Applying Serious Game’s Learning through Play to Standard Game Tutorial Design

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Abstract

Serious games have become a prevalent method of raising public awareness of complex subjects people would be hesitant to engage with. This work will analyse educational theory and game design used within serious games for the purpose of improving general tutorial design. This work was completed in conjunction with the development of a serious game focusing on raising awareness of the United Nations’ (UN) Sustainable Development goals. Research data generated during this project was used to examine practical applications of educational and development theory.

Keywords:Serious Games, Game Tutorial, Game Design, Educational Theory;

# Introduction

Despite what most players and some game developers would believe, a game’s tutorial system is one of the most crucial components when creating any video game. They act as a gateway for the game experience and poorly design tutorials can lead to a bad first impression. On the other hand, good examples utilising learning through play theory have been recognised as one of the most effective methods of learning new skills [36]. One sector of game development takes this beyond tutorials, in the form of educational experiences known as serious games.

Over the last two decades, serious games have become a prevalent method of raising public awareness of complex subjects people would be hesitant to engage with. Alternatively, they have been used as teaching aides or communication tools. By incorporating educational theory with game design, allows players to subconsciously understand information presented through game mechanics and then reapply this information to their everyday life. By correctly targeting game mechanics to a specific audience through theming or game genre [1], developers can create a teaching experience without the players even being aware that they are learning.

For serious games, tutorial sequences are the entire premise of the experience. Their purpose is to inform or teach a player about a concept through gameplay. Therefore, a successful serious game could be considered a successful game length tutorial. By applying the game design techniques within these titles to standard game tutorials would result in engaging sequences that act as both a teaching tool and an engaging opening to the game experience. Which is the focus of this work, to examine applications of educational theory and game design within serious games for the purpose of applying these techniques to improve current game tutorial design.

# Project Background

This work was completed in conjunction with the development of a prototype for a serious game focusing on raising awareness of the United Nations’ (UN) Sustainable Development goals [2]. This prototype also details the development of a system for collecting and displaying data automatically after each play session. The game and the generated research data will be used to examine practical applications of the educational and development theory explored throughout this work.

The main problem the project aims to solve is the public’s lack of individual responsibility for contributing to sustainable development, through raising awareness of the UN’s Sustainable Development goals. The UN’s Sustainable Development goals consist of seventeen goals that universally apply to all. Countries will mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change by 2030. The goals are design to expand on the UN’s Millennium Development Goals success [3], utilising a similar fifteen-year plan but expanded to ensure that the benefits apply universally.

The creation of this serious game prototype is intended for use as a continuing professional development (CPD) activity in a professional setting. To promote individual responsibility for demonstrating positive behaviours and for contributing to the development of sustainably literate and responsible users. The work completed on this project is design for use as a baseline for a full serious games project.

The design brief of the full sustainable serious game details the creation of seventeen short games each based on one of the UN Sustainable Development goals. The prototype consists of a single short game, which is a point and click rubbish sorting game based on the responsible consumption and development goal. Which tasks players with cleaning a house filled with rubbish by recycling it into the correct bins. The game is broken down into three stages, the first focuses on the player depositing rubbish found around the house into the bin they believe to be correct. The second requires the player to resolve mistakes they make when depositing rubbish. By either sorting the contents of the bin, which costs money per kilo gram of rubbish, or landfill the entire contents of the bin at no cost, including the correctly recycled rubbish. The final stage provides an overview of the players actions, such as the amount of rubbish landfilled or money spent. To engage the player with their results, they are required to spawn in objects with a listed weight to counter balance the weight of rubbish a town would generate, if the population were to make the same choices as the player. This is intended to show them a wider picture of the issue and why their individual contribution matters.

# Technical Background

Serious games use a combination of game design and educational theory to create a scenario that maximises learning through play. The sustainable serious game prototype was design using a selection of these theories for the purpose of examining their effectiveness when applied practically within game tutorials.

Game flow is a concept used to describe the process of creating tasks for the player to overcome while simultaneously motivating them to continue playing and complete more challenging tasks. Maintaining game flow is crucial to ensure the player continues to engage with the game and can be broken down into eight requirements [4]. The first is concentration, the player should be able to concentrate on a selection of tasks of their choice without distractions. This is key when teaching through play, should the player lose focus or concentrate on too many tasks could result in them missing crucial information they will need for later challenges. Next is challenge, without sufficient resistance players will lose interest in the game and not fully engage with the tasks. Should the game not challenge the player’s skill, they will never reinforce their knowledge and expand their skills beyond replication. The development and mastery of these skills allows players to combine and adapt their existing knowledge together with new information and experiences. However, the player should never be overwhelmed with challenge beyond their skill or control. Without a sense of control over their actions in the game, players will feel a disconnect between their input and the results. Random results can take away agency from players, since they’re unable to make informed decisions that reflect their level of understanding. The purpose behind the game’s goals and means of achieving them must be clear, with sufficient understanding based on feedback from the game environment. Players should be made fully aware of what they have accomplished and how they failed, giving weight to their actions. The results must be presented as the consequences of the player’s actions. Without this deeper experience players cannot immerse themselves in the game world and absorb the information interweaved into the game’s mechanics. Finally, social interaction should support and create opportunities for interaction between the player and their peers. Games do not require the players to interact directly, some games use leader boards or player comparison to challenge players to better themselves to out rank their peers. Game flow can be plotted on a graph showing that the process is a delicate balance between complexity of learning (Challenge) against player’s understanding (Skill) [5].

An integral part of the alpha and beta testing is identifying what the player’s level of educational understanding is. Kolb's [6] theory of experiential learning holds that adults learn through a process that involves a set of sequential steps. First, they obtain concrete experience, which they can then observe and reflect upon. From this they can formulate abstract concepts in response to this reflection. They then finish the cycle by experimenting to test the validity of these concepts. Applying this cycle to a simulation, allows participants to gain both the awareness of a complex situation and the experience from resolving the situation. The simulation allows them to experiment with various solutions to a problem in a safe environment.

Kolb’s theory is supported by the constructivism viewpoint, which focuses on an individual’s representation of the world formed through their own mental schemas and experiences [7]. The key points in constructivism are given by the direct link between learning and experience, by the active role of learners in constructing knowledge for themselves and by the application of knowledge onto solving realistic problems [8]. A method of implementing the constructivist approach in a game environment is to embed the learning content into the context of the game world, forcing the player to actively interact with it to advance in the game.

The other aspect of the educational testing is reviewing the effectiveness of teaching methods deployed through the game mechanics. Kirkpatrick's Four-Level Training Evaluation Model [9] addresses the impact of a training course on the learner’s knowledge. First the Reaction level, the learner acknowledges the information but it has no impact on their behaviour. The Learning level is reached once the learner’s knowledge has increased compared to the start of the training process. The learner reaches the Behaviour level once they applied this knowledge during the exact real-world equivalent of the activity. Finally, the Results level, the learner’s knowledge has a noticeable effect on their behaviour during any real-world application.

# Technical Research

As previously stated this work was completed in conjunction with a serious game project centred around the UN’s Sustainable Development goals. The user testing conducted at various stages throughout the game’s development provided opportunities for analysis of the effectiveness of the serious game’s teaching methods. Testing was split into two major events, alpha and beta testing, feedback from the alpha testing was used to improve the prototype during beta development.

During the project’s alpha development stage, the prototype did not contain any text-based tutorial systems and all educational information was accessed through the game’s mechanics. Therefore, during the alpha testing, the developer had to provide spoken context and instructions to participants, detailing the goal of the game and the controls. This included the fact that players could interact with rubbish in the environment by clicking on it. Participants were then observed exhaustively searching the environment to identify what counted as rubbish. While this is a desired behaviour, the depth to which players would search was not. Each play session was intended to last two to five minutes, however due to this behaviour, as figure 1 shows participants would spend up to ten minutes investigating the house. As a result, they would spend more time learning about the game’s environment than the underlying educational information. This has become a prevalent situation in open-world games that allow players to decide in which order to play content, such as Assassin’s Creed [10]**.** In which, players are presented with a vast amount of side quests resulting in them spending more play time completing optional tasks then playing mandatory content which progresses the game. Here the freedom of the gameplay is hindering the intended experience the developer has created. As stated earlier, maintaining game flow is crucial to teaching through serious game design. This requires the player to concentrate on a small selection of tasks, otherwise they could miss crucial information they will require for later challenges [4]. However, maintaining flow on the wrong aspect of the game can result in other aspects being completely overlooked. In this scenario, the game’s teaching methods may be more effective if the exploring mechanic were made less prevalent. Skyrim [11] is another open-world game with an emphasis on freedom of play, however, during its opening gameplay sequence the player is forced to move through a specific cave environment. Which allows the developers to rapidly present the player with challenges they must overcome before accessing the free roaming sections of the game. Ensuring they understand enough of the game’s mechanics to progress on their own once they leave the cave.

**Figure 1.** Comparison of length of Alpha play session and Beta play session.

Another observation made during the alpha testing was, despite being told to only bin rubbish, players attempted to interact with every object in the environment. Implying that, given the ability to do so, they were attempting to bin objects that were clearly not rubbish, such as furniture and books. This is an example of the development of negative behaviour, as players were attempting to test the boundaries of the system by behaving in a manner directly opposed to the educational goal presented through the gameplay. This is a clear example of the Explorers player behaviour type [12], who find enjoyment in attempting to break game rules and find unusual ways to play. If allowed to interact with the game in this manner, this group of players would miss crucial information about how to play the game and the educational information only accessible through interacting with the game in the intended manner.

To resolve these issues, during the beta development stage, the developer added a visual effect to the interactable objects. This decision was based on the issue scenario’s similarity to one of the point and click genre’s most prevalent issues, pixel hunting. Which is the process of searching a game environment a pixel at a time to find every possible object the player can interact with. Older examples of the point and click genre such as Day of the Tentacle[13] received lower reviews scores due to one or two scenarios in which most players spent hours searching for a single item. Which is why modern games like The Inner World [14] and this project, utilise visual effects that instantly provide the player an indication of what can be interacted with. While this does come at the cost of player exploration, it does prevent the game’s flow coming to a standstill due to the player being unable to find the one item necessary to progress.As Flow theory dictates, the visualisation of game mechanics must blend with the environment in a way that does not break the player’s immersion [4]. In addition, players linking educational information gained through the game to a real-world scenario is more readily achieved through the context of the game’s world [15]. To examine the effectiveness of this theory, the developer initially did not use the effect on the interactable objects during the results stage. As a result, players were observed being unsure if the objects would behave differently or whether they were required to interact differently. An unintentional example of this arose due to all the bins in the level appearing visually identical, despite having mechanical differences. The participants that did not explore these mechanics performed poorly, assuming they could put rubbish in any bin. When told the bins were different in the post-test interview, these participants stated they were completely unaware of this fact and assumed each bin was the same, as seen in figure 2. During their final attempt, they utilised this mechanic and performed far better. Uncertainty in visual direction can lead to players becoming frustrated because of the game’s mechanics seeming arbitrary [16].

**Figure 2.** Did you know each bin accepts different rubbish?

Another attributing factor to unclear directions during beta testing was participants ignoring all text-based tutorials. These text-based instructions were limited to one short sentence per box and only five boxes can be displayed in quick succession. This was done to maintain a low cognitive load on the participants [17]. Reducing the possibility of players skipping the tutorials due to being overwhelmed with excessive amounts of information they are required to absorb and process simultaneously. However, some participants instantly skipped these tutorial boxes without reading them, leaving them uncertain of how to proceed. Sustainable Shaun [1] is a serious game also centred around producing a more sustainable world, through reusing rubbish most people would landfill. Unfortunately, the developers used large sections of text before and after each level to give context and educational background for the players actions. Given that this game’s target audience is children, due to the high cognitive load, it is very unlikely this information would be read and very little will be retained.The post-test interview revealed that some participants had done this by accident, but most had done so out of habit, see figure 3. Stating that they skip all text-based tutorials due to their previously negative experiences with poorly constructed tutorials. This is another example of the Explorers player behaviour type [12], who enjoy discovering their own solutions to challenges. Demonstrating the necessity for a secondary or alternative tutorial method, while still allowing players to learn at their own pace and style, ensuring a comfortable cognitive load. A solution to this problem is to incorporate learning game mechanics into the game world [18]. The logic and reason for events in the game world should be dictated by the theory interweaved within the game’s mechanics. Meaning the environment must reflect the way the mechanics function, describing their functionality visually. Using tutorials similar to this helps to reduce the cognitive load of the initial text-based tutorials, increasing the chances a player will engage with the information during their session.

**Figure 3.** Did the player read or skip the tutorials?

As stated earlier, this first step of becoming aware of this information is crucial to creating a path for players to acquire new knowledge [6]. Becoming disconnected from this path due to confusion or inconsistent interactions will prevent players from progressing to future stages of learning. The next stage of learning is formulating gained information into knowledge they can apply within a given scenario. By reviewing the post-questionnaire, it was revealed that many players felt the controls were unintuitive and were distracting them from their task, see figure 4. Players attempted to click and drag to move interactable objects. Others failed to find the inspect function that reveals greater information about an interactable, with many expecting the information to appear when hovering the mouse over the object. This is a demonstration of how an unintuitive relationship between the player’s input and the action in game can greatly affect a player’s flow. Mobile games can be limited by their touch screens when attempting to implement traditional game control schemes. A good example is the mobile version of The legend of Zelda: A link to the past [19], which is consider to have intuitive controls on its original console the Super Nintendo Entertainment System (SNES). Whereas the mobile port received more negative reviews for its controls due to the buttons being on top of the screen space, requiring the player to cover up significant portions of their view of the world with their fingers. These unintuitive controls make the mobile version much less enjoyable for many players despite the game being mechanically identical on both consoles.Players should feel a sense of control over their actions in the game [4], otherwise the physical disconnect between the controller and the game becomes apparent. They should feel ownership for their actions, so that they can feel the weight of their decision and understand the meaning of their actions. Without this feedback, players will not take the lessons learnt to heart or connect them back to any real-world scenarios. Achieving this would enable players to formulate their own concepts of the world [6], enabling them to theorize possible applications for the gained knowledge [9].

Another question asked during the post-test interview, was whether they understood the prototype’s purpose. Many understood that they were being taught how to correctly sort recycling, due to the result system grading them based on the number of incorrectly sorted items, see figure 5. Also, some of these participants responded to the question with suggestion of expansions to the rules such as sorting by plastic type or requiring food containers to be cleaned first. This not only shows these participants understand the information within the game but are able to apply this knowledge to possible wider applications. Demonstrating that the serious game scenario flow cycle provides the necessary feedback for players to reflect on their choices and how this may impact their behaviour outside of the game. The cycle works by having the player first solve a problem, then make a decision based on the solution and then finally reflect on the results of their actions.

**Figure 4.** Did the controls feel intuitive?

These tests were conducted multiple times to reduce the possibility of anomalous data and determine whether repeated exposure to the environment improves the player’s knowledge. The results show that several of the participants that did not recycle correctly on their first attempt did so on their next attempt, after reflecting on their mistakes. However, a group emerged that consistently scored around the same incorrect recycling margin. By comparing the participants incorrect recycling margin against whether they were aware the bins were not identical, shows that those with a consistently incorrect recycling margin are the same participants that had failed to understand this mechanic. This indicates that despite the tutorial information boxes appearing at the start of each play session, these participants never altered their incorrect behaviour. It was observed that all participants skipped the information boxes after the first play session. This shows that players will only expose themselves to the same tutorial once, before assuming they have gained all the necessary knowledge, given that the information gained the first time was sufficient to complete the task. While repetition is useful for players to establish patterns of understanding, when no additional content is introduced, players will lose interest [17]. Only once the developer had informed these participants of the content they had missed, where they interested in correcting their behaviour. This is a case of players having their own individual representation of the world formed through their own mental schemas and experiences [7]. This perception of the world prevents them from seeing the flaws in their logic and correcting their behaviour, unless a source they consider reliable tells them they are incorrect, such as the game’s developer.

**Figure 5.** Do you understand the game’s educational purpose?

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# Future Expansions

The work completed during this project offers several opportunities that expand on the produced results or more deeply examines issues identified during the testing process. The sustainable prototype was completed with the intention of being expanded into a full serious game title, which would allow for more in-depth and varied testing. The data generated during this project was based on a sample group of five, twenty to twenty-five years old, university students. This sample is formed from participants all familiar with video game technology and have an interest in learning. Reconducting the experiment with a more varied participant pool will allow for comparisons between various video game target markets. Research has shown that adults learn differently to children [17]. Therefore, the results generated when participants of different personal backgrounds undergo the same testing process, has the potential to provide alternative insights from the current participant sample.

Another aspect that could be further explored is applying the same serious game scenario flow to the short games produced when adapting the other UN Sustainable Development Goals. This flow structure creates scenarios in which the player is presented with a problem to solve. Then based on their solution they must make a decision they feel is most appropriate and finally the opportunity to interactively reflect on their results through gameplay. This could be used to determine whether the structure improves the players ability to advance knowledge gained from controlled in-game scenarios to generating theoretical applications for more generalised scenarios outside of the game.

Finally, this work could be expanded into a project that entails the creation of a system that detects when a player begins behaving in an incorrect or negative manner. Upon detection the system provides the player with a tutorial to correct them. This project will have to consider when it is appropriate to correct behaviour and when the player should be allowed to discover their flaws on their own. In addition, the system must identify how to visualise these tutorials, such as through text-boxes or an in-context challenge that forces the player to reconsider how they have been using the mechanics. This expanded work would provide a method of preventing players from forming negative habits while still providing the player with the opportunity to fix their issues through experience.

# Conclusion

The data collected throughout this work has identified two key areas of tutorial design that must be considered regardless of game genre or tutorial type. The first is the structure used to dispense information to the player and the control methods used to retain learning flow. The second is non-intrusive methods of experiencing the game’s mechanics and merging the tutorial with the adjoining gameplay sequences.

The tutorial structure used can greatly affect the amount of information conveyed to the player and how much of the information they will retain. When interviewed test participants stated that the reason they skipped the text-based tutorials in the sustainable project was due to their past experiences with tutorials overwhelming them with information of which they retained very little of. Therefore, direct information tutorials should be kept to a minimum and spread out to maintain a low-level of cognitive load. Unless information cannot be conveyed by any means other than text or information visualisations, alternative tutorials systems must be deployed. Research shows that providing the player with pre-made gameplay sections to learn mechanics through experience, allows them to expand their skills at a pace comfortable for them. However, testing shows that gameplay should be focused on only the mechanics taught during the tutorial. When test participants were presented with environment exploring mechanics in addition to the educational mechanics, they became distracted. As a result, players spent more time exploring the tutorial’s environment instead of engaging with the educational information. Making it more difficult to link the experience with real-world applications. More problematically this freedom of choice allowed some players to develop negative behaviours by finding unintended methods of play that were opposed to the goal of the sustainable project. Therefore, tutorial sequences must be within controlled environments that offer no distractions from the intended learning task and must control the amount of information a player is presented within short spaces of time.

The methods used to integrate the tutorial into the experience of the game changes how the player perceives their task. When a tutorial is presented as an isolated learning experience, players will perceive the process as an interruption or unneeded obstacle they must overcome to return to the true experience of the game. On the other hand, when the tutorial seamlessly merges with the game experience, some players do not even register the sequence as being any different from the adjoining gameplay sequences. This is integral to maintaining the players immersion and the game’s flow. Likewise, during testing, players commented that the controls were unintuitive, preventing them from feeling in control of the action in game and distracting them from their task. This disconnect between the controller and gameplay, prevents the player from being immersed in the learning activity. Educational theory explains that allowing players to make mistakes and feel responsibility for the results, makes learners more likely to change their behaviour to produce a different outcome in the future. Unintuitive controls hinder the player’s ability to input their desired response to a scenario, leading to results that do not reflect their skill or choices. Resulting in players refusing to accept responsibility for their actions. Testing also revealed that when the tutorial goal or challenge the player needs to overcome is unclear, players will not find the intended solution. The sustainable game presented mechanically different objects using the same visual method. As a result, some players were completely unaware of the challenges the mechanic presented and developed a poor solution to the task. Showing that the visual context of a mechanic must reflect its purpose while simultaneously operating within the game world. Therefore, it is mandatory to integrate tutorials into the game in a way that does not upset the game’s flow and provides the player with the opportunity to discover a solution in a safe environment immersed within the game world.

During the analysis of sustainable game test results, game examples of the several of the issues identified were provide, showing that this is a current issue with current game design. However, at the same time examples of games correcting these is issues were also provided, demonstrating that attempts to resolve common tutorials problems have occurred. This highlights the true issue with current game tutorial design, some game developers are not allocating enough time and resources to design immersive tutorials. Thus, the solution drawn from this analysis is that game developers should consider how the mechanic will be taught to the player and adjust the mechanic’s design accordingly. They should not create the tutorial after completing development of mechanic, creating an out of world context tutorial environment completely removing the player from the game’s flow and separating the player’s learning from the context of the game.

References

1. Aardman Animation, “Sustainable Shaun”, 2015, <https://www.shaunthesheep.com/games/sustainable-shaun>
2. United Nations, “UN’s Sustainability Development goals” <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
3. United Nations, “UN’s Millennium goals” <http://www.un.org/millenniumgoals/>
4. Sweester, P., & Wyneth, P., “GameFlow: a model for evaluating player enjoyment in games”, Theoretical and Practical Computer Applications in Entertainment, Computers in Entertainment, Vol. 3, pp. 3-3, July 2005.
5. Gamasutra, “Cognitive flow: The Psychology of Great Game Design” <https://www.gamasutra.com/view/feature/166972/cognitive_flow_the_psychology_of_.php>
6. Kolb, D., “Experiential Learning”, Englewood Cliffs, Prentice Hall, pp. 20-38, 1984.
7. Bartlett, F. C., “Remembering: A Study in Experimental and Social Psychology”, Cambridge University Press, 1932.
8. Devries, B., & Zan, B., “When children make rules”, Educational Leadership, Vol 61, pp. 64-67, 2003.
9. Kirkpatrick, D. L., “Evaluating Training Programs: The Four Levels”. BerrettKoehler Publishers Inc, San Francisco, 1998.
10. Ubisoft, “Assassin’s Creed Franchise”, 2007, <https://assassinscreed.ubisoft.com/game/en-gb/home/>
11. Bethesda Softworks, “The Elder Scrolls V: Skyrim”, 2011, <https://elderscrolls.bethesda.net/en/skyrim>
12. Bartle, R., “Hearts, Clubs, Diamonds, Spades: Players Who Suit MUDs.” Journal of MUD Research, Vol. 1, 1996.
13. LucasArts, “Day of the Tentacle”, 1993, <http://dott.doublefine.com/>
14. HeadUp Games, “The Inner World”, 2013, <http://www.theinnerworld.de/about_EN.html>
15. Siriaraya, P., Visch, V., VermeeRen, A., & Bas. M., “A cookbook method for Persuasive Game Design”, International Serious Game Journal, Vol. 5, pp. 37-71, March 2018.
16. Angehrn, A. A., & Maxwell, K., “EagleRacing: Addressing Corporate Collaboration Challenges Through an Online Simulation Game”, Innovate, Journal of Online Education, Vol. 5, Aug 2009.
17. Catalona, C. E., Luccini, A. M., & Mortara, M., “Guidelines for an effective serious games”, International Serious Game Journal, Vol. 1, 2013.
18. Whitebread, D., Coltman, P., Jameson, H., & Lander, R., “Play, cognition and self-regulation: What exactly are children learning when they learn through play?”, Educational and Child Pschology, Vol. 26, pp. 40-52, 2009.
19. Nintendo, “Legend of Zelda: A Link to the Past”, 1991.