The Qualities of Games for Use in Education

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Chapter 1: Introduction

# Chapter 1 Introduction

## Project Description

A student’s learning experience is typically affected by their enjoyment of interacting with the material and their general interest in the topic material presented. As such, a student will have their own individual preferences and style of learning. Due to the rapid and prevalent development of technology, using video games as a means of teaching has been a topic of discussion.

This project aims to create an artefact in the form of a digital game and incorporate specific qualities into one level to demonstrate how a game may be used in a learning environment through the example of an “advanced game tutorial” that aims to not only act as the usual tutorial phase of the game but also to infer certain information about the game’s assorted enemy types.

## Project Contents

### Problem Description and Background

Education as it stands is still built on a system that is no longer needed in modern society. Ackoff and Greenberg (2008) explain that the current traditional methods of teaching are no longer as relevant as they once were as it is aimed to produce members of society that were likely to not question any fundamental aspects of how things operated. It is largely a system that focuses on teaching while disregarding learning as the last major stride in development in education was to industrialise it – having them operate efficiently like factories. While learning is the advancement of one’s understanding and knowledge on a given topic or subject, this can happen in the complete absence of teaching, which is the explanation of a subject from one person to another (Ackoff, 1991). The opposite of this is also true, teaching may occur with no learning.

One major flaw with this system currently is that it stifles the creativity and drive of some students as each level of education is largely the same and as such monotonous. As such, education needs some form of system to create an interest in learning for the students or risk providing only a means of teaching without individual students learning (Ackoff & Greenberg, 2008). It is therefore vital to provide learners in all levels of education with engaging content or methods of delivery that they will enjoy will cause them to be more motivated to learn and look further into that specific topic (Ackoff & Greenberg, 2008).

With the recent developments in technology and the fact that technology, in general, becoming more accessible, some institutions have adopted some forms of digital learning or assist traditional teaching with digital assistance. Deshpande and Huang (2011) state that the current generation of students is the first to grow up with abundant access to technology. They continue to state that, on average, these students spend almost double the time playing video games as they do reading (Deshpande & Huang, 2011).

Virvou, Katsionis and Manos (2005) echo the point that computer games are popular among individuals who are in schools and as such could provide a means to deliver content in an interesting and engaging manner. As such, the motivation behind this study is to further investigate the possibility of using video games as a means to encourage learning in teaching environments as current means of teaching may not be optimal for some individuals.



Figure 1: Example of an Educational Game (Quest Atlantis)

According to Annetta (2008), the movement for the inclusion of digital games to be used in teaching and training environments first started in 2003, two years after the field of ludology, the study of games, began to gain traction in academic literature. This initiative is what started the concept of a serious game as one that can be used in an academic sense to relay information (Annetta, 2008). After this point in time, various examples of serious games were made for purely academic study purposes and had found a very large use in simulation for use as explanation aides and medical training.

The use of games as simulations may stretch the colloquial definition of a video game but in academic terms, this is one facet of video games. Frasca (2002) cites that simulations, such as the ones discussed above, can fall into one of two categories, namely; Paidea (play) and Ludus (game). “Play” refers to the simulations that lack any defined set of rules and conditions to meet a fixed goal while “Game” refers to a simulation that has these conditions and a user can directly, according to the predetermined rules, move towards a fixed goal (Frasca, 2002).

From the abovementioned definitions and examples, there is a loose description of what a serious game typically looks like and where it can be applied. However, the qualities needed by these games to effectively relay information has not been directly explained in any one piece of literature. There is also a lack of explanation on how these qualities can be applied to a game to result in what may be described as a serious game.

## Aims and Objectives of Project

The primary aim of this study is to identify what qualities and principles can be applied to a video game to allow it to be used in a learning environment as a means to provide better engagement among certain students by providing an enjoyable delivery of information.

To effectively reach the aforementioned aim, all the following objectives will have to be met as certain objectives will benefit from the completion of others:

1. A literature study will need to be performed to gather information with a focus on:
   1. Ludology, narratology and simulation to better understand the academia centred around this project;
   2. Other implementations of serious games and the qualities they possess;
   3. The impact and effects of games in early development as this is the main “target audience” if this project were to be implemented as well as in a more general sense;
   4. Previous attempts to integrate game use in learning.
2. Collect examples of games that employ some form of teaching:
   1. Where objective 1-ii focuses on examples already discussed in an academic sense, this objective will make use of more informal analysis

The next aim of this project is to develop an artefact that the above knowledge can be applied to which will require the following objectives:

1. Learn and understand how to use the chosen development platform and associated environments;
2. Develop a base to build other levels/scenes off of;
   1. Development of basic scripts needed.
3. Create a specific scene/level within the aforementioned artefact that specialises in delivering information through various audio-visual stimuli that incorporates the principles and qualities found.

Chapter 2: Literature Review

# Chapter 2: Literature Review

## Introduction

This research study aims to develop a framework of qualities or principles needed for a digital game to be used effectively within an educational environment as well as whenever a game attempts to impart information in general. As such, this research study applies to any educational game and “serious games”.

This chapter will focus on available literature on several fields in an attempt to both explain the necessary background information and also perform a pseudo-meta-analysis on the available literature by presenting and then discussing what has already been done and what could still be done in each respective field, if applicable. These fields will include pedagogy, ludology and gamification as these are closely linked to the research question of this study. Pedagogy to discuss approaches to teaching, ludology to discuss the development and implementations of games and gamification to attempt to link the two.

## An Issue with Instructional Education

Education, as it stands, is still built on a paradigm that is no longer needed in modern society. One major flaw with the current system is that it stifles the creativity and drive of some students as each level of education is largely the same and is, as such, monotonous (Ackoff & Greenberg, 2008). Therefore, education requires some form of system to create an interest in learning for the students.

Ackoff and Greenberg (2008) explain that the current traditional means of teaching are no longer as relevant as they once were as it is aimed to produce members of society that were likely to not question any fundamental aspects of how things operated. It is largely a system that focuses on teaching while disregarding learning as the last major stride in development in education was to industrialise it – having them operate efficiently like factories (Ackoff & Greenberg, 2008). It is a system that is designed to keep moving often employing a “No Child Left Behind” policy which results in almost no time for anything other than the standardised and constantly measured curriculum (Gibson et al., 2006).

Table 1: Organisational Needs Between the Industrial and Information Ages - Adapted from Reigeluth (1996)

|  |  |
| --- | --- |
| **Industrial Age** | **Information Age** |
| Standardisation | Customisation |
| Adversarial relations | Cooperative relations |
| Compliance | Initiative |
| Conformity | Diversity |
| CEO as “king” | Customer as “King” |

This current paradigm of education is operated on the basis of standardisation to accommodate the change in societal needs and requirements that the industrial age brought with it (Reigeluth, 1996). Reigeluth (1996) states that this system was developed on the fundamental need of soring students into different categories and to allow for comparisons so that the training of the workforce could also be separated into different groups, those being labourers, having “hands-on” skills, and managers, who mainly had a managerial skill set.

However, with the shift into the “information age”, the requirements of the workforce have also changed. The industrial age being a time of mass-production with the emergence of various new processing technologies and the information age being characterised by the fact that information is being transmitted and generated at an ever increasing rate due to further technological developments (Gibson et al., 2006; Reigeluth, 1996). The most notable of the aforementioned paradigm shifts are that from conformity and compliance to initiative and diversity where greater value is placed on each individual’s strength and contribution to a project or organisation rather than each individual having the same skill set (Reigeluth, 1996). A few other differences between the needs of organisations during industrial age and the new requirements brought with the information age are depicted in the above table.

Reigeluth (1996) continues and states that the current paradigm is not focused on learning but rather categorisation. Ackoff (1991) hold a similar viewpoint stating that there is more of a focus on teaching rather than learning. It should be noted that teaching and learning are very distinct from one another as both can take place without the other (Ackoff, 1991). Learning is defined as increasing one’s ability to perform an act effectively while trying meet an objective through acquiring new knowledge whereas teaching is the process of providing this knowledge (Ackoff, 1991). Through this it is clear that institutions under this paradigm aim to give learners a verbose vocabulary to speak on topics that they do not fully comprehend (Ackoff, 1991).

Due to this aforementioned paradigm shift and in what requirements are desired by most organisations in the information age, a shift in instructional theory is also needed – one such as going from making use of passive learning through traditional teaching means to one that is centred on active learning (Reigeluth, 1996). These changes are discussed in more detail in the following section on pedagogy and learning theories and the means to accomplish them in the further sections on ludology and gamification.

## Pedagogy and Learning Theories

As one of the outcomes of this research study is a framework that details qualities and principles for a digital game to effectively present knowledge and information to a user one of the first areas to look towards and discuss is pedagogy which entails a general discussion about several learning and instructional theories as well as how motivation plays a role in learning. Pedagogy is the study of the transferal of knowledge in an educational environment through several lenses such as social, political and cultural (Li, 2012). As such it encompasses the fields and discussions of instructional design and theory as well as any learning theories.

### Learner’s at the Core of Learning

Some instructional theories focus on students learning with minimal interaction with a teacher or instructor. Reigeluth (1996) refers to the learning methods that follow his ideology as ones where an instructor acts as an indirect guide to a class of learners instead of the typical “sage on the stage” structure of a lecture or presentation.

Two of these aforementioned theories are the learning by doing and learning by teaching methods. Learning by doing functions on the principle that skills can be improved through practice and self-perfection on a particular topic or knowledge base (Fisch et al., 2009). This means of instruction has become increasingly popular amongst companies where they are able to make use of “on the job” training as it allows for a person to be productive immediately as well as become more proficient at tasks gradually (Fisch et al., 2009). The learning by teaching method works under the assumption that learners ae able to increaser their understanding on a certain topic by teaching it to other learners (Fisch et al., 2009). This method of learning has garnered more usage recently as it is a viable means of learning in environments with too few teachers or instructors and increases the overall learning process (Fisch et al., 2009). As shown in the following table, learning methods that place the learner in control are very flexible and as such can be incorporated when attempting to teach various and different fields or subjects (Ackoff, 1991).

Table 2: List of Several Learning Methods and Their Strengths - Adapted from (Moleda, 1995, as cited in Reigeluth, 1996)

|  |  |
| --- | --- |
| **Learning Method** | **Strengths** |
| Lectures or Presentations | Efficient, Standardised and Structured |
| Learners in Control | Very Flexible |
| Games and Simulations with a Rule System | Increased Learner motivation and Knowledge Transfer |
| Discovery as Individuals and Groups |

As shown in the above table, using games and simulations as a means of learning is nothing new and it has been found that they have been used as instructional tools as far back as 3000 B.C in China (Dempsey et al., 1996). Games are also a viable means of learning in a new paradigm of instructional design as it has been found to increase motivation amongst learners when used (Reigeluth, 1996). The distinction between a game and a simulation is discussed in one of the following sections. However, the increased motivation this means of instruction brings is important and should be noted as providing learners, in all levels of education, with content through methods of delivery that they enjoy will, as previously stated, cause them to be more motivated to learn and thus look further into that specific topic themselves which circles back to the increased transfer of knowledge through discovery as an individual (Ackoff & Greenberg, 2008; Reigeluth, 1996).

### Merrill’s First Principles of Instruction

Gibson *et al.* (2006) list and summarise several learning and instructional design theories that have the potential to be applied to a game used for learning. This study will, however, only look at Merrill’s First Principles of Instruction as it is the most recent of the ones depicted (Gibson et al., 2006).

Before discussing the principles that the name refers to in this theory, Merrill (2002) provides a few definitions for terms made use of. A principle in this context is a relationship that is always true regardless of the environment it is applied in (Merrill, 2002). A practice is any instructional activity (Merrill, 2002). A program is a means of instruction that makes use of several practices (Merrill, 2002). Merrill (2002) states that the first principles described are able to be implemented in any instructional system or environment as they are “design oriented” and as such relate more to creating learning environments rather than describing the means of knowledge transfer. Each of the following principles are also accompanied by three “corollaries” each which Merrill (2002) likewise explains.

The first principle of Merrill’s (2002) First Principles of Instruction is that the learning is problem centred. This principle describes three corollaries, the first of which being “Show Task” which states that learners should be shown what the types of problems they will be solving or will be able to solve with the knowledge that attain (Merrill, 2002). The next is “Task Level” which explains that the problems presented should keep learners engaged due to the complexity and not just the action of solving it (Merrill, 2002). The last corollary, “problem progression” describes that the problems presented should have some form of increasing complexity while still being comparable to previous iteration of the type of problem (Merrill, 2002).

The second principle is Activation which means that learning happens whenever previous experiences are used (Merrill, 2002). The first corollary, “Previous Experience”, states that the learning process is enhanced when a learner is able to draw upon relevant past experiences and apply the associate knowledge as a foundation for new knowledge (Merrill, 2002). “New Knowledge” is the second and explains that learners should be provided with a relevant experience as an additional foundation to add to their knowledge base (Merrill, 2002). The last corollary is “Structure” and details that learners should be encouraged to organise new knowledge according to some relevant structure (Merrill, 2002).

The third principle, Demonstration, proposes that learning takes place when the activities undertaken impart the knowledge instead of stating the information (Merrill, 2002). “Demonstration consistency” explains that any examples or visualisation should be kept in line with the original learning goals (Merrill, 2002). The next is “Learner Guidance” and states that learners should be shown where the relevant information for problems can be found be it in the form of comparative examples or various representation of one source (Merrill, 2002). “Relevant Media” explains that when media is used as a means of demonstration, different types can be used provided that they do not fight for a learner’s attention (Merrill, 2002).

The fourth principle is Application which states that leaning takes place when learners actively solve problems with the new knowledge they have acquired (Merrill, 2002). “Practice Consistency” is similar to Demonstration consistency but with a focus on the application of knowledge (Merrill, 2002). “Diminishing Coaching” is where the learners are provided with relevant feedback, but it is slowly lessened overtime (Merrill, 2002). It is also important that the problems provided to learners for practice have a good variety, as explained as “Varied Problems” (Merrill, 2002).

The fifth, and final, principle is Integration which is when the knowledge a learner has acquires s used by them in their everyday life (Merrill, 2002). The first corollary, “Watch Me”, explains that learners are provided to showcase the new knowledge or skill they have acquired (Merrill, 2002). “Reflection” deals with giving learners time to be able to debate with others on the topic involved (Merrill, 2002). Lastly, “Creation” states that learners should be able to make use of their new knowledge or skill in some personal capacity (Merrill, 2002).

The principles and corollaries provided by Merrill (2002) provide an expansive and detailed structure to be used when developing any learning opportunity making it an exceptional choice to adapt specifically to a digital game learning system. It does, however, lack a comprehensive discussion on how to keep learners engaged with content and, as such, the next subsection will discuss some theories pertaining to the role of motivation in learning.

### The Influence of Motivation

A learner’s motivation is what will drive them to engage with and enjoy the content being studied. This motivation can come in one of two forms according to Kapp (2012) and to better understand the theories focussed on learner motivation, this distinction will be discussed first.

The first is intrinsic motivation which is any motivation or drive to accomplish something and has originated from a desire to do something for oneself (Kapp, 2012). Thus, the motivation comes from the learner themselves. On the other hand, with extrinsic motivation, the drive and desire to accomplish a task of some kind stems from wanting some form of reward or to avoid punishment of some king (Kapp, 2012). Thus, motivation is created in return for something, either tangible or otherwise.

One model for motivating learners is the ARCS Model which was developed by John Keller (Kapp, 2012). This model is one that is frequently referenced in the aforementioned field of instructional design (Kapp, 2012). It comprises of four main elements with each focusing on designing instruction in a different way (Kapp, 2012).

The first of these is Attention and it is element is concerned with gaining and then keeping the learners’ interest. There are three main methods to accomplish this with the first being gaining attention through the use of relatable examples or surprise. The next is to create curiosity within the learners through means such as role-playing or hands-on examples. The last means to keep attention is variability which means to periodically changing the method of delivery (Kapp, 2012).

Relevance refers to having the content be relevant to the learner and Kapp(2012) mentions that this can be done through orienting the environment around achieving goals, creating a link between the motives of learners and that of the instruction means, displaying that the content is in somewhat familiar to the learners and finally developing a model of the results of learning the presented knowledge.

Another element of this model, confidence, is the expectations of success set by the learner and as such when they meet these expectations they are confident in their ability to do the work (Kapp, 2012). This can be aided by providing learners with clear expectations and requirement s upfront about the skill or knowledge. It is also helpful to provide smaller opportunities to succeed as with each success the learners will become more confident (Kapp, 2012).

The last element in the ARCS model is Satisfaction and is concerned with giving learners a sense of accomplishment and that the effort in the learning process has some value and weight to it (Kapp, 2012). This can be accomplished by allowing for learners to see how their newfound knowledge can be used, either through the use of a real-world demonstration or via some form of simulation (Kapp, 2012).

This section has detailed three aspects found within pedagogy, instructional design and learning theories each providing some insight into effectively transferring and imparting knowledge to a learner. Placing the learner at the centre of both teaching and learning allows for great flexibility in how to present that given material while Merrill (2002) provides a expansive framework to structure this presentation of knowledge whereas Kapp (2012), through citing John Keller, explains ways to keep learners motivated throughout the learning process.

## An Approach Through Ludology

Another approach that could be taken is one that is rooted in games as these are popular among those in schools and as such should provide a means to deliver content in an interesting and engaging manner (Virvou *et al*., 2005).

To be able to implement a digital game as a means of learning, an understanding of games in general is needed. This section details ludology in general and the various applications and topics it encompasses ha relate in some manner to the research problem discussed. These topics will include a discussion on games as a means of simulation and what is referred to as a “serious game” within the field.

### What is Ludology

Ludology is the formal and academic study of games

### Serious Games

Annetta (2008) states that the movement to include video games in teaching and training began in 2003, two years after the field of ludology began to gain traction itself. The type of games used in this context are often referred to as “serious games”.

What are serious games tho???

*Virvou, Katsionis and Manos (2005:54) mention that the endeavour to create serious games has yet to reach schools due to certain criticisms about games in general that hinders this.*

*The study of serious games became more theoretical and discussion-based at lower levels and more applied with actual use at higher levels, with a great impact on medical fields and training. As such, there is a fair amount of theoretical research on specific aspects that relate to serious games as simulations and within ludology as a whole, but only a few mention the qualities a game needs to better present information to a user. As such, theoretical knowledge on gamification a general learning theories will be analysed to develop this framework of qualities.*

* Serious Games for education and training (De Gloria, Bellotti, Berta, Lavagnino, 2014)

https://www.designtoolbox.co.uk/strategies/three-genres-of-game-research/

What are the characteristics of educational games? ‎

|  |  |
| --- | --- |
| **Characteristic** | **Description** |
| Rule‎-based | Events occur based on a set of knowable rules. |
| Responsive | Environment allows for player to act and responds promptly and saliently. |
| Challenging | Environment provides opportunities for success on difficult tasks. |
| Cumulative | Current state of the environment reflects player’s previous actions and allows for assessment of progress towards goals. |

* + A cognitive theory of multimedia learning: Implications for design principles RE Mayer
  + Computer Games in Education (Mayer, 2019)

*Annetta (2008) states that the movement to include video games in teaching and training began in 2003, two years after the field of ludology began to gain traction. These types of games are called “serious games”. These types of games have already had an impact on the military, medical and higher business education fields early in their conception and this trend continues to day with most serious games being used within the medical fields specifically (Annetta, 2008). However, there were attempts to use serious games, as simulations, within physics and engineering (Deshpande & Huang, 2011). Use as link to simulation games*

### Games as Simulation

Oievh

*Deshpande and Huang (2011:399) describe the use of games as a means of simulation for specific sections of work in physics and engineering courses as an addition to traditional teaching as it provides a relatively simple way to demonstrate certain phenomena. As such these authors discuss the simulation aspect of games rather than the narrative.*

* Ludology from Representation to Simulation (Frasca, 2002)
* Simulation versus narrative: Introduction to Ludology (Frasca, 2013)

## Gamification

This section will discuss the process of gamification and the theoretical knowledge behind it. This field is crucial to what this research study wishes to accomplish as it is the link to transform traditional teaching and learning into a game-based structure. Furthermore, this section will focus on the aspects of gamification that can be applied and translated into a digital game.

Gamification of Learning

* Discuss how gamification links to learning and what gamification is as well as how it typically works
* Link some qualities here
* Sources:
  + Karl Kapp book (is available @bib)
* Computer Games in Education (Mayer, 2019)

## Existing Gamified Teaching Systems and Educational Games

This section will detail various examples of previously implemented gamified teaching systems and educational games in an attempt to identify what approaches have already been detailed. Furthermore, this approach will also allow for the identification of which aspects are commonly used in educational systems and games among these implementations.

just discuss briefly all the smaller examples -quest Atlantis, Babylon, wolfs den….

*Annetta (2008:230) discusses multiple examples of these games, such as Discover Babylon and Quest Atlantis, that had been developed to immerse children and young adolescents in an academic environment. Further examples of the use of serious games have already had an impact on the military, medical and higher business education fields early in their conception and this trend continues to this day with most serious games being used within the medical fields specifically (Annetta, 2008:229).*

## Potential Issues and Effects of Game-Based Learning

Lastly, this section will document various issues and effects of using game-based leaning in attempt to ensure the framework of qualities and principles developed can avoid introducing them into the system that will be developed. Specifically, both the general effects of digital games and gamified learning (traditional teaching that makes use of several gamification tactics) will be described.

Effects of Games (Both in General and During Early Development)

* Discuss how games affect the user
* Mention examples from case studies
* Sources:
  + The Effect of Adventure Video Games on The Development of Student’s Character and Behavior (Kristiadi, Hasanudin, Sutrisno and Suwarto, 2019)
  + The best game in the world: Exploring young children’s digital game -related meaning-making via design activity (Mertala & Meriläinen, 2019)
  + A Meta-Analysis of the Cognitive and Motivational Effects of Serious Games (Wouters , Van Nimwegen, Van Oostendorp and Van der Spek, 2012)
  + Extensive childhood experience with Pokémon suggests eccentricity drives organization of visual cortex (Gomez, Barnett, Grill-Spector, 2019)

## Conclusion/Summary

Damn, shit works….

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