# Video Games for Health

## Principles and Strategies for Design and Evaluation

## Ivan Beale

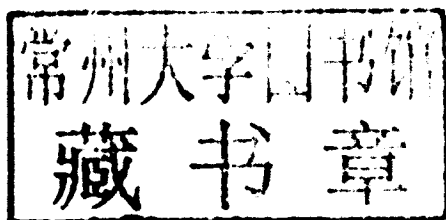# VIDEO GAMES FOR HEALTH: PRINCIPLES AND STRATEGIES FOR DESIGN AND EVALUATION

## IVAN L BEALE

For permission to use material from this book please contact us:
Telephone 631-231-7269; Fax 631-231-8175
Web Site: http://www.novapublishers.com

## NOTICE TO THE READER

The Publisher has taken reasonable care in the preparation of this book, but makes no expressed or implied warranty of any kind and assumes no responsibility for any errors or omissions. No liability is assumed for incidental or consequential damages in connection with or arising out of information contained in this book. The Publisher shall not be liable for any special, consequential, or exemplary damages resulting, in whole or in part, from the readers' use of, or reliance upon, this material. Any parts of this book based on government reports are so indicated and copyright is claimed for those parts to the extent applicable to compilations of such works.

Independent verification should be sought for any data, advice or recommendations contained in this book. In addition, no responsibility is assumed by the publisher for any injury and/or damage to persons or property arising from any methods, products, instructions, ideas or otherwise contained in this publication.

This publication is designed to provide accurate and authoritative information with regard to the subject matter covered herein. It is sold with the clear understanding that the Publisher is not engaged in rendering legal or any other professional services. If legal or any other expert assistance is required, the services of a competent person should be sought. FROM A DECLARATION OF PARTICIPANTS JOINTLY ADOPTED BY A COMMITTEE OF THE AMERICAN BAR ASSOCIATION AND A COMMITTEE OF PUBLISHERS.

Additional color graphics may be available in the e-book version of this book.

*Published by Nova Science Publishers, Inc.* ✦ *New York*

# VIDEO GAMES FOR HEALTH: PRINCIPLES AND STRATEGIES FOR DESIGN AND EVALUATION

# PUBLIC HEALTH IN THE 21ST CENTURY

Additional books in this series can be found on Nova's website
under the Series tab.

Additional E-books in this series can be found on Nova's website
under the E-books tab.

# MEDIA AND COMMUNICATIONS - TECHNOLOGIES, POLICIES AND CHALLENGES

Additional books in this series can be found on Nova's website
under the Series tab.

Additional E-books in this series can be found on Nova's website
under the E-books tab.

# Author's Foreword

It is now more than twenty years since I first became involved with the design, implementation and evaluation of behavior intervention programs. Working in university and hospital environments, primarily with children and young adults with learning disorders, I soon became aware of the need to develop programs that could be accessed easily by parents and families to be used with the individuals who needed them, and implemented with minimal input from professionals. With the advent and rapid proliferation of the personal computer, it was obvious that digital-based interventions would progressively replace, or at least augment, tutoring and therapies provided one-on-one by individual professionals. By 2010, psychological and educational interventions delivered by DVD or the Web have become widely regarded as accessible, acceptable, and effective alternatives to one-on-one interventions. For children and young people in particular, though not exclusively, the video game format has a special appeal arising mainly from its immersive and entertaining character. This appeal has sparked the interest of education, psychology and health professionals who have identified the need for a vehicle that will get through to young people where other methods have failed. The promise is there, but the challenge lies in making it work.

This book presents a systematic approach to the design and evaluation of so-called 'serious' video games, especially those intended to address health issues. The need for such a book became apparent to me from my own experience in education and health game design. Coming from an academic background in research on learning and learning disorders, I was looking to the scientific literature for guidance on how best to apply knowledge from education and psychology to include learning objectives in game design. I soon realized that there was little published research that was directly applicable to the design of serious games, especially those that I have called

'conceptual' games, that try to influence the player's attitudes, behavioral propensities and motivations, rather than focusing on specific skills or knowledge.

The science of serious game design is still in its infancy, well behind the remarkable advances that have been made in immersive game technology that is now commonplace. Those of us who have sought to use video game technology as a vehicle for education and health objectives have found ourselves to be without ready-made guidelines about how best to proceed. Starting only with the principles and strategies we have identified as useful in the design of teacher or therapist-delivered psychoeducational interventions, we have tried to adapt these to fit the video game environment, with varying degrees of success. Progress has been slow, but by 2010 there is a growing body of knowledge sufficient to be worth systematizing and passing on, potentially to assist the efforts of future designers of serious games.

My knowledge and understanding of serious video games has drawn on the work of many others. I am especially indebted to those with whom I have collaborated on intervention research over the years, especially my colleagues and students at the University of Auckland, my partners in the development of Reading Basics at Brainwaves, and the research team in the early days at HopeLab, especially Steve Cole, Pam Kato and Michael Kosako. HopeLab has continued to assist me by allowing me access to images and other data from Re-Mission for use in this book.

I'm sure that I would not have written this book if it were not for my father, Rolla Beale, who turns 100 years in December, 2010. Although the circumstances of his childhood denied him the opportunity for a university education, Dad has always been a great believer in the importance of science, rational thought, and empirical investigation, and I learned that from his example. Last, but not least, I would like to acknowledge my wife, Sandra Heriot, for the love, support and understanding she has always shown me, especially during the ups and downs experienced when I have been working on video game projects and necessarily absent from home for long periods.

Ivan Beale July, 2010

# ACKNOWLEDGMENT

# CONTENTS

# PART I: CURRENT ISSUES IN THE DESIGN OF SERIOUS GAMES

*Chapter 1*

# INTRODUCTION

There is wide interest in the potential of 'serious' video games as vehicles for learning. Especially in the health education domain, there are now many reports of the use of video games intended to produce changes in players' knowledge, attitudes or behaviors that will transfer to 'real life' settings outside the context of the game. Real progress in this exciting field may be seriously limited by the lack of evidence-based and theoretically driven models for creating learning strategies that can be incorporated in game design. In particular, there has been little published about how learning strategies should be used in game designs to maximize the achievement of learning objectives that are transferable to 'criterion settings' outside the game.

These criterion settings are the real life settings where health knowledge, behaviors and attitudes can influence health outcomes. A typical health game might target things like attitudes to adhering to a recommended treatment for an illness, actual compliance with a medication regimen, or avoidance of risky behaviors. An education game might target willing participation in a classroom activity that involves reading a book out loud or writing a story in a notebook.

This book sets out relevant evidence-based principles from the broad discipline of experimental psychology, especially the psychology of learning and cognition, and shows how these principles can be applied in the design of serious games. The purpose of serious games is to bring about changes in learner's attitudes and behaviors in a particular domain of education or health, and game designs therefore are efficacious only to the extent to which they achieve such changes.

The key to knowing whether or not a serious game is efficacious in reaching its learning goals is something called outcome evaluation. The key to knowing whether particular components of game design are having the planned effect on these goals is something called process evaluation. Outcome evaluation and process evaluation should be an essential part of the game development process. Without them, there is no way of knowing whether a serious game is achieving serious goals, nor can we tell how critical to this process are the different components of the game design. Although accepted procedures for carrying out such evaluations are well known and have even been applied in detail to digital interventions such as video games, there are very few reports in the literature of reasonable attempts to evaluate the efficacy of any serious games. As a consequence, both game developers and potential game users are pretty much in the dark about the efficacy of any serious game in relation to its purported goals.

A central theme of this book is that the usefulness or intrinsic value of a serious game is limited by how well the game development process fits with the requirements of evaluation theory. Ideally, a game should be designed with a view to the evaluation process that will determine to what extent the game is efficacious and which of its components are critical to its efficacy. The game development process must be referenced, at all stages, to the evaluation process that will ultimately determine whether the game actually achieves its goals. Unless this happens, the game can easily be badly flawed, a direct result of design judgments that are ill informed. This potentially is catastrophic for the developers, given the high cost of development.

Alternatively, a game may be completed, but not amenable to one or more important components of a proper evaluation. In this instance, there might be a range of undesirable consequences. For example, it might be impossible to make valid claims about the efficacy of the game or any of its components. Or it may be impossible to overcome negative views of stakeholders or potential consumers about the credibility or acceptability of the game. It cannot be overemphasized that the development of a plan for evaluation of all aspects of a game is as important as the development of any other aspect of game design.

Producers may well be tempted to assume that if the design of a video game is well informed by a development team and consultants with appropriate expertise and experience it is very unlikely that the game will not facilitate the desired learning outcomes. Producers will necessarily be mindful of the potentially high cost of formal evaluation of a product, and might lean towards alternative, and cheaper, ways of influencing the credibility and acceptability of their product. They might seek positive appraisals by authority

figures or enthusiastic testimonials by users. They might depend on their reputation as former producers of successful games or rely on the ability of their sales team to make the product desirable to potential users. Whatever the mix of strategies producers might ultimately opt for, it probably is beneficial in the long term that they are at least informed about relevant evaluation models, if only to have a better understanding of the resources required for their implementation.

The inconvenient, but undeniable, fact is that serious games are a relatively new development. They haven't been around long and we don't know much about what works and what doesn't. Very few serious games have been subject to thorough evaluation that reaches anything like the rigorous standards that have been applied to other behavior change methodologies. Fortunately, we do have a lot of established theories and principles of behavior change that have been applied to good effect in traditional psychoeducational programs. But we can only guess how to apply these theories and principles to best achieve outcome goals in serious game design.

The premise of this book is that we can best advance our knowledge of how to design serious games for health and learning by completing two requirements: First, we must apply to serious game design what we have learned from research on other kinds of psychoeducational interventions; second, we must evaluate how well that application of prior research survives the process of translation between genres. These requirements define the structure of this book, in which evidence-based ideas for game design elements that enhance learning are set out in a framework derived from evaluation theory and practice.

This adopted approach first of all serves the primary purpose of this book, which is to help developers of serious games to understand how to apply relevant principles of learning to the game design process, but it also will be helpful in providing criteria that developers can apply when appraising existing games that they might be looking to for design ideas. When we look at reports about the serious games that are out there, it seems at first glance that there are lots of positive reports about what these games are achieving in terms of their health and education goals. Also, taking the reports at face value, it would appear that in many cases principles of learning have been identified and applied to good effect in these game designs.

But when we analyze more carefully the content of these reports, the picture is much less rosy. Accepted criteria for designing studies intended as tests of the efficacy of the game as a psychoeducational intervention are not

met in most instances, and accepted protocols for evaluating different aspects of the intervention are seldom used or even referred to in the published reports.

Psychoeducational interventions are interventions that focus on a learner's (usually a patient or health professional) acquisition of illness and/or treatment related knowledge and/or skills derived wholly or partly from that knowledge. Psychoeducational interventions in the form of video games for increasing knowledge, self-help skills and attitudes have been developed for a range of chronic diseases such as asthma (Lieberman, 2001), cancer (Bush, Huchital, & Simonian, 2002; Dragone, Bush, Jones, Bearison, & Kamani, 2002; Kato, Cole, Bradlyn, & Pollock, 2008), obesity (T Baranowski, R Buday, D. I Thompson, & J Baranowski, 2008), cystic fibrosis (Duff, Ball, Wolfe, Blyth, & Brownlee, 2006), sickle cell disease (Yoon & Godwin, 2007) diabetes (Brown et al., 1997) as well as health preventive issues such as safe sex (Thomas, Cahill, & Santilli, 1997). These studies have generated some limited published evidence about the ability of such video games to bring about changes in health-related variables such as treatment expectations, treatment credibility and acceptability, treatment adherence, perceptions of internal states, pain management, participation in health care, decision making, risk judgments and risk behaviors.

However, there is not much research-based evidence on the efficacy of these health video games, that is, how efficacious they are in achieving outcome goals. Generally, the published evaluations of these health games do not meet criteria for systematic evaluation of computer-based interventions recommended in the literature (Beale, 2002; Spirito, 1999). In particular, research reports about the efficacy of health games contain little information about the learning theory and technology underpinning the design of the games, even though the learning design of a game is probably a critical determinant of its efficacy. In reports where the learning theory and technology in the game is only sketchily described, it is invariably the case that the validity and efficacy of the way the theory and technology have been applied in the game are not measured. This means that even if the game could be shown to be efficacious in terms of the outcome goals of the game, we still don't know whether this was a consequence of any aspect of the theory or strategies that supposedly underpin the learning design of the game. It's hard to develop a product when you don't know why it works, because you don't know what to change to make it work better. Also, it's hard to promote a product to wary consumers and stakeholders when you can't point to evidence of an active ingredient and a supporting theory.

Game developers and producers who don't come from a background of health or education sciences, probably the majority, might find these concepts foreign to their way of thinking. In the commercial entertainment environment, the goals are different, and so therefore is the process for attaining those goals. First and foremost, it's all about consumer appeal, then things like market share, sales, and return on investment. These different goals might, in a general sense, be conceptualized as learning versus playing. This is not to say that learning should not involve playing, nor playing result in learning; it's just a matter of emphasis.

In the case of serious games, playing the game must result in changes in player's health-related attitudes and behaviors. The plan is that these changes should be relatively permanent and apply outside the context of the game as well as within it. In other words, the changes produced by playing the game should be maintained over time, even when the game is no longer used, and should *generalize* to 'real-life' contexts.

But to be an effective vehicle for learning, a serious game must be desirable and 'cool'. Playing the game must be intrinsically motivating for the player, however he or she performs within the game. Otherwise, the game cannot succeed as a vehicle for learning. It should inspire, motivate, and allow the player to become immersed in a virtual environment in which the player can experience the sensations of 'flow' and 'soar'(Chan & Ahern, 1999).

The challenge for the game designer is to find the right balance between the goals of learning and playing. Fortunately, these two aspects support one another to a large extent. The experience of learning can add to the sense of play, and the experience of play can improve conditions for learning. However, the need to incorporate learning goals can constrain the design of play features, and this may result in compromise solutions. Acceptable solutions to design issues will require close collaboration between those whose job it is to ensure that the game results in learning and those whose job it is to make the game entertaining.

Game developers generally have extensive knowledge, based mainly on their prior experience as game developers, about design principles that are relevant to whether a game is likely to be entertaining enough to encourage extensive play, regardless of any motivation to play that might arise from learning in the game. Psychologists, educationists and health professionals in general would not be expected to have this sort of knowledge, despite all the expertise that they might have on the learning goals of the proposed game.

The design of serious games, then, is about the intersection of two cultures and the amalgamation of two sets of knowledge and experience in order to