, J. & Cla, R. E., 2006. Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching.. *EducationalL Psychologist,* 41(2), pp. 75-86.

Kleinbaum, D., Kupper, L., Nizam, A. & Muller, K., 2008. *Applied Regression Analysis and Other Multivariable Methods.* Belmont: Thamson Higher Education.

Klein, K. . J. & Knight, A. P., 2005. Innovation implementation: Overcoming the challenge. *Current Directions in Psychological Science,* 14(5), pp. 243-246.

Kolb, A. Y. & Kolb, D. A., 2005. The Kolb Learning Style Inventory - Version 3.1, Technical Specification. *Experience Based Learning Systems*.

Kolb, D. A., 1976. *The Learning Style Inventory: Technical Manual.* Boston: McBer & Company.

Kolb, D. A., 1981. *Learning Styles and Disciplinary Differences,* San Francisco: Jossey-Bass.

Kolb, D. A., 1984. *Experiential Learning: Experience as the Source of Learning and Development.,* New Jersey: Prentice-Hall, Englewood Cliffs.

Ku, C.-H., 2009. *Extending the Technology Acceptance Model Using Perceived User resources in Higher Education Web-Based Online Learning Courses,* Orlando, Florida: University of Central Florida.

Kuljis, J. & Liu, F., 2005. A Comparison Of Learning Style Theories On The Suitability For Elearning. *Web Technologies, Applications, And Services,* pp. 191-197.

Lauricella, S. & Kay, R., 2010. Assessing laptop use in higher education classrooms: The laptop effectiveness scale (LES). *Australian Journal of Educational Technology,* 26(2), pp. 151-163.

Laurillard, D., 1979. The processes of student learning. *Higher education,* Volume 8, pp. 395-409.

Lebec, M. & Luft, J., 2007. A mixed methods analysis of learning in online teacher professional development: A case report. *Contemporary Issues in Technology and Teacher Education,* 7(1).

Lee, Y.-C., 2008. The role of perceived resources in online learning adoption. *Computers & Education,* 50(4), pp. 1423-1438.

Lemire, D., 2002. Brief report: What developmental educators should know about learning styles and cognitive styles. *Journal of College Reading and Learning,* 32(2), p. 177–182.

Lewarn, B., 2001. *Maritime Education and Training: the future is now.* Kobe, International Association of Maritime Universities (IAMU), pp. 207-212.

Li, K. M., 2015. Learning styles and perceptions of student teachers of computer-supported collaborative learning strategy using wikis. *Australasian Journal of Educational Technology,* 31(1), pp. 32-50.

Maclean, P., 1952. Some Psychiatric Implications of Physiological Studies on Frontotemporal Portion of Limbic System (Visceral Brain).. *Electroencephalography and Clinical Neurophysiology,* 4(4), pp. 407-418.

Manochehr, N.-N., 2006. The Influence of Learning Styles of Learners in E-Learning Environments: An Empirical Study.. *Cheer,* Volume 18, pp. 10-14.

Manuel, M. E., 2017. Vocational and academic approaches to maritime education and training (MET): Trends, challenges and opportunities',. *WMU, J Maritime Affairs,* Volume 16, pp. 473-483.

MarEdu, 2005. *Safety on Sea.* [Online] Available at: http://www.maredu.co.uk/ [Accessed August 2016].

MariFuture, 2005. *MariFuture.* [Online] Available at: http://www.marifuture.org/Plans.aspx [Accessed May 2017].

MarTEL, 2010. *MarTEL.* [Online] Available at: http://www.plus.martel.pro/The-Project.aspx [Accessed August 2017].

Martin, F., Parker, M. A. & Deale, D. F., 2012. Examining interactivity in synchronous virtual classrooms. *International Review of Research in Open & Distance Learning,* 13(3), pp. 227-261.

Mason, J., 1994. Linking qualitative and quantitative data analysis. In: A. Bryman & R. G. Burgress, eds. *Analysing qualitative data.* London: Routlege, Taylor & Francis group.

Massouleh, N. S., 2012. Learner-Centered Instruction: A Critical Perspective. *Journal of Education and Practice,* 3(6), pp. 50-59.

Mathieson, K., Peacock, E. & Chin, W. W., 2001. Extending the technology acceptance model: the influence of perceived user resources. 32(3), pp. 86-112.

Mazzarino, M. & Maggi, E., 2000. The impact of the new onboard technologies on maritime education and training schemes in Europe: some findings from the 'METHAR' project. *Maritime Policy & Management: The flagship journal of international shipping and port research,* 27(4), pp. 391-400.

McCarter, C. P., 1999. STCW ’95: implementation issues: What is the pass mark?. *Marine Policy,* 23(1), pp. 11-24.

McCoy, B., 2013. Digital distractions in the classroom: Student classroom use of digital devices for non-class related purposes. *Faculty Publications, College of Journalism & Mass Communications,* Volume 71.

McGill, T. & Hobbs, V., 2007. How students and instructors using a virtual learning environment perceive the fit between technology and task. *Journal of Computer Assisted Learning,* 24(3), pp. 191-202.

Merrill, M. D., 2002. Instructional Strategies and Learning Styles: Which Takes Precedence? In R. Reiser & J. Dempsey (Eds.), .. *Trends and Issues in Instructional Technology,* pp. 99-106.

METHAR, 2000. *METHAR: Contract No. WA-96-ca.005,* s.l.: Transport Research and Innovation Monitoring and Information System.

Muirhead, P. M. P., 2004. New technology and maritime training in the 21st century: Implications and solutions for MET institutions. *WMU Journal of Maritime Affairs,* 3(2), p. 139–158.

Mulevu, C. M., 2012. *Investigating Applicability of Near Field Communication Technology in Kenya: A Model for Adopting NCF-Based Mobile Phone Payment Systems,* Madaraka Estate: Strathmore University.

Murphy, A., Farley, H., Lane, M., Hafeez-Baig, A., & Carter, B., 2014. Mobile Learning Anytime, Anywhere: What are our students doing. *Australasian Journal of Information Systems,* 18(3).

Myers, I. B., 1962. *The Myers-Briggs Type Indicator: Manual 1962.* Palo Alto, CA.: Consulting Psychologists Press.

Myers, I. B. & McCaulley, . H., 1985. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator.* Palo Alto, CA.: Consulting Psychologists Press.

Myers, I. B. & McCaulley, . H., 1998. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator.* Palo Alto, CA.: Consulting Psychologists Press.

O’Brien, R. M., 2007. A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity,* 41(5), p. 673–690.

O’Neil, W., 2001. IMO: Globalisation and the role of the seafarer. *IMO News: The Magazine of the International Maritime Oranization*, Issue 3, pp. 4-5.

O’Neil, W. A., 2003. The human element in shipping. *WMU Journal of Maritime Affairs,* 2(2), p. 95–97.

Oates, B. J., 2006. *Researching information systems and computing.* London: SAGE Publications.

Oh, S., Ahn, J. & Kim, B., 2003. Adoption of broadband Internet in Korea: the role of experience in building attitudes. *Journal of Information Technology,* 18(4), pp. 267-280.

Ondrus, J. & Pigneur, Y., 2007. *An assessment of NFC for future mobile payment systems.* Toronto, IEEE.

Onwuegbuzie, A. J. & Leech, N. L., 2005. Taking the “Q” Out of Research: Teaching Research Methodology Courses Without the Divide Between Quantitative and Qualitative Paradigms. *Quality and Quantity,* 39(3), pp. 267-295.

Pan, C.-C., 2003. *System use of WebCT in the light of the technology acceptance model: A student perspective,* Orlando: ProQuest Dissertations Publishing.

Papert, S., 1999. *Diversity in Learning: A Vision for the New Millennium.* [Online] Available at: http://www.papert.org/articles/diversity/DiversityinLearningPart1.html [Accessed January 2018].

Paredes, P. & Rodriguez, P., 2004. A Mixed Approach to Modelling Learning Styles in Adaptive Educational Hypermedia. *Advanced Technology for Learning,* 1(4), pp. 210-215.

Parkay, F. & Hass, G., 2000. *Curriculum planning.* 7 ed. Needham Heights: MA: Allyn & Bacon.

Pask, G., 1972. A fresh look at cognition and the individual. *International Journal of Man-Machine Studies,* 4(3), pp. 211-216.

Pask, G., 1975. *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology.* Amsterdam; New York: Elsevier.

Pask, G., 1976a. *Conversation Theory: Applications in Education and Epistemology.* s.l.:Elsevier.

Pask, G., 1976b. Styles and Strategies of Learning. *British Journal of Educational Psychology,* 46(2), pp. 128-148.

Pask, G. & Scott, B., 1973. Caste: A System for Exhibiting Learning Strategies and Regulating Uncertainties. *International Journal for Man-Machine Studies,* 5(1), pp. 17-40.

Patil, V., Nikhil, V., Vinchurkar, S. & Patil, B., 2014. *NFC based health monitoring and controlling system.* s.l., IEEE, pp. 133-137.

Pintrich, P. R. & De Groot, E. V., 1990. Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology,* 82(1), pp. 33-40.

Piombo, C., Batatia, H. & Ayache, A., 2003. *A framework for Adapting Instruction to Cognitive Learning Styles.* Athens, IEEE.

Popescu, E., 2009. *Addressing Learning Style Criticism: The Unified Learning Style Model Revisited.* Berlin, Heidelberg, Springer, pp. 332-342.

Pourzanjani, M., Schröder, J.-U. & Zade, G., 2002. Maritime education and training (MET) in the European Union: how can maritime administrations support MET. *IAMU Journal*, 2(2), pp. 50-56.

Radner, R. & Rothschild, M., 1975. On the allocation of effort. *Journal of Economic Theory,* 10(3), pp. 358-376.

Rahul, A., G, G. K., H, U. K. & Rao, S., 2015. Near Field Communication (NFC) Technology: A Survey. *International Journal on Cybernetics & Informatics (IJCI) Vol. 4, No. 2, April 2015,* April, 4(2), pp. 133-144.

Ramsden, P. & Entwistle, N. J., 1981. Effects of Academic Departments on Students' Approaches to Studying. *British Journal of Educational Psychology,* 51(3), pp. 368-383.

Raschick, M., Maypole, D. E. & Day, P. A., 1998. Improving field education through Kolbs' learning theory. *Journal of Social Work Education,* 34(1), pp. 31-42.

Remédios, D., Sousa, L., Barata, M. & Osório, L., 2006. NFC Technologies in Mobile Phones and Emerging Applications. *Information Technology For Balanced Manufacturing Systems. IFIP International Federation for Information Processing*, Volume 20, pp. 425-434.

Reynolds, M., 1997. Learning Styles: A Critique. *Management Learning*, 28(2), pp. 115-133.

Richardson, W., 2012. Preparing students to learn without us. Educational Leadership: For Each to Excel. *Educational Leadership,* 69(5), pp. 22-26.

Richmond, A. & Liu, L., 2005. *Students' learning style of traditional courses versus online distance courses.* Phoenix, AZ, USA, Association for the Advancement of Computing in Education (AACE), pp. 576-578.

Riechmann, S. W. & Grasha, A. F., 1974. A Rational Approach to Developing and Assessing the Construct Validity of a Student Learning Style Scales Instrument. *Journal of Psychology: Interdisciplinary and Applied,* 87(2), pp. 213-223.

Ruble, T. & Stout, D., 1993. Learner Styles and End-User Training: An Unwarranted Leap of Faith. *Management Information Systems Quarterly,* March.17(1).

Santos, I. M., 2013. Integrating personal mobile devices in teaching: The impact on student learning and institutional support. *Learning & Teaching in Higher Education: Gulf Perspectives*, 10(2).

Sapsford, R. & Jupp, V., 2006. *Data collection and analysis.* 2nd ed. London: SAGE Publications.

Sarkar, S., 2012. The Role of Information and Communication Technology (ICT) in Higher Education for the 21st Century. *The Science Probe,* 1(1), pp. 30-41.

Saunders, M., Lewis, P. & Thornhill, A., 2009. *Research methods for business students.* 5th ed. Harlow: Pearson Education Limited.

Schröder, J.-U., Pourzanjani, M., Zade, G. & Kaps, H., 2002. The Thematic Network on Maritime Education, Training Mobility of Seafarers (METNET): The Final Outcomes. *4th IAMU General Assembly*.

Schunk, D. H., 2005. Self-regulated learning: The educational legacy of Paul R. Pintrich. *Educational Psychologist,* 40(2), pp. 85-94.

Sekaran, U. & Bougie, R., 2010. *Research Methods for Business: A Skill Building Approach.* 5th ed. NJ: Wiley.

Shicheng, Y., 2009. *Challenges and Opportunities for Maritime Education and Training: China's Perspective.* [Online]
Available at:
http://www.eskema.eu/DownloadFile.aspx?tableName=tblSubjectArticles&field=PDF%20Filename&idField=subjectArticleID&id=67.
[Accessed December 2015].

Siegel, D. M., 2008. *Accepting Technology and Overcoming Resistance to Change Using The Motivation and Acceptance Model*, Orlando, Florida: University of Central Florida.

Simpson, C. & Du, Y., 2004. Effects of learning styles and class participation on students' enjoyment level in distributed learning environments. *Journal of Education for Library and Information Science*, 45(2), pp. 123-136.

Smith, E. & Keating, J., 1997. *Making Sense of Training Reform and Competency-based Training.* Wentworth Falls: Social Science Press.

SOS, 2005. *CFF Maritime Education Division.* [Online] Available at: http://www.c4ff.co.uk/MaritimeEducationDivision.aspx?menu=divisions#SOS [Accessed October 2017].

Sperry, R. W., 1964. *Problems outstanding in the evolution of brain function: James Arthur Lecture on the evolution of the human brain.* New York: American Museum of Natural History.

Sprenger, M., 2010. *Brain-based teaching in the digital age.* Alexandria, VA: ASCD.

Stash, N., Cristea, A. & De Bra, P., 2006. *Adaptation to Learning Styles in ELearning: Approach Evaluation.* Chesapeake, VA, AACE,, s.n., pp. 284-291.

Steffens, K., 2006. Self-Regulated Learning in Technology-Enhanced Learning Environments: lessons of a European peer review. *European Journal of Education,* 41(3-4), pp. 353-379.

Streiner, D., 2003. Starting at the Beginning: An Introduction to Coefficient Alpha and Internal Consistency. *Journal of Personality Assessment,* 80(1), pp. 99-103.

Taylor, S. & Todd, P. A., 1995. Understanding Information Technology Usage: A Test of Competing Models. *Information Systems Research,* 6(2), pp. 144-176.

Terrell, S. R. & Dringus, L., 2000. An investigation of the effect of learning style on student success in an online learning environment. *Journal of Educational Technology Systems,* 28(3), pp. 231-238.

Terry, M., 2001. Translating learning style theory into university teaching practices: An article based on Kolb's experiential learning model. *Journal of College Reading and Learning,* 32(1), pp. 68-65.

Thompson, S. J., Johnstone, C. J. & Thurlow, . M. L., 2002. *Universal design of large scale assessments (Synthesis Rep. No. 44).,* Minneapolis, MN: University of Minnesota.

Traxler, J. & Wishart, J., 2011. *Making mobile learning work: Case studies of practice.* Bristol: ESCalate (HEA Education Subject Centre).

Tyler, S. & Entwistle, N. J., 2003. Approaches to learning and studying inventory: self-score version. In: *The Managers Good Study Guide: An Essential Reference with Key Concepts, Tools and Techniques Explained.* Milton Keynes, U.K.: Open University Worldwide Ltd, pp. 339-352.

UniMET, 2017. *Unification of Marine Education and Training.* [Online]
Available at: www.unimet.pro
[Accessed August 2017].

Van der Heijden, H., 2003. Factors influencing the usage of websites: the case of a generic portal in The Netherlands. *Information & Management,* 40(6), pp. 541-549.

Venkatesh, V. & Davis, F. D., 2000. A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, Volume 46, pp. 186-204.

Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D., 2003. User Acceptance of Information Technology: Towards a Unified View. *MIS Quarterly*, 27(3), pp. 425-478.

Wang, M., Shen, R., Novak, D. & Pan, X., 2009. The impact of mobile learning on students' learning behaviours and performance: report from a large blended classroom. *British Journal of Educational Technology*, 40(4), pp. 673-695.

Warden, C. A., Stanworth, J. O., Ren, J. B. & Warden, A. R., 2013. Synchronous learning best practices: An action research study. *Computers & Education*, Volume 63, pp. 197-207.

Yamagata-Lynch , L. C., 2014. Blending online asynchronous and synchronous learning. *International Review of Research In Open And Distance Learning*, 15(2), pp. 189-212.

Yates, J., 2014. Synchronous online CPD: empirical support for the value of webinars in career settings. *British Journal Of Guidance & Counselling*, 42(3), pp. 245-260..

Yin, R. K., 2014. *Case Study Research Design and Methods.* Thousand Oaks, CA: Sage.

Yoon, S.-U., Joshi, S. & Shim, S.-S., 2014. *A new simple Wi-Fi direct connection method using NFC on remote control and DTV.* s.l., IEEE, pp. 170-175.

Ziarati, R., 2006. *Safety at Sea-Applying Pareto Analysis.* UK., s.n.

Ziarati, R., Demirel, E. & Albayrak, T., 2010. *Innovation in Maritime Education and Training.* Shanghai, ResearchGate.

Ziarati, R., Demirel, E., Lahiry, H. & Ziarati, M., 2011. *Internatıonal Cooperatıon for Marıtıme Educatıon and Traınıng.* s.l., Unification of Marine Education and Training, pp. 381-388.

Zimmerman, B. J., 2002. Becoming a self-regulated learner: An overview. *Theory into Practice*, 41(2), pp. 64-70.

Zimmerman, B. J. & Campillo, M., 2003. Motivating self-regulated problem solvers. In: J. E. Davidson & R. J. Sternberg, eds. *The psychology of problem solving.* New York: Cambridge University Press, pp. 233-262.

Zull, J. E., 2002. *The art of changing the brain: Enriching the practice of teaching by exploring the biology of learning.* Sterling, VA: Stylus Publishing LLC..

APPENDIX

Appendix A

Questionnaire Survey Instrument

Proposed iMET Questionnaire

Impact of the proposed **iMET** on the cadet training

The increased use of advanced IT has made it of important to develop the Maritime Education and Training technologies through using Technology Enhanced Learning (TEL) as a tool to achieve a Virtual Learning Environment (VLE) on-board the training ship AIDA IV.

The research is being carried out on-board the Arab Academy for Science, Technology and Maritime Transport training ship AIDA IV, If you have any other comments or questions, on this questionnaire subjects please contact Capt. Ahmed Youssef, the researcher Tel: +2(0)1223187898, a.m.taha@2011.ljmu.ac.uk , Or Alan Wall, director of study for this research, Tel: +44(0)1512312493, A.D.Wall@ljmu.ac.uk

The allocation of some of your precious time in filling in this questionnaire will add to the accuracy of this research and is intended to contribute to the MET development.

Please answer the questions in respect to the iMET (Interactive Maritime Education and Training) after watching the iMET presentation and movie, a permission from the AASTMT College of Maritime Transport dean and the training ship "AIDA IV" has been obtained to deliver this questionnaire to the cadets on-board AIDA IV, participation in the research will be entirely voluntary and participants' identities will be protected throughout the research process, responses will be kept confidential. Student names are never reported with their responses or with the other information collected. The research will be conducted within the ethical framework as outlined in LJMU Code of Practice for Research.

Your responses will be greatly appreciated.

NOTE: YOUR PERNONAL INFORMATION WILL REMAIN STRICTLY CONFIDENTIAL.

Please return completed questionnaires:

By hand to Ahmed Youssef Taha, Room# 101, College of Maritime Transport and Technology, Arab Academy for Science, Technology and Maritime Transport, P.O.Box 1029 Abu Qir, Alexandria, Egypt.

****I have been provided with information about the purpose of this study and I am happy to participate.*** ☐

Section A: Personal Information

Name (optional)

Nationality:

Country of Residence:

Age:

Gender:

Section B: Educational Background

1. High School: National: □; IGCSE □ ; American Diploma □; Other □
2. High School Score: (50%-60%) □; (60%-70%) □; (70%-80%) □; Over (80%) □
3. English language: Poor □ ;Fair □ ;Good □ ;Very Good □ ;Fluent □
4. Credit hours achieved: (50-60) □; (60-70) □; (70-80) □; Over (80) □
5. G.P.A: (2.0-2.4) □; (2.4-2.8) □; (2.8-3.4) □; Over (3.4) □

Section C: Cadet Technology Acceptance and iMET

- **iMET Perceived usefulness (U):**

U1) Do you think the implementation of iMET tool would be beneficial for training on-board

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

U2) iMET will be an added value for OOW duties training

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

U3) iMET will enhance gaining required practical skills on-board

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

U4) iMET will help understanding theoretical aspect of MET

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

U5) iMET will support putting theoretical knowledge into practical one

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- **iMET Perceived Ease of Use (E)**

E1) Do you think that technology is essential for you

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

E2) Are you a frequent user of mobile applications

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

E3) Are you a frequent user of Marine mobile applications

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

E4) Are you a frequent user of Microsoft office

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

E5) Do you play video games frequently

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- **iMET Perceived resources (R)**

R1) iMET will improve your Lifesaving and Firefighting equipment training

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

R2) iMET will improve your seaman ship training

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

R3) iMET will improve your Engine room familiarisation training

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

R4) iMET will improve your Stability and Cargo calculations training

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

R5) iMET will improve your Safety behaviour on-board

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

R6) iMET will improve your Maritime English

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

R7) iMET will improve your self-reliance, rationality and sense of responsibility

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- **Attitude towards using (A) iMET**

A1) I would be able to use Technology Enhanced Learning on-board AIDA IV

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

A2) Are you willing to use iMET for your as a main training guide

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

A3) Are you willing to increase your usage of Marine educational software’s

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

- **Behavioural Intention to Actual System Use (B) of iMET**

B1) Do you personally intend to use your handheld device for self-tutoring

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

B2) Do you intent to use iMET as training tool on-board AIDA IV

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

B3) Cadets **(your colleagues)** will use the handheld device for self-tutoring on-board AIDA IV

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

Thank you for your time! ☺

Appendix B

Semi Structured Interview Survey Instrument

Section A
Post
Special Studies/ Courses
Section B
Marine background (seatime)
Marine background (type of vessel)
Marine background (rank)
Marine background (company)
Section C
Teaching background
Teaching speciality
Teaching time
Section D
Technology personal usage
Technology usage in MET
Section E

Current training methods	Theoritical	On job training	Simulation	CBT	Theoritical & Practical	Others

Training anticipated outcomes

OOW duties		LSA & FFA		Seamanship		Eng. Familiraization	
Stability & cargo		Safety behavior		Maritime english		Leadership & team	
Practical skills		Theoritical		Others			

Training current outcomes

OOW duties		LSA & FFA		Seamanship		Eng. Familiraization	
Stability & cargo		Safety behavior		Maritime english		Leadership & team	
Practical skills		Theoritical		Others			

Section F
Candidates observed weakness points
Candidates observed strength points
Graduate required knowledge & skills
Opinion about iMET implementation

Preceived usefulness	
Preceived ease of use	
Preceived Resources	
Precieved Intention to use	
Technology Acceptance	
Expectations	
Limitations	

iMET Preception Interview Report

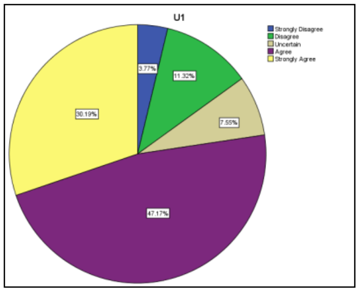
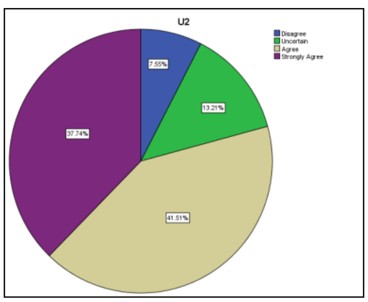
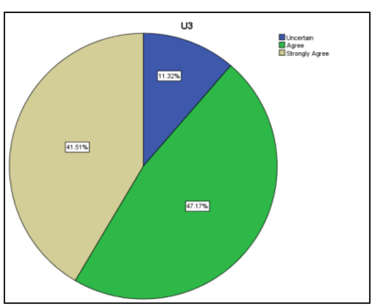
Name:

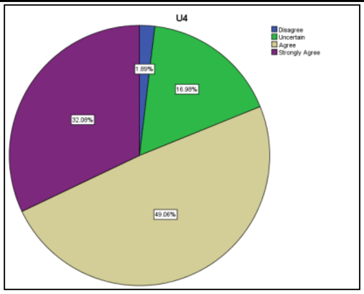
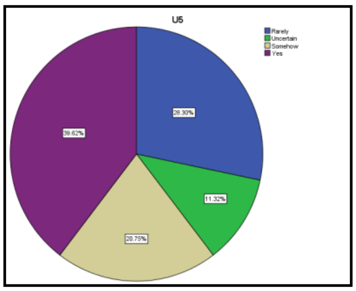
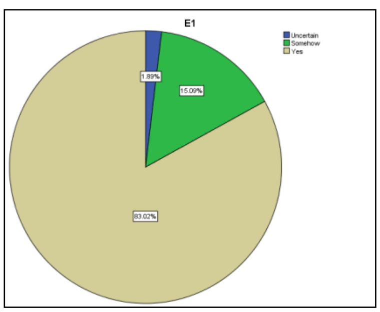
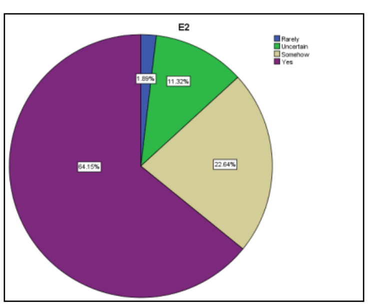
Post:

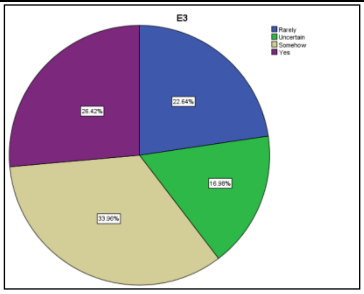
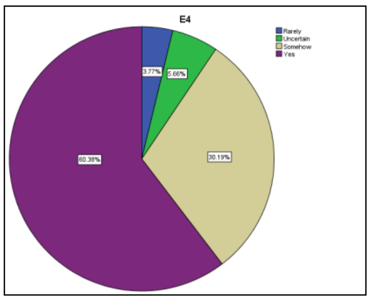
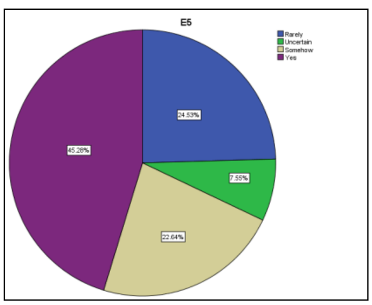
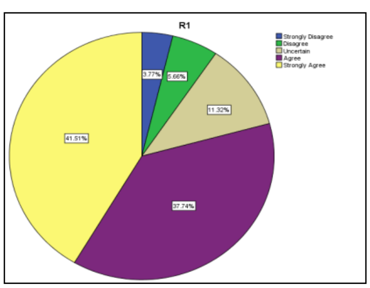
Date :
Location:

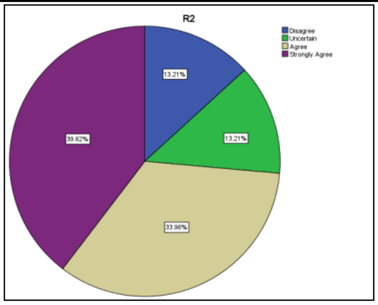
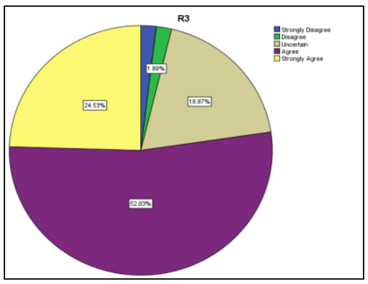
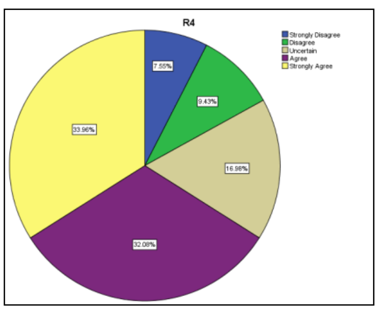
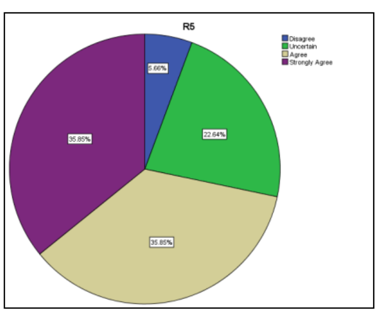
Appendix C

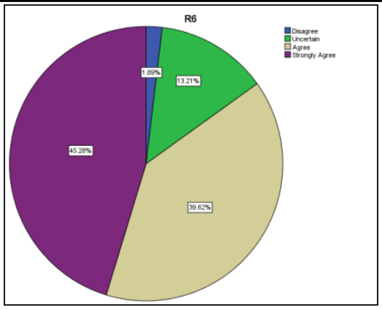
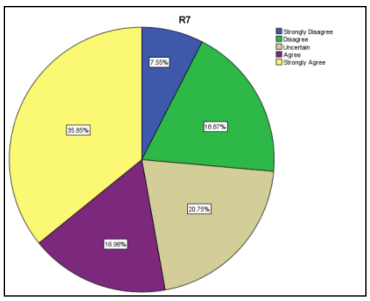
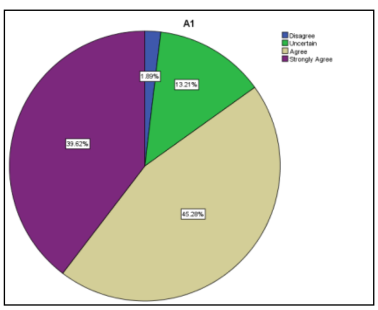
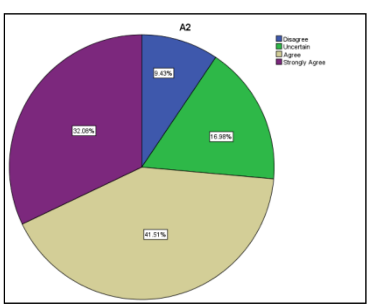
Table (1) Frequency Tables of Items of Questionnaire Respondents for Pre-intervention

		Frequency	Percent
U1	Strongly Disagree	4	3.8
	Disagree	12	11.3
	Uncertain	8	7.5
	Agree	50	47.2
	Strongly Agree	32	30.2
	Total	106	100.0
U2	Disagree	8	7.5
	Uncertain	14	13.2
	Agree	44	41.5
	Strongly Agree	40	37.7
	Total	106	100.0
U3	Uncertain	12	11.3
	Agree	50	47.2
	Strongly Agree	44	41.5
	Total	106	100.0
U4	Disagree	2	1.9
	Uncertain	18	17.0
	Agree	52	49.1
	Strongly Agree	34	32.1
	Total	106	100.0

			
U5 	Rarely	30	28.3
	Uncertain	12	11.3
	Somehow	22	20.8
	Yes	42	39.6
	Total	106	100.0
E1 	Uncertain	2	1.9
	Somehow	16	15.1
	Yes	88	83.0
	Total	106	100.0
E2 	Rarely	2	1.9
	Uncertain	12	11.3
	Somehow	24	22.6
	Yes	68	64.2
	Total	106	100.0
E3	Rarely	24	22.6
	Uncertain	18	17.0
	Somehow	36	34.0

<table>
<tr><td>
</td><td>Yes
Total</td><td>28
106</td><td>26.4
100.0</td></tr>
<tr><td>E4

</td><td>Rarely
Uncertain
Somehow
Yes
Total</td><td>4
6
32
64
106</td><td>3.8
5.7
30.2
60.4
100.0</td></tr>
<tr><td>E5

</td><td>Rarely
Uncertain
Somehow
Yes
Total</td><td>26
8
24
48
106</td><td>24.5
7.5
22.6
45.3
100.0</td></tr>
<tr><td>R1

</td><td>Strongly Disagree
Disagree
Uncertain
Agree
Strongly Agree
Total</td><td>4
6
12
40
44
106</td><td>3.8
5.7
11.3
37.7
41.5
100.0</td></tr>
<tr><td>R2</td><td>Disagree
Uncertain
Agree</td><td>14
14
36</td><td>13.2
13.2
34.0</td></tr>
</table>

	Strongly Agree	42	39.6
	Total	106	100.0
R3 	Strongly Disagree	2	1.9
	Disagree	2	1.9
	Uncertain	20	18.9
	Agree	56	52.8
	Strongly Agree	26	24.5
	Total	106	100.0
R4 	Strongly Disagree	8	7.5
	Disagree	10	9.4
	Uncertain	18	17.0
	Agree	34	32.1
	Strongly Agree	36	34.0
	Total	106	100.0
R5 	Disagree	6	5.7
	Uncertain	24	22.6
	Agree	38	35.8
	Strongly Agree	38	35.8
	Total	106	100.0
R6	Disagree	2	1.9
	Uncertain	14	13.2
	Agree	42	39.6

	Strongly Agree	48	45.3
	Total	106	100.0
R7 	Strongly Disagree	8	7.5
	Disagree	20	18.9
	Uncertain	22	20.8
	Agree	18	17.0
	Strongly Agree	38	35.8
	Total	106	100.0
A1 	Disagree	2	1.9
	Uncertain	14	13.2
	Agree	48	45.3
	Strongly Agree	42	39.6
	Total	106	100.0
A2 	Disagree	10	9.4
	Uncertain	18	17.0
	Agree	44	41.5
	Strongly Agree	34	32.1
	Total	106	100.0
B1	Rarely	2	1.9
	Uncertain	6	5.7
	Somehow	18	17.0

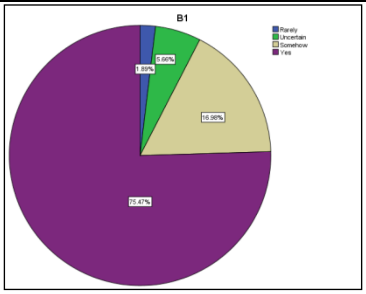
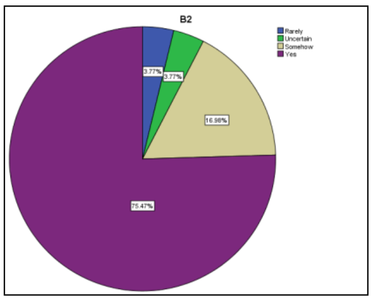
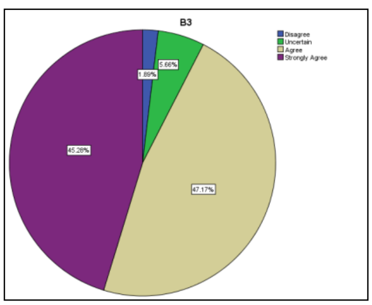
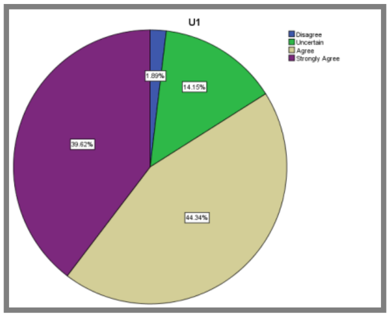
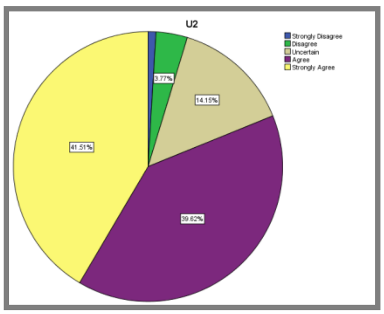
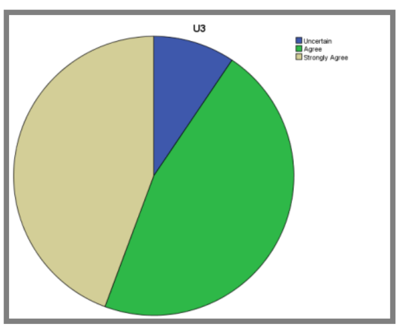
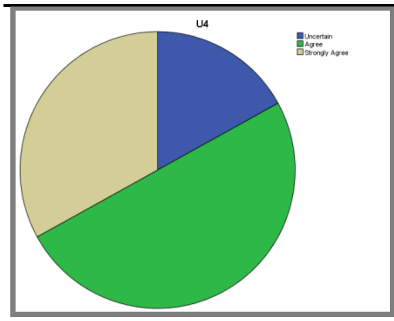
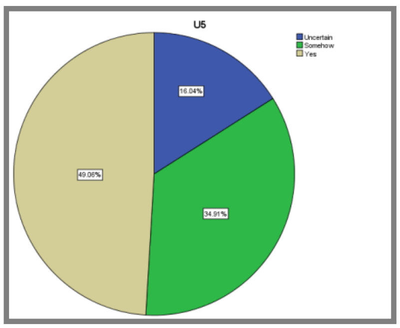
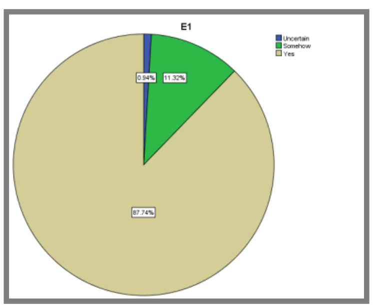
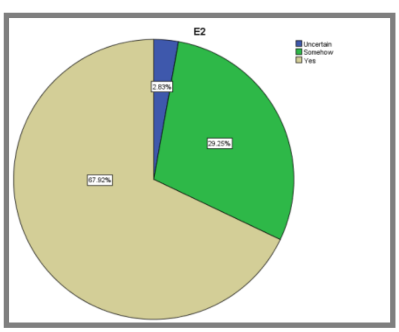
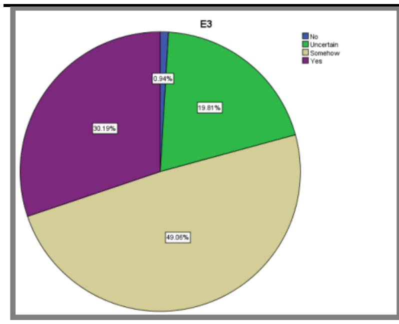
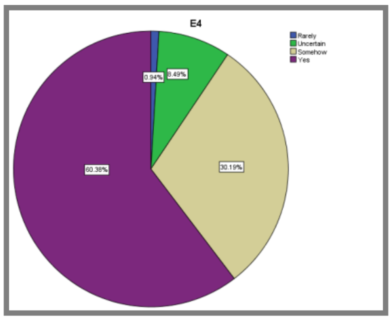
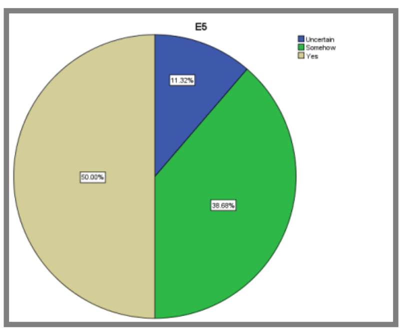
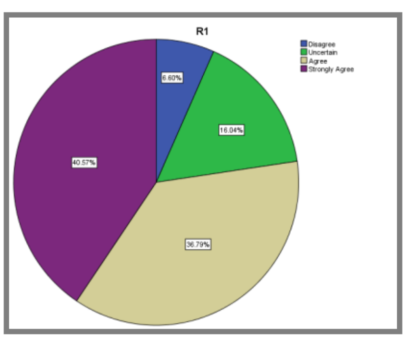
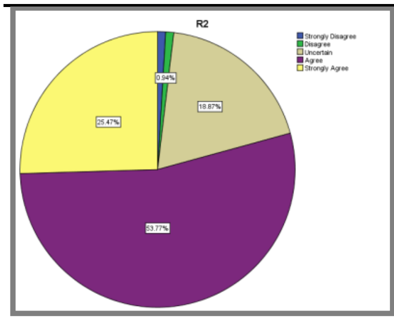
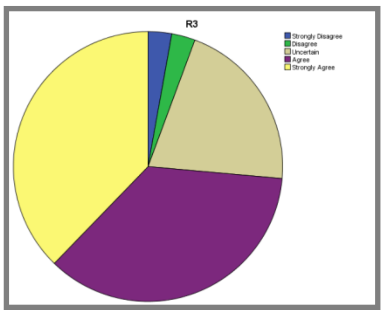
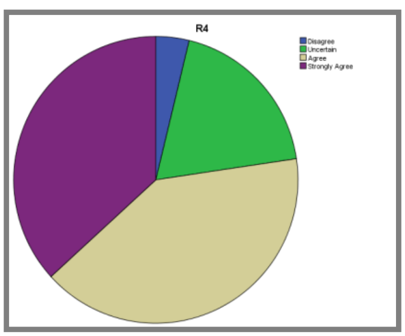
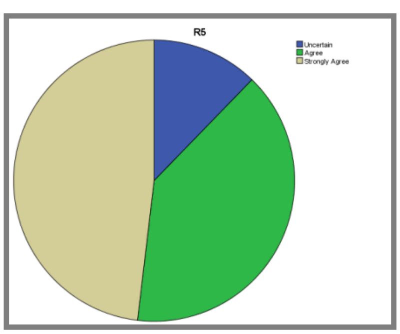
<table>
<tr><td rowspan="2">
</td><td>Yes</td><td>80</td><td>75.5</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="5">B2

</td><td>Rarely</td><td>4</td><td>3.8</td></tr>
<tr><td>Uncertain</td><td>4</td><td>3.8</td></tr>
<tr><td>Somehow</td><td>18</td><td>17.0</td></tr>
<tr><td>Yes</td><td>80</td><td>75.5</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="5">B3

</td><td>Disagree</td><td>2</td><td>1.9</td></tr>
<tr><td>Uncertain</td><td>6</td><td>5.7</td></tr>
<tr><td>Agree</td><td>50</td><td>47.2</td></tr>
<tr><td>Strongly Agree</td><td>48</td><td>45.3</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
</table>

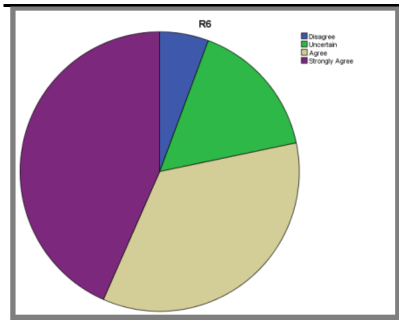
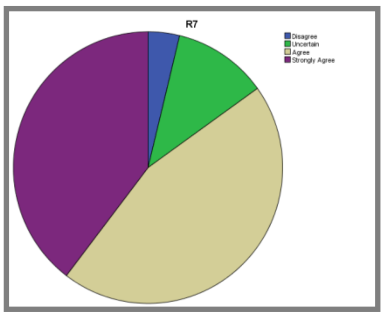
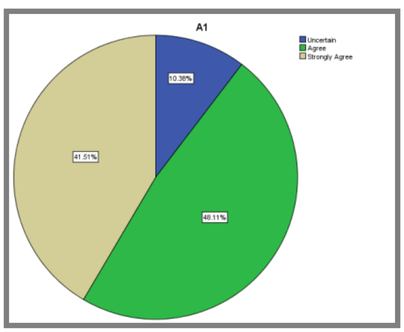
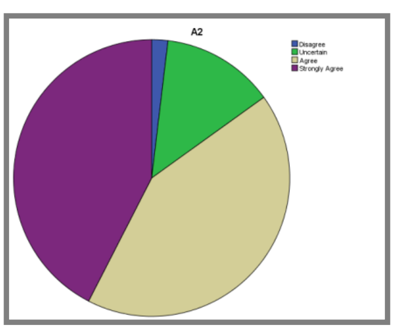
Table (2): Frequency Tables of Items of Questionnaire Respondents of Post Intervention

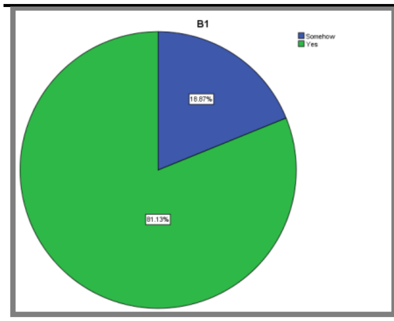
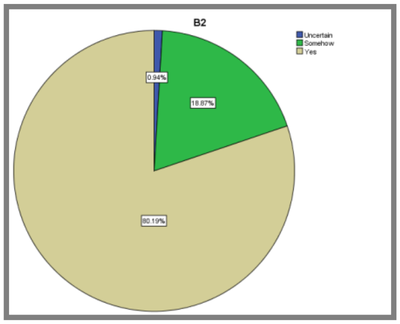
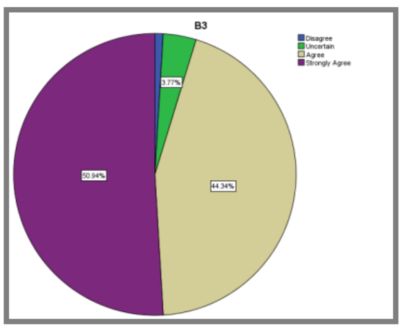
<table>
<tr><th></th><th></th><th>Frequency</th><th>Percent</th></tr>
<tr><td rowspan="5">U1

</td><td>Disagree</td><td>2</td><td>1.9</td></tr>
<tr><td>Uncertain</td><td>15</td><td>14.2</td></tr>
<tr><td>Agree</td><td>47</td><td>44.3</td></tr>
<tr><td>Strongly Agree</td><td>42</td><td>39.6</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="6">U2

</td><td>Strongly Disagree</td><td>1</td><td>0.9</td></tr>
<tr><td>Disagree</td><td>4</td><td>3.8</td></tr>
<tr><td>Uncertain</td><td>15</td><td>14.2</td></tr>
<tr><td>Agree</td><td>42</td><td>39.6</td></tr>
<tr><td>Strongly Agree</td><td>44</td><td>41.5</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="4">U3

</td><td>Uncertain</td><td>10</td><td>9.4</td></tr>
<tr><td>Agree</td><td>49</td><td>46.2</td></tr>
<tr><td>Strongly Agree</td><td>47</td><td>44.3</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="4">U4</td><td>Uncertain</td><td>18</td><td>17.0</td></tr>
<tr><td>Agree</td><td>53</td><td>50.0</td></tr>
<tr><td>Strongly Agree</td><td>35</td><td>33.0</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
</table>

			
U5 	Uncertain Somehow Yes Total	17 37 52 106	16.0 34.9 49.1 100.0
E1 	Uncertain Somehow Yes Total	1 12 93 106	2.8 29.2 67.9 100.0
E2 	Uncertain Somehow Yes Total	3 31 72 106	2.8 29.2 67.9 100.0
E3	Rarely Uncertain	1 9	0.9 8.5

<table>
<tr><td rowspan="3">
</td><td>Somehow</td><td>32</td><td>30.2</td></tr>
<tr><td>Yes</td><td>64</td><td>60.4</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="5">E4

</td><td>Rarely</td><td>1</td><td>0.9</td></tr>
<tr><td>Uncertain</td><td>9</td><td>8.5</td></tr>
<tr><td>Somehow</td><td>32</td><td>30.2</td></tr>
<tr><td>Yes</td><td>64</td><td>60.4</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="4">E5

</td><td>Uncertain</td><td>12</td><td>11.3</td></tr>
<tr><td>Somehow</td><td>41</td><td>38.7</td></tr>
<tr><td>Yes</td><td>53</td><td>50.0</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="5">R1

</td><td>Disagree</td><td>7</td><td>6.6</td></tr>
<tr><td>Uncertain</td><td>17</td><td>16.0</td></tr>
<tr><td>Agree</td><td>39</td><td>36.8</td></tr>
<tr><td>Strongly Agree</td><td>43</td><td>40.6</td></tr>
<tr><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td rowspan="2">R2</td><td>Strongly Disagree</td><td>1</td><td>0.9</td></tr>
<tr><td>Disagree</td><td>1</td><td>0.9</td></tr>
</table>

	Uncertain	20	18.9
	Agree	57	53.8
	Strongly Agree	27	25.5
	Total	106	100.0
R3	Strongly Disagree	3	2.8
	Disagree	3	2.8
	Uncertain	22	20.8
	Agree	38	35.8
	Strongly Agree	40	37.7
	Total	106	100.0
R4	Disagree	4	3.8
	Uncertain	20	18.9
	Agree	43	40.6
	Strongly Agree	39	36.8
	Total	106	100.0
R5	Uncertain	13	12.3
	Agree	42	39.6
	Strongly Agree	51	48.1
	Total	106	100.0
R6	Disagree	6	5.7
	Uncertain	17	16.0

	Agree	37	34.9
	Strongly Agree	46	43.4
	Total	106	100.0
R7 	Disagree	4	3.8
	Uncertain	12	11.3
	Agree	48	45.3
	Strongly Agree	42	39.6
	Total	106	100.0
A1 	Uncertain	11	10.4
	Agree	51	48.1
	Strongly Agree	44	41.5
	Total	106	100.0
A2 	Disagree	2	1.9
	Uncertain	14	13.2
	Agree	45	42.5
	Strongly Agree	45	42.5
	Total	106	100.0
B1	Somehow	20	18.9
	Yes	86	81.1

<table>
<tr><td></td><td>Total</td><td>106</td><td>100.0</td></tr>
<tr><td>B2
</td><td>Uncertain
Somehow
Yes
Total</td><td>1
20
85
106</td><td>0.9
18.9
80.2
100.0</td></tr>
<tr><td>B3
</td><td>Disagree
Uncertain
Agree
Strongly Agree
Total</td><td>2
6
50
48
106</td><td>0.9
3.8
44.3
50.9
100.0</td></tr>
</table>