

FLIP2G

Deliverable 1.1

Review on serious games for education and training

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Abstract:	The deliverable gives a state-of-the-art of the current gamification and serious games market as well as examples of methodologies and products currently in the market for serious games for learning and training.
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Keyword List:	Serious Games, Gamification, Game based learning, Training and Education
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Consortium

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List of Abbreviations

The following table presents the acronyms used in the deliverable in alphabetical order.

<i>Abbreviation</i>	<i>Description</i>
ToC	Table of Contents
RPGs	Role-Playing Games
MMORPGs	Massively Multiplayer Role-Playing Game
MaTHiSiS	Managing Affective-learning THrough Intelligent atoms and Smart InteractionS
PC	Personal Computer
RAGE	Realising an applied Gaming Eco-system
NPCs	Non=Playable Characters
ICTs	Information and communication technologies
F2P	Free-to-play

Executive Summary

The deliverable is the first approach to the report on the serious games for education and training in the market along with the various techniques employed in these games. The content of this report will be the starting point on the other activities of the project.

The deliverable provides an overview on the market development that has happened in the industry in past few years and the reasons to drive the growth of this industry including the effects of serious games on kids and the increase of usage in adults. The deliverable captures the various mechanics, stories, aesthetics, technology and transmedia practices used in the industry to develop these games and their effects.

The deliverable gives examples of various serious games in the market for education and training of various skills and targeted at various target groups. This gives us a starting point on what we can use in the development of the serious game as part of FLIP2G project. Following that, the deliverable gives how different platforms and ecosystems available to showcase the project and get help and tools for development.

Finally, the deliverable shows the business models we can use in the distribution of the game and the potential of innovation in the techniques we can use in the development of the serious game.

1 Introduction

1.1 Scope

The deliverable's scope is to outline the state-of-the-art of the serious games in education and training. The deliverable expands on gamification, game based learning and serious games as well as the cause for the rise in the use of these methodologies in the education and training market.

The deliverable further expands on the mechanics, story, technologies and other factors affecting the design and the development of such techniques. Examples of serious games currently being used for education and training have been specified to show the methodologies used to produce engagement and better learning results. Several platforms for development are available based on the analysis of the end users, intended results and the targeted sectors. We also mention the ecosystems available to get resources to develop these games.

Finally, we mention the business models in use for the deployment of serious games, and how we will be able to exploit the serious game we built during the project.

1.2 Audience

The main audience of this deliverable and its content is the Consortium members although the deliverable will be made public for general public to get the knowledge on the contents.

1.3 Structure

The structure of the document is as follows:

- Section 1 introduces the deliverable, the audience to the deliverable including the consortium and the usefulness of the deliverable once made publicly available by the consortium.
- Section 2 is divided into 4 sections on the current state of the art of the industry in gamification and serious games
 - The first sub-section describes the current gamification methodologies in use to create an engagement in the education and non-education perspective.
 - The second sub-section describes the serious games available in the market for learning.
 - The third sub-section describes the various platforms for which the games can be deployed and are being built. This section also involves the ecosystems available for serious game development and deployment.
 - The final sub-section describes the business models in use for the distribution of serious games. This section describes how private companies and studios are able to fund the development of serious games.

- Section 3 of the deliverable describes the potential of innovation in the development of serious games as well as the gamification methodologies currently used. These will include new theoretical studies on serious games, as well as the use of new leisure gaming tools in serious games.
- The final section concludes the study of the current state-of-the-art of the serious games and overviews the methodologies we can employ in FLIP2G project.

2 Current State of the Art

2.1 Gamification, game based learning and serious games

Due to the combination of external market forces, community and design challenges, each learning-and-development or training department will come to a decision point on gamification. For the purposes of the discussion in the realm of organizational learning, gamification, game-based learning and serious games are effectively the same thing, because, in a corporate environment, all learning relates to strategy objectives and has a serious purpose, regardless of the level of gamification involved.

There are three main reasons for the increase in gamification: marketplace forces, the connection between games and learning in children, and rising interest in games among adults.

2.1.1 Marketplace forces

Estimates for worldwide, gamification market will touch \$22.9 Billion by 2022 (Gamification Market by Application, by Deployment Type, by Solution, By End-User, by Geography- Global Market Size, Share, Development, Growth and Demand Forecast, 2012-2022). The gamification market is being driven by several factors such as its increasing adoption in corporate and institutions, and people's growing engagement with social networking sites. According to a study conducted by the University of Colorado on the impact of simulations and games among adult learners, gamification techniques offer 14% higher skill-based knowledge, 11% higher factual knowledge, and 9% increase in knowledge retention rate, over the traditional methods of learning.

2.1.2 The connection between games and learning in children

Research by Dr. Arne May at Germany's University of Regensburg clearly showed that learning a new task produces a demonstrable increase in the brain's gray matter in mere weeks. In addition, brain scientists the world over agree that games' challenge-achievement-reward loop promotes the production of dopamine in the brain, reinforcing the desire to play. Game based knowledge produces long term learning effects and not just short-term learning effects in children. Research by Wouters and others indicates that games vs. text-based knowledge, when tested immediately after the instruction, are likely to have similar results, but when tested days later the game-based knowledge is better retained.

2.1.3 Rising interest among adults in games

Statistics around who is actually playing with this Infographic on Social Gaming Demographics for 2012¹. It is interesting to note that:

- 58% of Social Gamers are over 40 years old

¹ <http://www.digitalbuzzblog.com/infographic-social-gaming-demographics-statistics-2012/>

- 29% are married with children
- 79% have a college degree or better
- 44% earn over \$50,000 per year
- 8% of people access the games from a mobile phone

As soon as organizational misperceptions regarding time management and cultural integrity are put aside, gamification becomes an opportunity to improve retention of key content or behaviours.

2.2 Learning theories behind serious games

There have been several learning theories that have been developed over the years, arguing the process of acquiring. There seem to be three main reasons for the increase in gamification knowledge takes place and how we learn. Though there are a number of learning theories, the ones that are most useful in the serious game context are (Understanding Video Games)

- 1) **Behaviourist Theory**: This theory was developed in the 1919 by John Watson, and is still one of the major underlying principles for teaching. This theory centres on the fact that if a task is repeated enough times, it will be engrained in the student's memory. This approach to learning does not focus much on the rationale behind the task, just the learning outcome, it is more pragmatic, and the student is rewarded for successfully completing the task. The use of an external reward is integral since it, according to the researches, provides the stimuli for learning process. In the serious game context, this means that there is less of a focus between learning and the game instead of the uses of the game as a reward for learning. This approach towards learning can be seen and used in several educational video games, which use levels, points, achievements, etc. to reward successful learning/progression. This is also known as Behaviourism.
- 2) **Instructional Theory** [3]: With advancement in research and technology over the last couple of decades, the importance of cognitivism was realised by researchers. Building upon previous works, the Instructional Theory of learning was developed. Where Behaviourism theory dealt mainly with extrinsic motivations, Instructional theory also deals with intrinsic motivations. It claims that both types of motivations are involved in the process of learning and there are several obstacles that hinder the learning process. These include attention, processing speed, interface and motivation.

In the context of serious games and gamification, games of higher complexity and scope are able to provide both the extrinsic and intrinsic motivation for the players to keep on playing and learning in the process. The research lays down some of the most important factors when designing a good educational game, at par with successful commercial games. These are

- a) **Fantasy**: Fantasy is a major component of entertainment video games, as they intend to build and present a compelling, immersive and rich fantasy world for the players to play

in and explore. Some researchers argue that good fantasy can provide the required intrinsic motivation for the players, instead of abstract and distant games, such as finding a missing number of filling in the blanks.

- b) **Control:** Another key component of successful commercial games is the sense of control. The players feel a sense of control over their avatars and game world, and that their actions have consequences. A good sense of control is, as per several industry experts, is vital in the game's success/failure.
 - c) **Challenge:** Every game has some degree of challenge, an obstacle that has to be overcome in order to finish or get better at the game. They range from saving the princess (in the case of Mario), and mastering all of the complex gameplay and mechanics of the game being the best player (in the case with most competitive video games). For some players, this the main driving factor for playing the game. If used properly, they can prove to be successful in engaging for the players to keep on playing, and learning in the process.
 - d) **Curiosity:** All games have a sense of wonder and curiosity. With humans being innately curious, offering a vast, unknown and complex world/content to the players will naturally encourage them to play and find out more. This is most common in Role-Playing Games (RPGs) and Massively Multiplayer Role-Playing Games (MMORPGs). Here, the player has to explore a large and complex world, do quests and side quests, trade, form relationships with the characters in the game or, in some cases, other players in order to find out more. Here, serious games fall behind, since most of the time the information is spoon-fed to the player, leaving little to the imagination.
- 3) **Constructivist Theory** [3]: Continuing with the tread of further development and research in this field, the Constructivist theory of learning was developed as a result of the previous two theories. This theory states that learning occurs for everyone individually and at a personal a meaningful way, and that knowledge is constructed through freedom and exploration. In the context of serious games, this means that elements such as player's freedom to explore and experience the game for himself/herself is at the heart of effective learning. Looking at video games, researchers found the following intrinsic qualities, which help facilitate in their success:
- a) **Semiotic Domains:** Just like in real life, video games offer a semiotic domain for its players, with signs and symbols that the players have to learn and get familiar with, in order to navigate through the game.
 - b) **Learning and Identity:** Video games are good at creating a sense of agency and identity within the virtual realm. This can provide new learning experiences, and could be used to encourage players to learn.

- c) **Situated Meaning and Learning:** Video games can offer new forms of learning, when they are placed in a domain and they understand it from the inside out. By interacting with the world, the player could find different ways to learn.
- d) **Telling and Doing:** Video games have the ability to emphasise or amplify important elements and information so that the player understands them, and also provides a safe environment for the players to experiment and play in, with no real-life consequences and provides constant feedback on the same.
- e) **Cultural Models:** The content in video games represent ways of perceiving the world, and also uses information implicit in the game's universe. Games can be used to teach about other domains in life, depending upon the type of the game, it's content and learning outcomes

2.2.1 Mechanics, story, aesthetics, technology and transmedia

Other researchers and developers break down games, serious or commercial, to their most vital components, to see how they can be used in a learning context [1]. According to this, the two most important aspects of the transfer of knowledge in digital games are:

- 1) The study of a game's most vital elements, namely mechanics, story, aesthetics, technology and transmedia in the context of serious games.
- 2) Placing serious games in the history digital games as well as cultural media.

2.2.1.1 Mechanics

A game's mechanics cover mostly the actions, interactions, and activities the player is required to do in the game (and what the game offers) in order to progress through it. For example, in Mario, the mechanics are running, jumping, and occasionally, shooting. It is arguably one of the most important and defining feature of a game. In the context of serious games, researchers and developers alike try to figure out to what degree can the game's mechanics limit, prefigure, and shape the learning outcomes intended by the game and how can they be used to give a better learning experience to the players.

2.2.1.2 Story

Although not an integral part of several video games, which bank upon their mechanics, others provide a rich story and universe for the players to explore and play in. A rich and interesting narrative can provide a good motivation for certain players to keep playing. In the context of serious games, the question arises, "What knowledge can be structured within the story of the game to prepare for constructive learning experiences, especially when compared to traditional learning methods or through other audio-visual mediums?" [1].

2.2.1.3 Aesthetics

Aesthetics in video games cover things like the look and feel of the game. Unlike commercial games, serious games generally have a simulative or representative relationship with reality and real-life processes and methods. Due to this expectation, it is crucial that serious games clearly identify which parts are fact and which are fiction. Some researchers argue that the knowledge transfer and knowledge production and their relationship with reality have still to be researched.

2.2.1.4 Technology

Technology has an important part to play when it comes to learning and training. According to some researchers, knowledge and learning in general depend upon the reduction of external load and the design of the interaction. With the advancement of technology, we can see new and innovative ways of knowledge transfer. Although a certain amount of realism is required, the question then remains on how reductions of complexity of the real-world processes that is being emulated in serious games effect the knowledge transfer effectiveness, and how to properly emulate real world processes as accurately as possible, while removing redundant information.

2.2.1.5 Transmedia

Serious games are more embedded in real world social, cultural and economic processes than entertainment games, as previously discussed. The skills acquired in serious games can be applied, partly or fully, in their real-world counterparts. They can also be used to raise awareness and to form political opinions. It is then crucial that serious game design and research require a good understanding of transmedia and the integration of theoretical and practical knowledge. It is here that game studies, social sciences and humanities can work together in order to provide a fun and effective learning experiences using serious games.

2.3 Serious games available in the market

In the previous section, some of the established frameworks and rationale behind serious games have been discussed. Unlike Gamification, which is the inclusion of gameplay elements and mechanics into non-game related field, like education, business and so on in order to increase engagement and motivation of the participants, serious games are games designed specifically to teach the users about a certain topic, train, to increase awareness about something, and so on, in a playful manner. Serious games have been around for centuries, and continue to be used to this day. Games have the ability to simulate real world processes and methods, encourage risk taking, with virtually no real-world consequences, and collaboration, and are relatively cheap to develop. All these factors make games a desirable choice to train, teach, create awareness and so on.

There are various serious games in the market, all made by different institutions for different reasons. In the following sub-sections, some examples of serious games will be examined, each of which have been developed for different reasons and demographics, along with some of their methods of incorporating learning with play.

Some of these examples include Foldit, a game developed to learn more about protein molecules, X-Plane 11, a flight simulator aimed to be used, both commercially as well as professionally, to recreate a pilot's cockpit and to control a plane. World Without Oil is an awareness raising game, which aimed to create a scenario where the world has run low on oil and the players have to give their accounts on what they would do in such a situation. The last example is Shark World, a project management game, which aims to teach its players about project management, and all of its economical, and social aspects.

2.3.1 Foldit



Figure 1: Foldit Title Screen

Arguably one of the more well-known and successful serious games, Foldit² was developed by the University of Washington and released in 2008. It is a puzzle game, where the players are required to fold structures of protein molecules as perfectly as they can, using the tools provided to them. As the players progress, the structures get progressively more complex. The more accurate the structure, the more the players scored. The highest scoring structures were sent back to the researchers for them to study and analyse it, and it can be applied in the real world.

² <https://fold.it/portal/>

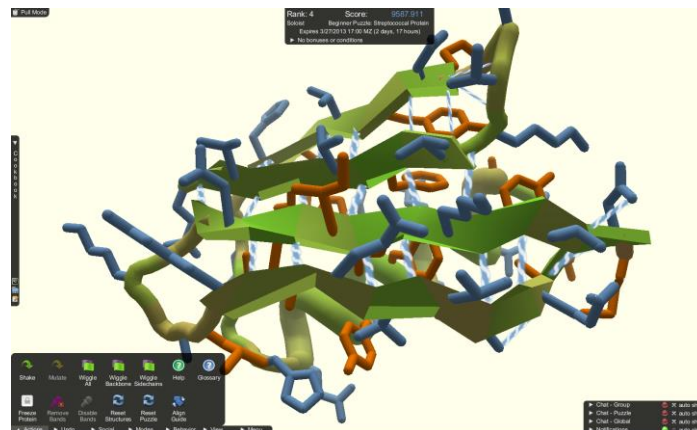


Figure 2: Foldit Screenshot

The game proved to be successful, both with the players and the researchers. The players found the game engaging, with 240,000 registered users, while the researchers gained valuable insights into protein structures. In a 2010 paper, the authors credited Foldit's 57,000 players for their contributions in providing useful results in their research.

The game aimed to be successful. Since protein molecules are highly complex and there are hundreds of thousands of different type of protein molecules in the human body, and would take even a super computer centuries to calculate all of the possible shapes. However, with the help of foldit and its player base, researchers were able to identify and study a large number of such molecules at a fast rate.

2.3.2 Flight Simulator



Figure 3: X-Plane 11 Title Screen

Flight simulators are applications, which are designed to simulate an airplane, and how it flies. There are several uses for it, including pilot training, designing aircrafts, the dynamics of the flight and how it can be improved or made safer. Nowadays, all pilots must first train using flight simulators, before they can even start training on an actual plane. These use a combination of both software and hardware to recreate an actual flight (with controls mimicking what one finds in an actual plane) in

order to provide an authentic flight experience. One such flight simulator used is X-Plane³, developed by Laminar Research.



Figure 4: X-Plane 11 Screenshot

The first instalment was released in 1995, and now the 11th instalment is now available to the market, both for private and professional use. Using real world empirical data, the flights are designed so that they emulate actual planes as accurately as possible.

Additionally, the players also have the option to create their own aircrafts and test them out using the toolkits provided to them. Using various plugins, the players can also add new features, such as controls, modules, maps, and so on.

X-Plane Pro, a version for commercial purposes, is FAA certified (a government-sanctioned certificate that is required in order to be a legit pilot training simulator) and provides the software (and sometimes hardware) for institutions for training their pilots.

³ <https://www.x-plane.com/>

2.3.3 World Without Oil



Figure 5: World Without Oil title

There are several “What if?” serious games available, which involve roleplaying and uses the player’s imagination to form a narrative. World Without Oil⁴ was an alternate reality game developed by a team of veteran game developers, and is an awareness raising game, created to show the effect our need for oil has on the economy, environment and the quality of life.



Figure 6: World Without Oil screenshot

The gameplay involves the players being in a situation where the world has run low on oil, one of the most important recourses, and how to act in it. The players are required to imagine this scenario and document their lives in it. The most compelling stories would be incorporated into the main narrative. These could either be in the form of videos, images blog entries, phone calls or emails. The website would store all these entries and could be accessed by anyone there.

⁴ <http://www.worldwithoutoil.org/>

The game provides a lesson plan for teachers on how to use the game. There is a total of 10 lesson plans, which are

- 1) Oil Crisis – Get Into the Game: The global oil crisis has begun. Begin the inquiry into the effects of less oil in our daily lives
- 2) How Bad Can it Get? : Fuel prices begin to rise because of this shortage, with no possible fix in sight.
- 3) Life is Starting to Change: Widespread changes can be observed. Goods and services that depend on cheap oil prices being to suffer.
- 4) Elasticity and Collapse: This investigates the factors that define elasticity in relation to oil, such as lifestyle, geography, and so on.
- 5) Oil Dependency Among Nations: The oil shortage has caused some nations to reconsider their foreign policies, and its effects on other nations and international diplomacy.
- 6) Food Without Oil: This deals with the impact of oil shortage on food supply. Without oil to transport and distribute food, many are forced to look for locally grown foods.
- 7) Breakdown: The government is hit hard with oil shortage, leading to green and red zones in cities, as well as refugee camps in the country.
- 8) Preparation and Community: With the government unable to properly address and tackle the issue, communities are seeking within themselves for possible solutions
- 9) Lessons Learned: Now that the crisis has been stabilized, how do we move forward?
- 10) Your World Without Oil: Help out the WWO team by delivering your report and communicate what is happening to you in the crisis.

2.3.4 Sharkworld



Figure 7: Shark World Title

Project management is an important and highly sort after skill these days. Projects ranging from developing an application or building a bridge, all require good project management skills, in order to avoid any problems, conflicts, scheduling or budget issues. There are several commercial games which focus on this; however they are usually watered down in order to appeal to the majority of the players. There are, however, games which try to emulate this accurately. One such game is Sharkworld⁵.



Figure 8: Shark World Screenshot

In the game, the player takes control of a project manager, with several specialists and people working under him/her, and is tasked to construct a shark aquarium with the help of said specialists. The game not only covers the economic aspect, but also the social aspects, conflict management and diplomacy. The project develops in real time, and the game interacts with the players through websites, cutscenes, emails, articles, and so on, all to provide an authentic project management experience.

2.3.5 MaThiSiS project

MaThiSiS project⁶, funded by the European Commission, delivers an educational platform providing every type of learner a different type of setting on their device that they have personally to achieve individualised learning experience that is adapted to their personal experiences, the learners are provided with various serious games and other educational material which adapts to their learning experience.

⁵ <http://www.sharkworldgame.com/>

⁶ <http://mathisis-project.eu/>

Mathisis provides the students with multiple different serious games for learning, analytical, mathematical, alphabetical skills. The students range between 9 year old and 18 year olds. Each of the learning experience is personalised based on their skills, previous evaluations and emotional state.

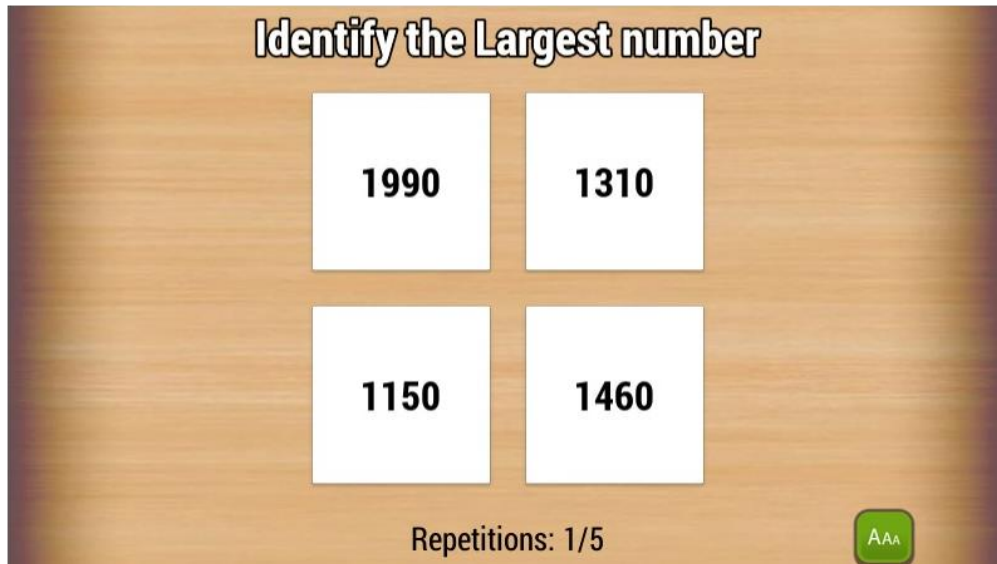


Figure 9 Example of a MaThiSiS game

2.4 Platforms and ecosystems in the market

2.4.1 Platforms

Commercial, or, entertainment games come in a wide variety of platforms. Things like PCs, Xbox, PlayStation, handheld devices, web browser and recently, smartphone, all providing a medium to play the game on. Similarly, serious games also come in a variety of platforms, depending upon their scope, target audience, complexity and so on. Each platform has their own advantages and disadvantages, and developers and researchers should ideally keep that in mind when designing serious games, in order to properly exploit the platform.

In the following sub-sections, some of the most widely used platforms will be discussed, along with some games that are on it, and their advantages and disadvantages, namely the Personal Computers, Smartphones, and Web Browsers.

2.4.1.1 Personal Computers (PC)

One of the most popular and widely used platforms used today, the PC market has grown substantially since they first came into the market in the 1980s, including desktop computers, laptops, and tablets. Nowadays, virtually every office or business uses computers, for coding, for calculations, for writing reports or articles, rendering 3D objects, and so on. According to Statista, a

website that provides statistics based on 20,000+ sources, nearly half of the world's population (48.3%) is estimated to own a computer at home in 2018, and this number would only rise, with computers getting cheaper and more accessible every year.

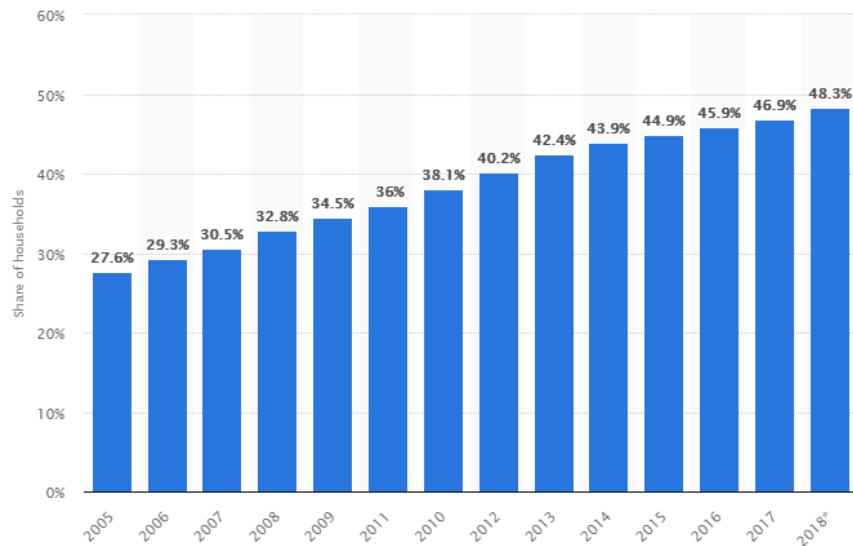


Figure 10: Percentage of Households with a Computer

There have been several video games, both commercial and serious, that have been on the PC. Games such as “Oregon Trail”, “Where in the World is Carmen Sandiego?”, etc. have proven to be successful educational video games on the PC. Additionally, with the growing popularity of Steam, which a number of people use to purchase video games from, and it being relatively easy and straightforward to publish game on, publishing games on the PC is easier than before. According to Steam Spy, an online platform which provides metrics of games on steam, 7,672 games were released in 2017, or approximately 21 games per day. This indicates that publishing games on the PC is getting more and more accessible and popular with developers.

Some of the advantages of publishing on the PC are accessibility, easy to publish games without the need of a publisher (with Steam, Epic Store, etc). However, some of the disadvantages include saturation of the market, along with competition from big budget AAA title video games.

2.4.1.2 Smartphones

The smartphone came around 2007, with the release of the first Apple iPhone. Since then, the market has grown exponentially ever since, with companies Apple and Samsung releasing new phones every year with more and more powerful hardware. For instance, the first iPhone, which came out in 2007 had 512 MB of RAM with a 412 MHz processor. The latest iPhone, the iPhone XS, which came out in 2017, is equipped with 4 GB or RAM with a 2.4 GHz processor.

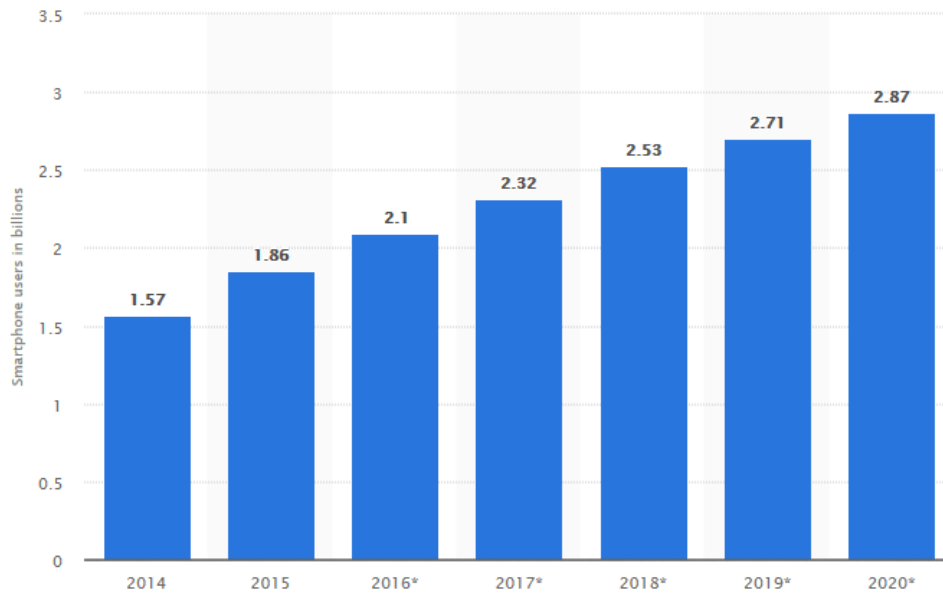


Figure 11: Number of People Who Own Smartphones

The market growth of smartphones has also been rapid. As per Statista, in by 2018, approximately 2.5 billion were estimated to own smartphones. Smartphones are getting more accessible and cheaper every year. Additionally, with the advent of the App Store for iOS (Google Playstore for Android) has made it easier for developers to publish their products to the market.

Some of the advantages of publishing on smartphone are accessibility and reach they have. These two factors make publishing on smartphones seem viable. These are also a part of the disadvantages of publishing on smartphones. The market is saturated and highly competitive. For example, approximately 500 games were published everyday on the Apple App Store alone in 2016. The app would have to compete with numerous other apps. Additionally, in the case with android, there is segregation, since android comes in a number of devices, each having different specifications and having different version of Android installed on them, which makes testing more challenging.

2.4.1.3 Web browsers

Web browsers are an important part of both smartphones and computers. It is the medium through which we access the internet and have been around since the early days of the internet. Today, there are several web browsers available, like Google Chrome, Mozilla Firefox, Microsoft Edge, and so on, with Google Chrome being one of the most popular browsers currently, across all devices and mediums.

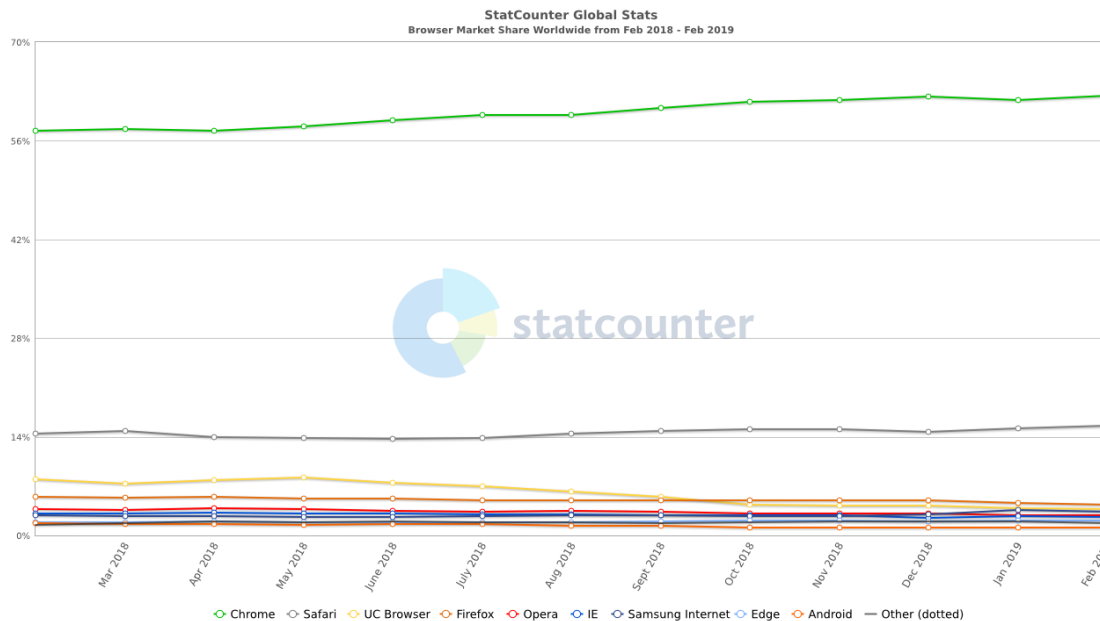


Figure 12: Web Browser Market Share 2018

Web browsers, just like the other platforms mentioned before, benefit from accessibility. In fact, web browsers have an edge over the other platforms, in that the same website can be accessed from PCs, laptops, smartphones, consoles, and so on. This means that if the game is published on a web browser, it can be accessed with almost any device. Moreover, web games are faster, and cheaper to develop than of the games. The biggest disadvantage of web browser games is that they are technically inferior to their PC/Console/Smartphone game counterpart and are limited in terms of features.

2.4.2 Ecosystems

With the emergence of serious games and gamification in the last couple of decades, there have been stride made to incorporate them into the existing systems for training and education. There are several ecosystems that have emerged, which are online communities or institutions which aim to provide a space for collaboration and spreading of methods, processes and so on, on how to encourage and use game-based learning efficiently.

In the following sub-sections, two such ecosystems will be examined, namely the RAGE Project, which is an online collective of various institutes and game studios, aiming to use game development tools to improve efficiency and motivation within the European workforce.

The second is Quest Atlantis, an online platform that was developed be researcher, teachers and game developers for students between ages 9-12. The main aim for this project was to provide a virtual world for kids from across the globe to play and interact in. Learning would occur through quests and missions, and in the process also encourage collaborations and exchange of ideas and values within various cultures.

2.4.2.1 RAGE project



Figure 13: RAGE Project Logo

RAGE project⁷, funded by European Commission, which developed an online platform, with collaboration and partnership from various organizations and institutes such as The Open University of Netherlands, Universidad Complutense de Madrid, PlayGen and others, is a project started with the intention of using applied games to improve the skills, employability and professional performance of the workforce all across Europe. The initiative aims to transfer reusable game technology and knowledge to develop innovative Applied Games easier, faster and more cost efficient.

The RAGE project workplan consists of 5 closely-connected elements, which is composed by 10 work packages. These elements include:

- 1) Research and Technology Development: This is where the team is divided into multiple small teams, that adopt SCRUM like agile development methodologies in order to produce quick and iterative prototypes or proof of concepts and improving on them.
- 2) Validation of the Assets' Applicability: Here, the assets produced by the Research and Technology Development teams are tested and their usability and viability are evaluated for game developers with the help of feedback from the consortium, and from the wider community.
- 3) Applied Games' Pilots: Here, real world pilots are arranged in 6 different application contexts, representing different markets and target groups for applied gaming, along with covering learning effectiveness.
- 4) Validating Ecosystems: Eventually, the research and development done in the previous steps is gradually extended to the population of the participants in the network, as connect as many participants in the existing network as possible in order to get a more detailed and valuable feedback for improvement and iterations.
- 5) Validating the Business Models: Finally, and almost as importantly, RAGE assists organizations by validating the asset-based business cases developed by them and to

⁷ <http://rageproject.eu/>

provide consultation on how to develop an effective and successful business model tailored to them and their product

2.4.2.2 Quest Atlantis

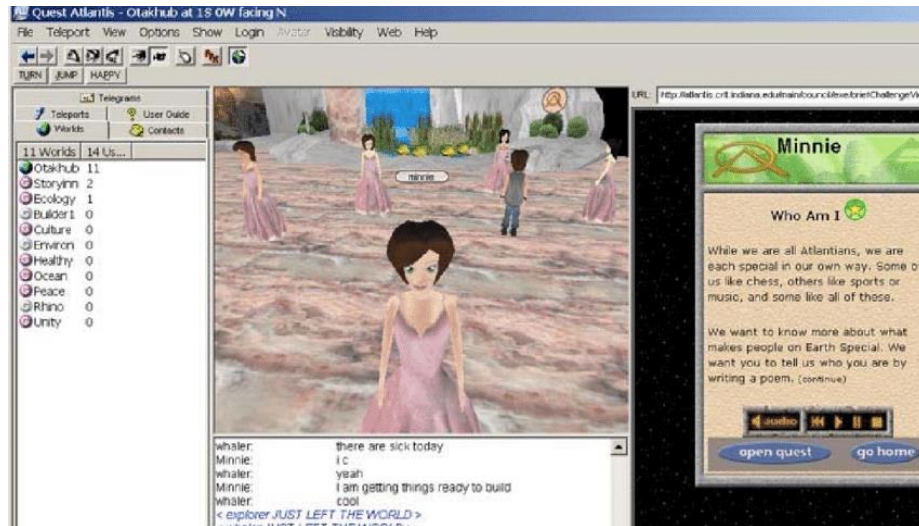


Figure 14: Quest Atlantis Screenshot

The Quest Atlantis⁸ project, developed in the early 2000s, was an immersive 3D multiuser, computer graphics learning and teaching environment developed for children aged between 9 and 12, for teaching. The developers behind Quest Atlantis intended to combine the strategies used in commercial video game environment with the lessons from educational research on learning and motivation, to provide a fun experience for the children to learn in. The children would create online personas, would be able to travel across the virtual world, talk to other users, mentors and Non-Playable Characters (NPCs) and would get educational activities (called Quests), which they were required to finish in order to progress.

The theoretical framework behind this project involved researching and borrowing ideas from learning and social science theories, such as activity theory, cognitive theory, sociocultural constructivism, and so on. The researchers argue that play creates a proximal development for children, and is vital for their development. Using this underlying principle, the triadic foundation for design was laid, which are education, entertainment, and social commitments. The other important factor was to create an immersive and compelling experience without the use of guns or violence, which are common parameters in majority of commercial video games on the market.

For designing the educational part, the team believed that the participants should be involved in doing their domain-related activities, and not just receive the results of other people's activities, like

⁸ https://en.wikipedia.org/wiki/Quest_Atlantis

lectures and texts received in the classroom. The student should instead receive a more hand-on approach to learn, with the help of stories, quests, and so on.

The other obstacle was designing the entertainment part, since the content of the game and the learning outcomes would be rendered futile if the game was not entertaining for the children. Children have grown up around exciting and engaging media around them, such as movies, TV, video games and so on. In contrast, such mediums in an educational context are limited. One such was to address that was to create a virtual world, like the ones found in Massively Multiplayer Online Role-Playing Games (MMORPGs) such as World of Warcraft. This world would host hundreds of thousands of players, playing simultaneously, with a bunch of quests and side quests, and the players could interact with other players as well, encouraging collaboration.

The final pillar of the design foundation was social commitments. The researchers viewed that it was not only education but also the design work should be conducted in a socially responsive manner. This meant the design should convey empowerment, and being socially responsive while articulating.

The researchers and developers behind this project view new technology, like the Internet, as having a lot of potential, since it can allow users to get a more global perspective on issues and processes, and can then find solutions to complex problems. It was their hope that through Quest Atlantis, children could connect with other children from across the globe, exchange ideas and views, to make them aware at a young age, especially in this day and age of globalization, and also come to value their own culture and community in the process as well.

2.4.2.3 BEACONING

The project BEACONING⁹, funded by the European Commission, stands for Breaking Educational Barriers with Contextualised, Pervasive and Gameful Learning and will focus on ‘anytime anywhere’ learning by exploiting pervasive, context-aware and gamified techniques and technologies, framed under the Problem-Based Learning approach. The project seeks to pilot such an innovation in real operational environments.

BEACONING states its objectives as follows:

- Integrate technologies, pedagogical and social perspectives: using pervasive, context aware and gamified approaches ensuring that the BEACONING platform is innovative while also extending their scientific understanding and practice-based experiments of engaging a community of learners including those with disabilities with a more inclusive, connected and contextualised learning processes.
- Develop, implement and validate the BEACONING platform that: leverages cutting-edge approaches including the Future Internet technology, mobile, gamification, pervasive

⁹ <https://beaconing.eu/>

gaming, game content generation, game authoring, human-computer interfaces, learning analytics and problem-based learning model (usable, adaptable, extendable and sustainable).

- Explore and measure the level of engagement, effectiveness and impact: enabled by the BEACONING platform towards incentivising learners and fostering acquisition and transfer of knowledge and skills, validate this through large-scale pilots involving a community of stakeholders and practitioners in Europe, and provide an exploitation and business plan for the platform adoption.

In conjunction with 15 partners, BEACONING aspires to pilot innovation in a real operational environment, aligning with DMLL's ethos in disruptive media and the impact on changing mind-sets and creating new models and practices of teaching and learning. BEACONING presents its platform as combining opportunities for new ICTs in multiple ways that merge learning acquired in formal, non-formal and informal means, developing the skills for today's abled and disabled learners and workforce. BEACONING concept Large-scale pilots aims to validate and inform the development of the BEACONING ecosystem that democratises learning across and among fully abled and those with mild to moderate physical and mental impairments (age 15 to 24), undergoing general and vocational training.

2.5 Business models in use

One of the most important aspects of any game, commercial or otherwise, is monetization. A game has to be profitable in order to see any sort of future. Having a well-researched and thought about business model(s) for monetisation is key to ensure good quality products in the future. Most companies rarely use just one model for generating revenue, but instead use a combination of several models. It boils down to the type of product or service one is providing and the target demographics of the game, and the company structure.

2.5.1 Paid product model

The paid product is the most widely used and obvious business model, employed by virtually every organization. The app or product is available in the market for anyone to purchase. Once the user has purchased it, he/she has full access to the whole product and its features. Video games are no exceptions. This has been the standard model for monetization for the majority of game available in the market. Additionally, with the advent of online digital distribution services such as Steam, App Store, etc., it has become much easier for developers to publish their games themselves. Earlier, publishing a game was a difficult task, and usually required the assistance of a publisher. The studio would develop a game, and the publisher would take care of marketing, stock, transport and distribution of the game. Now, since the world is moving towards more digital technology, that requirement has gone down. In mobile market, paid apps are less common or popular. However, in the PC and Console market, that is still the standard method of monetization.

An example of a game that uses this model is Democracy 2, a political simulation game that aims to mimic the field of politics. The players must employ good leadership and diplomatic skills in order to rise the ranks and ultimately become a president/prime minister. After that, the player must do their best to stay in power.



Figure 15: Democracy 2 Store Page

There are several advantages of using this model

- 1) The revenue generated is high at the beginning and the growth is fast
- 2) There is less fear about drop-off, since the user has already made the purchase before having access to the game
- 3) Positioning and the company's place in the market is clearer, based on sales metrics
- 4) The consumer base is generally more loyal

A few things to keep into mind when using this model are

- 1) Since the consumers are expected to pay before they have any access to the product, the quality of said product has to be much better, should the company aim to stay in the market and keep the consumer base for future products
- 2) Proper marketing and research is crucial, so that the correct demographics is marketed the game.

2.5.2 Freemium/Free-to-Play monetization model

The freemium model is one of the most widely used monetization models in software development. Developed in the 1980s, this model involves publishing their software for

free for the users. However, in order to unlock some additional features, services or goods, the users would have to pay for them. This model has been used in video games too, but with the rapid growth in popularity of casual games on mobile, the freemium model really took shape. In video games, a variant “free-to-play” (F2P) model emerged. There are several ways organizations implement F2P monetization. Some include:

- 1) Putting a vertical slice of the game out for free for the audience, and then in order to unlock later sections of the game, the user would have to pay. Games like Angry Birds, Cut the Rope, etc have adopted this.
- 2) Other games have the entire game available to the market for free, and instead sell in-game items, currencies, and so on, or rely on in-game advertisement for revenue. This can be seen in games like Clash of Clans, Candy Crush, Pokemon GO, and so on.

This model of monetization has proven to be successful in the mobile gaming market, with some games incorporating this into the main gameplay loop. According to Statista, the majority of the highest grossing apps on the mobile market, all employ the F2P model, namely Pokemon GO, Candy Crush Saga,

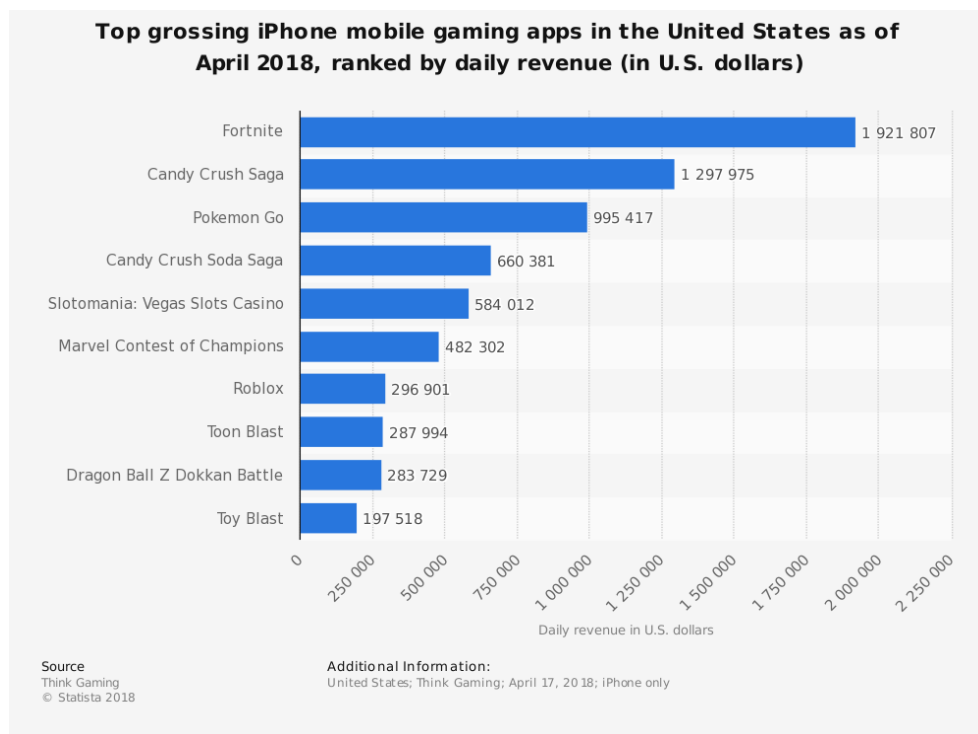


Figure 16: Highest Grossing Apps iOS in 2018

The rationale behind this model is putting the game out for free would attract more customers, and of those customers, a small percentage of them would convert into paying customers eventually. Some of the advantages of using Free-to-Play business model are

- 1) Since the product (or at least some part of the product) is free to download and play, it would attract more customers, meaning the conversion rate for paying users would be more.
- 2) Additionally, the product being free means that the product is easier and more efficient to market.

In the context of serious games, there are several examples of games using such models for monetization. One such example is Duolingo.



Figure 17: Duolingo Logo

Duolingo is an edutainment app developed to help the users learn a different language, such as English, Spanish, German, Italian, etc. The app employs many of the game design elements, such as levels, power-ups, progression and so on to make the learning process fun and engaging for the users. The app is available free for anyone willing to test out the app. The app has a shop, from where the users can purchase powerups, in-game currencies, etc.

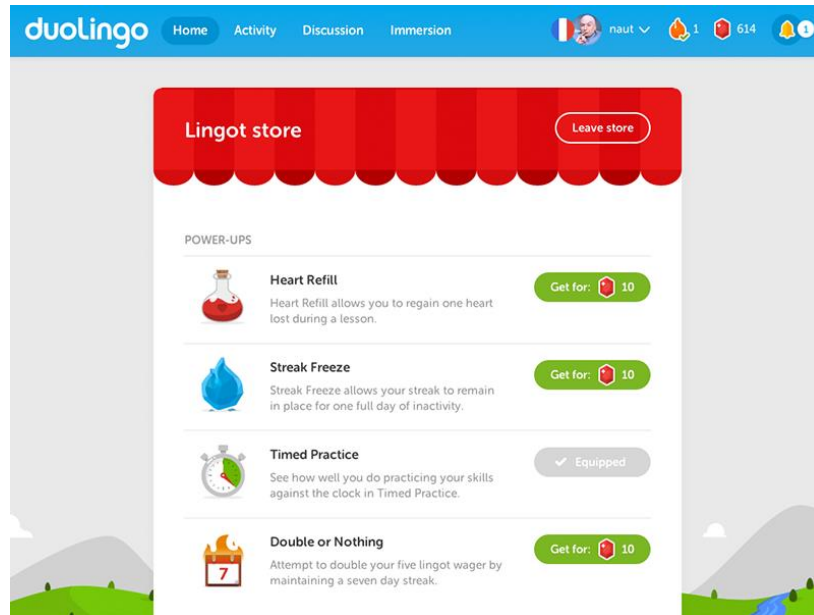


Figure 18: Duolingo Shop

However, when using this method of monetization, it is important to know and address some of the disadvantages of using this model, some of which include:

- 1) This model relies heavily on having a large number of users in order to yield profits. The conversion rate in free-to-play models for both Android and iOS is typically 1-3%. This means that there must be several hundreds of thousands of active users at least to make some sort of revenue. The drop off rate of free-to-play games is high, with almost 50% players, who installed the app, stopping playing in the first few days alone.
- 2) The growth of the game economically is slower than the with other business models, since the players would have to first play, get better, and progress through the game first before they would spend money on the game.
- 3) The cost of the items has also to be taken into consideration. If the cost of items or services is too low, then the revenue generated would also be low and slow. If the cost is too high, then that would deter potential paying customers.
- 4) Finding a perfect balance between the gameplay and monetization is vital. If important features, content or progression were tied too much with microtransactions, it would repel customers (or pay-to-win as they are referred to as). On the flipside, if there were too few microtransactions, then the revenue generated would be too little to sustain the game in the end.

- 5) The game has to be updated and new features added in regularly in order to not stagnate and lose players. Usually, the players who spend the most on a game are the ones who have progressed the most. In order for them to keep playing and spending, the game needs to be updated with new content and features regularly.

2.5.3 Subscription based monetization model

Another widely used monetization model is the subscription model. This model involves giving access to all of the features available in the product to the customer, in exchange for a fixed monthly payment. The user is free to stop or cancel their subscription any time they want, but would not have access to said features from there on out. On the flipside, for users who have not yet subscribed, either a part of the product can be made available (like in free-to-play games) or none of the features until the user subscribes (like in Netflix). In the last couple of years, especially with the growth in popularity of services such as Netflix, Spotify, etc, the subscription model of monetization has grown in popularity as a viable business model for apps, games, websites, etc. Netflix, in the field of streaming services, has grown both in popularity and economically in the last decade. According to Statista, the as of 2018, Netflix had approximately 137 million subscribers. Netflix is an online streaming platform, where the users have access to a vast library of movies and TV shows. However, it is only available to users who have subscribed.

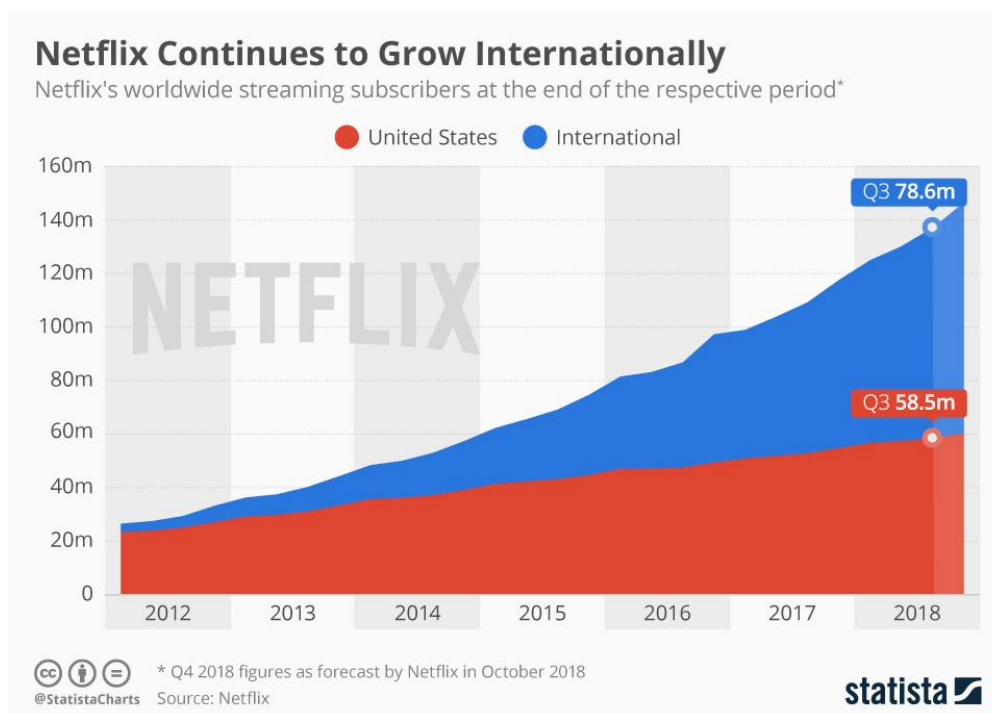


Figure 19: Netflix Subscribers

Another example of growing popularity of subscription-based monetization model is Spotify. Spotify is another streaming platform, where the users have access to a vast library of music and podcasts. The difference here from Netflix is that Spotify can also be used by users who have not subscribed.

For those users, they still have access to the app, but cannot use all of the features, such as no advertisements between songs, offline mode, etc. As of 2018, Spotify has almost 200 million monthly users.

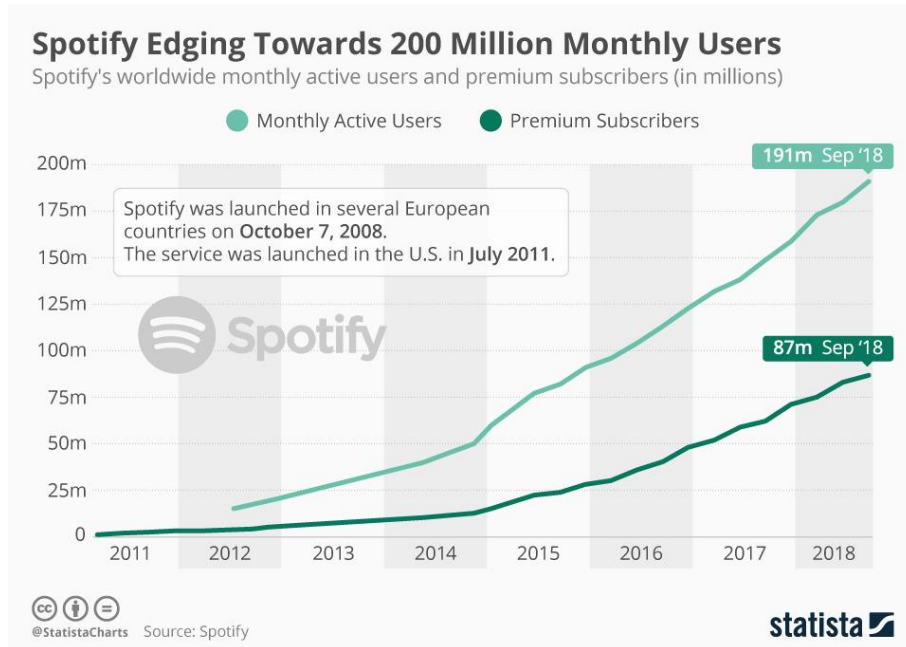


Figure 20: Spotify Users

There are a number of serious games that use the subscription model. One such game is *Zombies, Run!*, a serious game aimed at health and fitness.

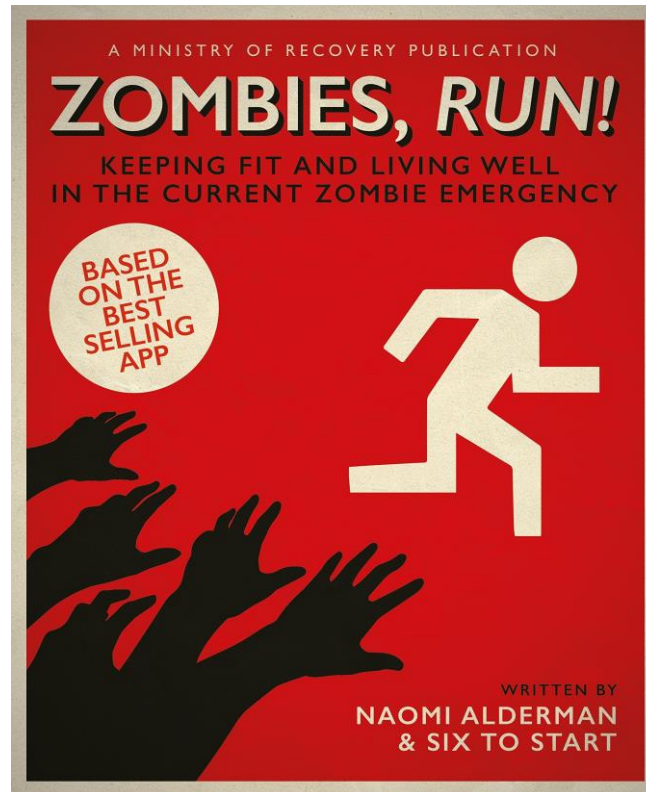


Figure 21: Zombies, Run! Logo

Using a zombie apocalypse as the setting, the players have to complete a variety of missions (mostly involving running a certain distance). The more the user runs, the faster he/she can progress through the story. The free version of the app is available on the app market for anyone to download and play. They also, however, provide subscriptions, through which the users have access to more missions and features.

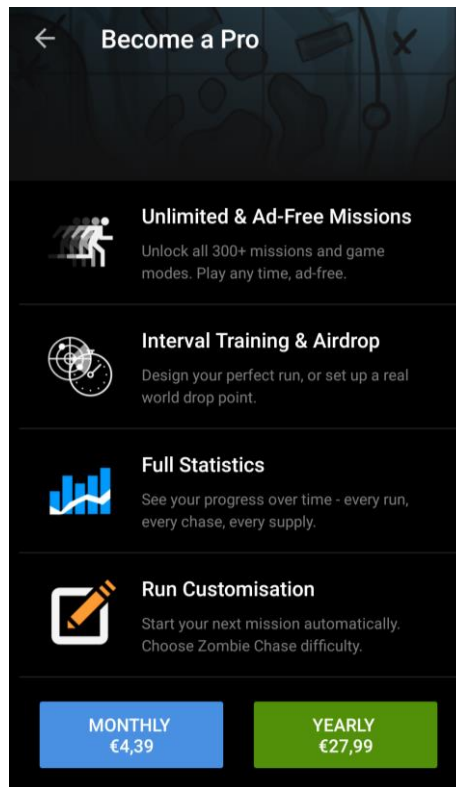


Figure 22: Zombies, Run! Subscription Features

The concept of subscription is not new. It has been around for a long time, for instance things like magazines, mobile networks, television, etc. have all been adopting this model for decades. There are several advantages of adapting this monetization model, including

- 1) There is more stability economically, since the revenue stream is timely and predictable
- 2) The customer conversion rate is higher than in free-to-play game, since they have to make an investment in order to fully use the product and are less likely to stop using the product.
- 3) The relation between the developers and the clients is better when it comes to subscription-based models.
- 4) This model is easy and convenient for the consumers.

However, some things to keep into consideration when thinking about this is

- 1) Since the users are required to pay monthly, the quality of the product is most important to ensure continued usage of the product
- 2) The content and features provided should justify the users paying for it. If the features/content offered is too little, there would be no incentive for anyone investing money in it.

- 3) The services have to be updated and new features need to be added regularly to prevent stagnation.

3 Potential of innovation

When it comes to serious games aimed for education and training, specifically in the field of education, there is a need to make a distinction. There are roughly 3 categories of educational video games. Firstly, there are commercial educational games, which are learning games designed to teach the players about a certain topic or topics, such as algebra, spelling, grammar, and so on. These also aim to be appealing to the market in order to increase profits. Some notable examples are “Math Blaster”, “Castle of Dr. Brain”, and so on.

The second type of educational video games, which can be used in a learning context, although may have not been designed for that purpose specifically. There are several such titles available in the market, some of which were used in a learning environment. Games such as Civilisation, Minecraft, etc fall under this category of educational games.

The third type of educational video games are research-based serious games, which are also designed in order to teach the player, but differ in the fact that:

- 1) They try to use innovative and novel methods of teaching through gameplay and mechanics, usually backed up by prior research (the game is usually a result of the research done).
- 2) The learning outcomes are well documented (also a result of the research). (Book – Understanding Video Games).

However, compared to their commercial counterparts, educational video games often do not perform as well. There are several reasons behind it. Some researchers and professionals argue that some of the reasons behind this are as follows:

- 1) Drill and Practice Learning Method: Drill and Practice method of learning through memorization. This is based on the fact that if someone keeps repeating a task, it will eventually be stored in their memories. This method does not necessarily deal with understanding, rather it involves memorization. A number of educational games use this for its educational content. Although useful for some topics, some researchers argue that this is not the most efficient way of learning.
- 2) Learn and Play not Integrated Together: A continuation from the previous point, educational games often find themselves having learnt and play as separate entities, which happen exclusive of each other. As a result, both tend to hinder each other. As research has demonstrated, learning and play should be integrated and work together in order to be successful, which is the main logic behind game-based learning.
- 3) Little Intrinsic Motivation: One of the shortcomings of educational video games is that it offers little intrinsic motivation, something found in commercial video games, and instead, relies on external rewards, such as rewards, points, etc to motivate the players. This is, as some researchers point out, is insufficient to keep the players.

- 4) **Simplistic Gameplay:** A common complaint against educational video games is that the gameplay and mechanics are simplistic, like the games of arcade machines and adventure games. Even though it can be effective for younger audience, in order to increase the appeal and provide motivation for other players, the mechanics has to have some form of depth and complexity, which the player would be required to master in order to progress and get better at.

Some other researchers argue that serious game and gamification have some underlying problems, some of which include:

- 1) It has some degree of hype and expectations, which although is positive thing since it encourages more research and development, it also weighs it down
- 2) The term “gamification” is misleading and narrow, since it implies that it is a specific application of digital game elements. Furthermore, it also implies that learning cannot occur without play.

A result of the above-mentioned points, serious games are often referred to as “Chocolate-Covered Broccoli”, to address the underlying problem of making a game fun, yet educational at the same time.

4 Conclusion

This deliverable gives a first overview of the market of serious games in the education and training industry. The deliverable shows the increase in the usage of game-based technologies in learning and the reasons for this include the connection between games and learning in children is quite evident and the rise of adults in gaming has been increase significantly in the past few years.

The deliverable shows the usage of mechanics, storylines, aesthetics and technology in the transmedia of developing serious games and how researchers decide the use of these tools in designing a serious game. The deliverable concludes the different tools used by various serious games to achieve their intended results of folding proteins to solve problems to learning how to fly.

It was concluded that the Personal Computer game market is one of the biggest markets for game development and playing with smartphones gaining traction quite fast and development of personalised gaming. Web browsers have been the best source of distribution of games to multiple platforms at once and would be the best solution for FLIP2G project's serious game deployment. The ecosystems available for the distribution of the games will give some good opportunity in distribution of the game as well as help in the development of the game/s.

Furthermore, the deliverable focuses on the 3 business models used in the industry for the exploitation of serious games and making the games profitable. For FLIP2G, the best method would be a freemium model for exploitation but the final decision of this would be taken following extensive research on all possible scenarios.

Lastly, the deliverable focuses on the potential of innovations in the industry showcasing and elaborating various methods for the innovations and we plan to use these methods in the development of the serious games to produce a beyond state-of-the-art experience in teaching and learning methodologies for the participants of FLIP2G project's trials and users.

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