

Mixed Reality has been part of our lives ever since we first started to dream of creative ways to comprehend information and concepts through actual and imaginative experiences. This book explores the latest research informing education design in virtual and augmented reality. By utilising numerous studies and examples, it describes the differences between perceived knowledge, usage area, technologies, and tools. It will help the reader gain a better understanding of the nature of virtual or augmented realities and their applications in theory and practice.

Zeynep Tacgin has worked in the education technologies field for more than 10 years. She completed her post-doctoral research at Charles Sturt University. She is an Adjunct Associate Professor at Charles Sturt University and a Lecturer Marmara University. She received her PhD in Computer Education and Instruction Technologies in 2017, and is currently interested in merging Mixed Reality (MR) technologies and distance education. Her specialties are wearable educational technologies; innovative learning environments; technology integration in education; education management and policy; distance education; augmented and virtual reality; simulations; instructional design; and material development.

978-1-5275-4813-8

www.cambridgescholars.com

Cover design © Zeynep Tacgin, 2020

Cover image *Cyber Network Background*
by Pete Linforth from Pixabay, 2018



List of Illustrations.....	x
List of Tables	xiv
Preface	xv
What is this book about?	xv
What is this book not about?	xvi
Who is this book for?	xvii
How is this book used?	xviii
The specific contribution of this book	xix
Acknowledgements	xx
Chapter One	1
What is MR?	
1.1 Introduction	1
1.2 A history of MR technologies	4
1.3 Where does the MR concept come from?	10
1.4 Summary of Chapter 1	13
Chapter Two.....	15
What is VR?	15
2.1 Definitions.....	15
2.1.1 Terms for understanding VR.....	17
2.1.1.1 Virtuality	17
2.1.1.2 Virtual object/image.....	17
2.1.1.3 Virtual world/environment	17
2.1.1.4 Presence.....	18
2.1.1.5 Telepresence	19
2.2 Types of VR.....	19

2.2.1	Immersive VR	21
2.2.2	<i>Non-Immersive VR</i>	25
2.3	Current VR Technologies.....	26
2.3.1	Hardware.....	26
2.3.1.1	HMDs (Head-Mounted Displays) as an Output.....	26
2.3.1.1.1	Understanding HMDs	27
2.3.1.1.2	Tethered HMDs	30
2.3.1.1.3	Mobile phone integrated HMDs.....	35
2.3.1.1.4	Stand-alone HMDs	40
2.3.1.2	Inputs.....	45
2.3.2	Software	51
2.3.2.1	Game Engines.....	52
2.3.2.2	3D modelling tools.....	56
2.3.2.3	360° Video editing.....	58
2.4	Benefits	59
2.5	Disadvantages	61
2.6	Examples of VR applications.....	61
2.6.1	VR in Education.....	61
2.6.2	VR in Medicine	64
2.6.3	VR in the Military	67
2.6.4	VR in Engineering	68
2.6.5	VR in Architecture.....	69
2.6.6	VR in Entertainment	70
2.7	Summary of Chapter 2	72
Chapter Three.....		74
What is AR?		74
3.1	Definitions.....	75
3.1.1	Terminology associated with AR	76
3.2	Types of AR	77
3.2.1	Marker-based AR.....	78
3.2.2	Markerless-based AR	80
3.3	Current AR Technologies.....	82
3.3.1	Hardware.....	83

3.3.1.1 Tracking systems for AR	83
3.3.1.2 AR Displays.....	84
3.3.1.2.1 Head attached displays (HADs)	85
3.3.1.2.2 Handheld displays.....	92
3.3.1.2.3 Spatial Displays.....	93
3.2.2 Software	95
3.2.2.1 Interaction in AR interfaces	96
3.2.2.1.1 Tangible AR interfaces	96
3.2.2.1.2 Collaborative AR interfaces.....	98
3.2.2.1.3 Hybrid AR interfaces.....	100
3.2.2.1.4 Multimodal AR interfaces.....	101
3.2.2.2 AR development tools	103
3.2.2.2.1 Vuforia.....	105
3.2.2.2.2 EasyAR	105
3.2.2.2.3 Wikitude.....	106
3.2.2.2.4 Kudan	106
3.2.2.2.5 ARToolKit	106
3.2.2.2.6 ARCore	107
3.2.2.2.7 ARKit	107
3.3 Benefits of AR	110
3.4 Disadvantages	113
3.5 Examples of AR Applications	115
3.5.1 AR in Education.....	115
3.5.2 AR in Medicine	117
3.5.3 AR in the Military	121
3.5.4 AR in Engineering and Architecture.....	124
3.5.5 AR in Entertainment	131
3.6 Summary of Chapter 3	133
Chapter Four	135
MR in Education	135
4.1 VR in Education	136
4.1.1 VR applications for primary school	137
4.1.2 VR applications for high school and university	143

4.1.2.1 Mathematics and geometry.....	143
4.1.2.2 Science.....	143
4.1.2.3 Medicine	146
4.1.2.4 Architecture and engineering.....	148
4.1.2.5 Art.....	149
4.1.3 VR applications for in-service & professional training.....	151
4.2 AR in Education	157
4.2.1 AR applications for primary school.....	158
4.2.1.1 AR applications for science training.....	160
4.2.1.2 AR applications for social science training.....	161
4.2.3 AR applications for high school and university	162
4.2.3 AR applications for in-service & professional training.....	167
4.3 ID in MR.....	172
4.3.1 What is ID?	172
4.3.2 Characteristics of the ID process	174
4.3.3 MR ID models	177
4.3.4 Should I use MR technologies for my teaching process?	182
4.3.5 How do I design my MRLE?.....	185
4.3.5.1 3D environment design	186
4.3.5.2 Hints for deciding on your ID	191
4.4 Summary of Chapter 4	195

Chapter Five	197
An Example IVR Study: Evaluating the design features of a sensory IVRLE.....	197
5.1 Abstract	197
5.2 Introduction	198
5.2.1 Purpose	200
5.3 Methodology.....	201
5.3.1 Working group.....	201

5.3.2 Data gathering tools	201
5.3.3 Data analysis	202
5.4 Findings.....	203
5.4.1 The VRLE interface.....	203
5.4.2 Evaluation from subject experts	205
5.4.3 Evaluation from instructional designers	206
5.4.4 Are the design features of the VRLE sufficient for the nursing students?	207
5.4.5 Is there any statistical significance among the learners' evaluations of design features?	208
5.5 Results.....	208
5.6 Discussion	209
5.7 Future Work.....	210
Abbreviations.....	211
Glossary	214
Bibliography	222
Index.....	265